Session:	**C07P1: Antenna engineering: today and tomorrow - 1**
Type:	Convened Session
Date:	Monday, April 12, 2010
Time:	14:30 - 16:10
Room:	Room 119
Chairs:	I.E. Lager
	M. Martínez Vázquez, P. Ingvarson

Time	Title	Abs No
14:30	**Antenna Optimization Using Multi-Objective Algorithms**	C07P1-1

Travassos, X.L.[1]; Lima, M.M.B.[1]; Vieira, D.A.G.[2]; Lisboa, A.C.[2]; Ida, N.[3]
[1]SENAI, BRAZIL;
[2]ENACOM, BRAZIL;
[3]The University of Akron, UNITED STATES

This paper presents several applications of multiobjective optimization to antenna design, emphasizing the main general steps in this process. Specifications of antennas usually involve many conflicting objectives, related to directivity, impedance matching, cross-polarization and frequency range.
These requirements induces multiobjective problems, which are formulated, solved and analyzed here for three distinct antenna designs: a bowtie antenna for ground-penetrating radars, a reflector antenna for satellite broadcast systems, and a meanderline antenna for radio-frequency identification tags. Both stochastic and deterministic methods are considered in the analysis.

Time	Title	Abs No
14:50	**Continuing Engineering Education and Life-long Learning**	C07P1-2

Ferrando-Bataller, M.; Antonino-Daviu, E; Ripoll-Soler, C; Turro, C
Universidad Politecnica de Valencia, SPAIN

This paper discusses the development of a multimedia training material and the possibilities of using Information and Communications Technologies (ICT) for delivering Continuing Engineering Education and Life-Long Learning. A special remark should be done on the use of web technologies and media authoring tools for Antenna Courses.

Time	Title	Abs No
15:10	**The European School of Antennas: Triennium 2007-2009**	C07P1-3

Maci, Stefano
Universita di Siena, ITALY

The European School of Antennas (ESoA) is at its sixth year of life. Since its foundation in January 2005, this school had the objective to provide European training to PhD students, early stage researchers and young engineers in industry in antennas, propagation, and electromagnetic applications. This paper presents the objective of ESoA, the results, and the impact on the antennas and propagation community in the triennium 2007-2009.

Time	Title	Abs No
15:30	**Promotional and Prospective Plans for Engineering Careers. ICT Focus**	C07P1-4

Jofre, Lluis[1]; Cordoba, Joanfra[2]; Robert, Laura[3]
[1]Universitat Politecnica de Catalunya, SPAIN;
[2]EnginyCAT, Dep, SPAIN;
[3]Fundac. Catalana Recerca e Innovació, SPAIN

In the developed countries vocational demand for scientific and technical studies is a serious concern for government, universities and companies and different analysis and programs are promoted to try to compensate the steady decrease of their demand. From an attentive analysis of the different academic and professional parameters it comes clearly the need to increase engineering attractiveness among youngsters. Science and technology proficiency will become of the leading economic development factors.

Session:	**C04P01: Metamaterials Applications - 1**
Type:	Convened Session
Date:	Monday, April 12, 2010
Time:	14:30 - 16:10
Room:	Room 120
Chairs:	K. Mahdjoubi
	M. Antoniades

Time	Title	Abs No
14:30	**Realization of a Horizontally Polarized, Low-profile, Omnidirectional Antenna with an EBG Reflector**	C04P01-1

Nakano, Hisamatsu; Satake, R; Yamauchi, J
Hosei University, JAPAN

A structure composed of two fed arc strips and two parasitic arc strips, and an EBG reflector is investigated for realizing a horizontally polarized, omnidirectional antenna. The effects of the configuration parameters on the antenna characteristics are analyzed and discussed.

Time	Title	Abs No
14:50	**Anisotropic Behaviour and Negative Refraction in Stacked Subwavelength Hole Arrays Metamaterials**	C04P01-2

Navarro-Cia, M.[1]; Beruete, M.[1]; Falcone, F.[1]; Sorolla, M.[1]; Campillo, I.[2]
[1]Universidad Publica de Navarra, SPAIN;
[2]CIC nanoGUNE Consolider, SPAIN

Oblique incidence on a stack of subwavelength hole arrays wafers is analyzed. A strong anisotropic behaviour is observed and for P-polarized illumination, the refracted beam emerges at negative angles whereas for S-polarized illumination it is at positive angles. Two-dimensional dispersion diagrams are calculated to predict qualitatively the performance of the structure in terms of the refraction, which is subsequently demonstrated with experiments in the millimetre-wave range.

Time	Title	Abs No
15:10	**The Ridge Gap Waveguide as a Wideband Rectangular Hard Waveguide**	C04P01-3

Kildal, Per-Simon[1]; Ng Mou Kehn, M.[2]
[1]Chalmers University of Technology, SWEDEN;
[2]NCTU, TAIWAN

The present paper will give an overview of the work on hard surfaces and hard waveguides leading to the wideband ridge gap waveguide. The overview will be supported by both computed and measured results of the performance of hard waveguides and gap waveguides, clearly showing the wide bandwidth and low losses of the latter. This is a major improvement compared to the original hard waveguides, enabled by the wideband parallel-plate cut-off fenomena used for the gap waveguides.

Time	Title	Abs No
15:30	**Omnidirectional Circularly Polarized Antenna Using Zeroth-Order Resonance of Metamaterial Transmission Line**	C04P01-4

Park, Byung-Chul[1]; Lee, Jeong-Hae[1]; Tae, Heung-Sik[2]
[1]Hongik University, KOREA, REPUBLIC OF;
[2]Kyungpook National University, KOREA, REPUBLIC OF

The omnidirectional circularly polarized (CP) antenna using a circular mushroom structure with curved branches is proposed. The antenna uses the zeroth-order resonance (ZOR) mode of epsilon negative (ENG) transmission line (TL) to obtain a vertical polarization and an omnidirectional radiation pattern. Also, the horizontal polarization is obtained by the curved branches. The measured 3 dB axial ratio is observed in 0-15iÆ and 202-360iÆ of an azimuthal plane.

Time	Title	Abs No
15:50	**Compact, Wideband and Multiband Antennas Based on Metamaterial Concepts**	C04P01-5

Eleftheriades, G.V.; Antoniades, M.A.; Zhu, J.; Selvanayagam, M.
University of Toronto, CANADA

In this review article, various antenna designs that are based on metamaterial concepts are presented which have been developed at the University of Toronto. Through this work, and even though some of the antenna designs utilize only a single metamaterial unit cell, it is demonstrated that the metamaterial conceptual route can lead to innovative antenna designs with excellent performance characteristics.

Time	Title	Abs No
14:30	**A 2.45 GHz Low Cost and Efficient Rectenna**	A01-1

TAKHEDMIT, H[1]; MERABET, B[2]; CIRIO, L[3]; ALLARD, B[4]; COSTA, F[2]; VOLLAIRE, C[5]; PICON, O[3]
[1]AMPERE, ECL/ESYCOM, UPEMLV, FRANCE;
[2]SATIE, ENS Cachan, FRANCE;
[3]ESYCOM, UPEMLV, FRANCE;
[4]AMPERE, INSA Lyon, FRANCE;
[5]AMPERE, ECL, FRANCE

This paper reports a novel rectifying antenna (rectenna) based on modified bridge rectifier at 2.45 GHz. The circuit has been developed using a global simulation technique which associates electromagnetic and circuit approaches. This rectifier doesn't need neither input HF filter nor bypass capacitor. This makes the structure more compact and low cost. The rectifier achieves an efficiency of 61% at 10 mW and the rectenna shows 52% of efficiency when the power density is 0.15mW/cm².

Time	Title	Abs No
14:50	**Design, Integration, and Packaging of a Wireless Module for Location Finding and Healthcare Applications**	A01-2

Rida, Amin[1]; Tan, Edward[1]; Shaker, George[2]; Nickolaou, Simos[3]; Tentzeris, Manos[1]; Nikolaou, Symeon[4]
[1]Georgia Institute of Technology, UNITED STATES;
[2]University of Waterloo, CANADA;
[3]Frederick University, CYPRUS;
[4]Frederick Research Center, CYPRUS

This paper presents a solution for a low cost wireless module using a zigbee wireless microcontroller or IEEE 802.15.4 standards and inkjet printing on low cost substrate for the Radio Frequency (RF), antenna, as well as printed traces used for signal routing. The simplicity of the design outlined in the paper as well as the fabrication technique used could potentially improve prototyping as well as production techniques for such wireless modules.

Time	Title	Abs No
15:10	**Multi-Standard UHF and UWB Low Profil Reader and TAG Antennas for RFID and Positionning Applications**	A01-3

DELERUYELLE, Thibaut; Pannier, Philippe; Egels, Matthieu; Alarcon, Juvenal; Bergeret, Emmanuel
IM2NP, FRANCE

In this article, tag and reader multi-standards RFID antennas are presented. These antennas are matched on one the UHF RFID (860-960 MHz) and on the ECC UWB frequency band (6-8.5 GHz). Tag is composed of two antennas, one match for the RFID applications with classical RFID input impedance, one for UWB matched at 50 Ω. Tag sizes are limited to credit card sizes (85x54 mm). Reader antenna is an association of a bowtie and a dipole antenna and it is matched on 50 Ω on twice bands

Time	Title	Abs No
15:30	**Simple Electromagnetic Sensor for Simultaneous Measurement of Three Orthogonal Linear Polarizations**	A01-4

Ivsic, B.; Bonefacic, D.; Bartolic, J.
Faculty of Electrical Engineering and Computing, University of Zagreb, CROATIA

This paper proposes a design of the shorted stacked patch which operates in GSM (900 MHz) band and its integration in the cubic-like sensor structure. Each pair of opposite patches is intended to measure one polarization of the EM field. By adding the three received signals it is possible to obtain the total field strength. Such sensor is capable to measure the strength of three orthogonal polarizations simultaneously.

Session:	**C28P1: New frontier in RFID technology - 1**
Type:	Convened Session
Date:	Monday, April 12, 2010
Time:	14:30 - 16:10
Room:	Room 125
Chairs:	G. Marrocco
	M. Tentzeris

Time	Title	Abs No
14:30	**Loop Antenna for UHF Near-Field RFID Reader**	C28P1-1

Chen, Z. N; Goh, C. K.; Qing, X.
Institute for Infocomm Research, SINGAPORE

A loop antenna with phase shifters is proposed for UHF near-field RFID readers. Using stub phase shifters, the solid-line loop antenna is capable of generating strong and uniform magnetic field in a near-field zone even though the perimeter of the loop is electrically large. Based on this design concept, a square loop antenna with a perimeter of two wavelengths at 915 MHz is prototyped and exhibits 100% reading rate with the reading range up to 24 mm.

14:50	**Can A Physically Secure RFID Be Produced?: A Review of RFDNA**	C28P1-2

DeJean, G; Kirovski, D
Microsoft Research, UNITED STATES

A certificate of authenticity (COA) is an inexpensive physical object that has a random unique structure with high cost of near-exact reproduction. An additional requirement is that the uniqueness of COA's random structure can be verified using an inexpensive device. A system designed for objects that behave as COAs in the electromagnetic field is proposed. The objective is to complement RFIDs so that they are physically, not only digitally, unique and hard to replicate.

15:10	**Chipless Tags for RF and THz Identification**	C28P1-3

Tedjini, S.[1]; Perret, E.[1]; Deepu, V.[1]; Bernier, M.[1]; Garet, F.[2]; Duvillaret, L.[2]
[1]Grenoble-INP/LCIS, FRANCE;
[2]Grenoble-INP/IMEP-LAHC, FRANCE

This paper discusses a new configuration of chipless tags. For the first time we introduce a novel tag structure that can be coded in its volume an in its surface. The information coding of the surface is obtained via metallic forms that encompass a specific electromagnetic signature, somewhat quite similar to already published chipless tags. The information coded in the volume is obtained thanks to a multilayer structure operating in the THz domain.

15:30	**Miniaturized Multipurpose Dual UHF RFID Band Antenna**	C28P1-4

Ali Babar, A.; Ukkonen, L.; Sydanheimo, L.
Tampere University of Technology, Dept. of Electronics, Rauma Research Unit, FINLAND

In this paper the design, development and performance of a miniaturized multipurpose dual band planar antenna is discussed. The dual band antenna is destined to work on two UHF RFID bands, which are 433MHz and the European RFID band (865MHz-868MHz). The main objective to design such an antenna was to have an antenna design having a small size, with an acceptable radiation pattern. The antenna can be useful for close range RFID reader units and other small consumer electronic units.

15:50	**RFID Array Sensing**	C28P1-5

Capdevila, S.[1]; Jofre, L.[1]; Romeu, J.[1]; Bolomey, J.Ch.[2]
[1]Universitat Politècnica de Catalunya, SPAIN;
[2]Supelec, FRANCE

In this paper the use of RFID tags for the measurement of physical parameters in a distributed set of points is presented. Experimental results for two different scenarios are presented; the first uses a 2D RFID array to measure the field distribution of a radiating aperture, while the second detects the change in the close environment of an array of RFID tags to determine the water level of a container.

Session:	**Mo-Poster Session A1: Antenna Theory**
Type:	Poster
Date:	Monday, April 12, 2010
Time:	14:30 - 16:10
Room:	Foyer 2
Chairs:	F.D. Quesada Pereira
	J. Basterrechea

Time	Title	Abs No
14:30	**Near Region of Antennas in Piecewise-Homogeneous Media**	Mo-1

Levin, Boris[1]; Bank, M.[1]; Levy, Y.[1]; Haridim, M.[1]; Rechels, T.[2]
[1]Holon Institute of Technology, ISRAEL;
[2]HIT-Holon Institute of Technology, ISRAEL

The mutual effect of electric dipoles located in the near region of each other is considered. The problem is solved with due account of that the space is a heterogeneous medium with an equivalent permittivity. Calculations are based on the theory of folded dipoles. It is shown that by means of a compensation method one can produce a weak field in a given area and diminish a user's irradiation. The calculation and experimental results validate the high efficiency of the compensation method.

| 14:30 | **Integral Equation Macromodel of a Slot-Excited Microstrip Antenna** | Mo-3 |

Kucharski, Andrzej
Wroclaw University of Technology, POLAND

In this work, the idea of Integral Equation Macromodels (IEMs) is applied to speed-up numerical analysis of slot-fed microstrip antennas. The microstrip antenna macromodel is constructed on the basis of surface integral equation (SIE) formulation solved with standard method-of-moments (MoM) technique, where we apply equivalence-principle domain-decomposition method (EP-DDM) combined with wideband approximation using asymptotic waveform evaluation (AWE).

| 14:30 | **Theoretical Design of a Simultaneous Ku/Ka-Band Feed-System** | Mo-5 |

Granet, Christophe; Davis, I.M.; Kot, J.S.; Pope, G.
BAE Systems Australia Ltd, AUSTRALIA

The theoretical design of a simultaneous Ku/Ka-band feed-system covering the full commercial Ku-band and the full military Ka-band is presented.

| 14:30 | **Design, Manufacture and Test of an Optimized Horn for a Holography Experiment** | Mo-7 |

Granet, Christophe[1]; Kesteven, M.J.[2]; Smart, K.W.[3]
[1]BAE Systems Australia Ltd, AUSTRALIA;
[2]Australia Telescope National Facility, AUSTRALIA;
[3]CSIRO ICT Centre, AUSTRALIA

We present here the optimization of an axially corrugated horn with a very broad radtion pattern to be used in a holography experiment.

| 14:30 | **Comparison of Different Strategies for Conversion of Triangular Mesh Into Quadrilateral Mesh** | Mo-9 |

Kolundzija, B.[1]; Kostic, M.[2]; Mrdakovic, B.[2]; Sumic, D.[2]
[1]Department of Electrical Engineering, University of Belgrade, SERBIA;
[2]WIPL-D d.o.o., SERBIA

EM simulation of models described by a quad mesh, using higher order method of moments offers great computational efficiency. In order to exploit this, a robust algorithm generating a quad mesh is needed. The paper gives new variants of algorithm which starts from triangular mesh and then eliminates excess details and re-meshes triangles into quads. Three new strategies of merging neighbour triangles into quads are proposed. Their robustness is investigated on an example of a helicopter.

| 14:30 | **An Efficient Technique to Accelerate the Simulation of Passive Shielded Microwave Circuits** | Mo-11 |

golestanirad, laleh; mattes, michael; Mosig, Juan R.
EPFL, SWITZERLAND

An efficient algorithm is presented for simulating passive microstrip layouts consisting of arbitrary shaped circuitry embedded in a shielded stratified media using an area of influence (AI) approach with a full-wave integral-equation-based numerical solver. The procedure involves introducing an effective area centered at each basis-function within which the interaction of that basis function with others is taken into account in filling Method of Moment matrix.

| 14:30 | **Efficient Analysis of Radiating Problems by Hybrid FDTD/PO Method** | Mo-13 |

Noga, A.; Topa, T.
Silesian University of Technology, POLAND

A hybrid technique combining the FDTD method and Physical Optics (PO) approximation is investigated as tools for efficient analysis of antennas radiating in the presence of complex structures (i.e. dielectric bodies and electrically large conducting platforms). Numerical examples are given to demonstrate considerable saving in both computer memory and CPU time offered by the proposed approach.

| 14:30 | **Optimization of Multilayer Frequency Selective Surfaces Using the Binary Particle Swarm Optimization Algorithm** | Mo-15 |

Gutierrez, Angel; Perez, Jesus Ramon; Basterrechea, Jose
Universidad de Cantabria, SPAIN

In this work, the frequency response of a dual layer FSS is optimized by means of a binary version of the particle swarm algorithm, that determines the best physical parameters of the structure. Furthermore, a cost function is defined taking into account the transmission and reflection coefficients, obtained with a multilayer FSS analysis method, that combines the Conjugate Gradient Fast Fourier Transform with the discrete plane wave spectrum method to calculate the full structure behavior.

| 14:30 | **Near-Field Electromagnetic Dosimetry for *in vitro* Studies at Millimeter Waves** | Mo-17 |

Zhadobov, M.[1]; Sauleau, R.[1]; Thouroude, D.[1]; Nicolas Nicolaz, Ch.[1]; Le Quement, C.[2]; Le Drean, Y.[2]
[1]Institute of Electronics and Telecommunications of Rennes, FRANCE;
[2]Intracellular Protein Homeostasis group, FRANCE

A near-field millimeter-wave exposure system allowing cell culture exposures at 60 GHz is proposed. The design is optimized to obtain homogeneous distribution of the specific absorption rate (SAR) within the cell layer for the incident power densities up to 67 mW/cm^2. This exposure system will be used in bioelectromagnetic experiments to determine power thresholds corresponding to functional modifications in human cells.

| 14:30 | **On Efficient UHF RFID Coverage Inside a Room** | Mo-19 |

Dimitriou, A. G.[1]; Bletsas, A.[2]; Polycarpou, A. C.[3]; Sahalos, J. N.[1]
[1]Aristotle University of Thessaloniki, GREECE;
[2]Technical University of Crete, GREECE;
[3]University of Nicosia, CYPRUS

The problem of improving the identification performance of a UHF RFID system inside a room, is investigated. In contrast to prior art that has focused on simplistic models, a 3D ray-tracing propagation model is developed. It is found that careful reader antenna placement must be performed to control destructive interference patterns. Significant performance gains are observed by implementing tags' diversity. Finally, a device that successfully manipulates destructive interference is introduced.

| 14:30 | **An Efficient Full-Wave Analysis of Irregular-Shaped Conformal Antennas in a Layered Spherical Media** | Mo-21 |

Khamas, Salam
University of Sheffield, UNITED KINGDOM

An efficient method of moments approach for the analysis of arbitrarily shaped spherical antenna is presented, where the Rao–Wilton–Glisson triangular basis functions and the dyadic Green's functions have been employed. The computation efficiency has been enhanced further using an asymptotic extraction technique in conjunction with the mixed potential integral equation representation of the electric field.

| 14:30 | **Design of a Low-Loss Low-noise Tapered Slot Phased Array Feed for Reflector Antennas** | Mo-23 |

Arts, M.[1]; Ivashina, M.[1]; Iupikov, O.[2]; Bakker, L.[1]; van den Brink, R.[1]
[1]ASTRON, NETHERLANDS;
[2]Sevastopol National Technical University, UKRAINE

Upgrading the Multi-Frequency-Front-Ends of the Westerbork Synthesis Radio Telescope (WSRT) by multiplebeam phased array feeds will improve its survey speed by a factor 20. The present paper describes two design steps of the dual-polarized TSA array required for this upgrade. Redesign of the TSA element, integration of the Low Noise Amplifier on the feed line substrate and a more rigid connection between the elements improved the low-noise performance, stability and reproducibility of the array.

| 14:30 | **CPS Fed Linearly-Tapered Cavity Backed Slot Antenna for 60 GHz Applications** | Mo-25 |

Jenning, M.; Plettemeier, D.; Liang, T.-J.
Dresden University of Technology, GERMANY

In this paper a cavity-backed linearly tapered slot antenna for 60 GHz operation is presented. Compared with other antennas, the footprint of the new antenna are reduced. This allows their usage in arrays at a finer pitch, thus reducing the footprint requirements of the whole array or allowing the usage of more antenna elements in an unscaled array. The antenna is shown to have a gain better than 6 dBi over a frequency range of 57...66GHz and a very smooth pattern both in the E- and H-plane.

14:30 **An Iterative MoM/PO Method Based on MBF/Krylov Approach** Mo-27

Andrés García, B[1]; González-Ovejero, D[2]; Craeye, C[2]; García-Muñoz, L.E.[1]; Segovia-Vargas, D[1]
[1]Universidad Carlos III de Madrid, SPAIN;
[2]Universite Catholique de Louvain, BELGIUM

In this paper we present a fast iterative technique to analyze large reflectors combining Method of Moments (MoM) and Physical Optics (PO). The iteration is based on a Krylov approach imposing orthogonality on each step, together with the use of Macro Basis Functions (MBF) on the feed region. The complexity of the problem is reduced by a $N_f P$ factor with Nf the number of unknowns in the reflector and P the number of MBFs, with respect to previous approaches.

14:30 **Hierarchical Simplex Optimization Applied to Antenna Array Problem** Mo-29

Olcan, D.; Kolundzija, B.
University of Belgrade, SERBIA

We present results for hierarchical optimization based on uniform random search and Nelder-Mead simplex algorithms. The proposed optimization is applied to one antenna array design problem. The obtained results show that the hierarchical optimization can lead to more efficient optimization than non hierarchical approach in terms of minimal number of electromagnetic solver calls.

14:30 **Enhanced Elliptical Fresnel Zone Plate Antenna** Mo-31

Jafari Jam, Reza[1]; Oshaghi, S. Hamid[1]; Lotfi Neyestanak, Abbas Ali[2]
[1]Telecommunications Engineering Group, Proffesor Hessaby Foundation, IRAN, ISLAMIC REPUBLIC OF;
[2] Iranian Research Institute for Electrical Engineering, IRAN, ISLAMIC REPUBLIC OF

This paper presents an enhanced Offset Fresnel zone plate antenna (FZPA) using dielectric rods. The dielectric rods enhance the antenna side lobe level and cross polarization level. The proposed antenna is simulated using XFDTD software and fabricated which is verified by good agreement between simulated and measured results. Variation effects of the focal-length-to diameter (f/D) ratios are investigated. Also effect of different offset angle on antenna performance is discussed.

14:30 **An Alternative Technique for Stabilizing the Boundary Elements Method in Electromagnetics** Mo-33

De Bleser, Jan-willem; Van Lil, Emmanuel; Van de Capelle, Antoine
Katholieke Universiteit Leuven, BELGIUM

The instability of the electric field integral equation at low frequencies is studied. The source of this instability is identified, both in mathematical and physical terms, and an alternative, possibly stable form of the integral equation is suggested. Implementation details for this alternative are then discussed, touching on the selection of basis function and the handling of the singular kernel. Positive results from the almost-completed simulator are shown.

14:30 **A Solution to a 2D Electromagnetic Imaging Problem Based on Closed-form Radiating and Non-radiating Sources** Mo-35

Gragnani, Gian Luigi[1]; Diaz Mendez, M.[2]
[1]University of Genoa, ITALY;
[2]DIBE - University of Genoa, ITALY

This paper deals with the possible use of a closed-form solution to an equivalent inverse source problem, in order to solve the original inverse scattering problem and provide a method for electromagnetic imaging. Preliminary investigation are about the enhancement that the insertion on the solution of non-radiating terms could provide. Simulations show that the limitations related to the radiating part of the solution could be partially overcome by using also non-radiating components

14:30 **Broad Band Analysis of Arbitrarily Shaped Microwave Filters Using a Novel Singular Value Decomposition Technique** Mo-37

Quesada Pereira, Fernando Daniel[1]; Vidal, A[2]; Pérez Soler, F. J.[3]; Berenguer, Andrés[4]; San Blas, A.[4]; Mira, F.[5]; Boria Esbert, V. E.[2]; Gimeno, B.[6]; Álvarez Melcón, A.[7]
[1]Technical University of Cartagena, SPAIN;
[2]Universidad Politecnica de Valencia, SPAIN;
[3]Aurorasat Software and Testing, SPAIN;
[4]Universidad Miguel Hernández, SPAIN;
[5]Centre Tecnologic de Telecomunicacions de Catalunya, SPAIN;
[6]Universidad de Valencia, SPAIN;
[7]Universidad Politécnica de Cartagena, SPAIN

A new full-wave electromagnetic analysis method based on the Boundary Integral Resonant Mode Expansion (BI-RME) is presented in this paper. The technique allows the computation of the broad band circuital response of arbitrarily shaped cavity filters. The coaxial excitation of this kind of filters is rigorously modeled by taking into account the high order modes on the coaxial aperture. A singular decomposition algebraic procedure has been implemented for the BI-RME formulation.

14:30 **Modeling of VLF/LF Antenna Insulators with an Arbitrarily Oriented Thin Wire Loaded TLM Node** Mo-39

Cuggia, Renaud[1]; Verissimo, G.[1]; Dubard, J.-L.[1]; Ney, M.[2]; Pichot, C.[3]
[1]Nice - Sophia Antipolis University, CNRS, FRANCE;
[2]TELECOM Bretagne Institute, CNRS, FRANCE;
[3]Université de Nice - Sophia Antipolis, CNRS UMR 6071, FRANCE

This paper deals with the development of a time-domain full wave simulation tool for Very Low Frequency/Low Frequency antennas taking into account the surrounding components such as insulators. To overcome very large multi-scale problems involved with VLF/LF radiating structures, an efficient 3D arbitrarily oriented wire node was implemented in the TLM method. The implementation of insulators as lumped component in this 3D wire model is now proposed.

14:30 **Multi-Scale Modeling Of Antennas With TLM Method** Mo-41

Verissimo, G.[1]; Cuggia, R.[1]; Dubard, J.-L.[1]; Ney, M.[2]; Pichot, C.[1]
[1]Nice - Sophia Antipolis University, CNRS, FRANCE;
[2]TELECOM Bretagne Institute, CNRS, FRANCE

Time-domain full wave simulation techniques have proved to be very efficient for antenna design. Nevertheless, multi-scale modelling arising in many applications such as Very Low Frequency/Low Frequency (VLF/LF) antenna or wire-patch antenna remains a challenging problem. To avoid thin wire meshing with very fine details into large computational domains, an efficient way for modelling arbitrary oriented thin wires in 3D-TLM mesh is presented.

14:30 **High Stability Large Reflectors For Ka Band** Mo-43

YARZA, AMAIA[1]; CASTRO, OTILIA[1]; SANTIAGO, JULIAN[2]; LIMIÑANA, CRISTINA[1]
[1]EADS CASA ESPACIO, SPAIN;
[2]ESA / ESTEC, NETHERLANDS

The performances of a 2.4m deployable reflector, developed to fulfil the requirements demanded by the Ka band, are presented. The main characteristics of the new concept are : fully manufactured in CFRP. metallised radiant surface, the automated proces of the skin lay-up with the Fibre Placement machine and adaptable to the strength needs, very good dimensioning stability, adequate mechanical response to survive the environmental tests and good RF performances.

14:30 **Reflector Vibroacoustic Response To Launch Acoustic Excitation** Mo-45

YARZA, AMAIA[1]; CASTRO, OTILIA[1]; SANTIAGO, JULIAN[2]; PARDO, JOSE LUIS[1]
[1]EADS CASA ESPACIO, SPAIN;
[2]ESA / ESTEC, NETHERLANDS

A new acoustic analysis methodology, in the frame of the low frequency FEM/BEM coupling, has been developed using a new tool in order to be able to optimise our product and to be inside the commercial market of the space telecommunication industry. The acoustic test correlation exercise of a 2.4m reflector is included to show how accurate it is.

14:30 **Generalized 1D-MAP True FDTD Planewave TFSF Formulated for Lossy Multilayered Mediums** Mo-47

Tengmeng, Tan; Tan, TM
University of Calgary, CANADA

Many electromagnetic problems of practical interest invite the determination of the fields scattered by objects illuminated by a plane wave excitation. Examples may include: radar cross section evaluation, buried object detection (such as mines), and mapping of subsurface structures. General solutions to these problems can only be obtained by numerical means and the finite-difference time-domain (FDTD) is arguably one of the most effective numerical schemes to study such problems (it handles inhomogeneity well).

Session:	**Mo-Poster Session A2: Arrays & Reflectarrays**
Type:	Poster
Date:	Monday, April 12, 2010
Time:	14:30 - 16:10
Room:	Foyer 2
Chairs:	F.J. Ares-Peña
	J.E. Brown

Time	Title	Abs No
14:30	**Antenna Array Enhancement Using Mushroom-Like Electromagnetic Band Gap(EBG)**	Mo-2

md tan, mohd nor; Abd Rahman, Tharek; Abd Rahim, Sharul Kamal; Ali, Mohd Tarmizi; Jamlos, Mohd Faizal
universiti teknologi malaysia, MALAYSIA

A double elements micro-strip antenna with mushroom-like electromagnetic band gap (EBG) inserted between elements have been investigated. The performances of the antenna before and after the EBG are inserted between the micro-strip patches are analyzed. The results shown that the performance of the array changes if EBG parameters such as EBG size, spacing between EBG, number of column of the EBG inserted between the elements and also the thickness of the substrate are changed.

14:30	**Reduced sideband levels in time-modulated linear arrays using time-symmetric switching**	Mo-4

Tong, Y; Tennant, A.; Langley, R.J
The University of Sheffield, UNITED KINGDOM

A new approach to producing low sideband pattern levels in time-modulated linear arrays is presented. The technique uses a switching sequence which is time-symmetric within the switching period. Numerical examples are presented to compare the proposed approach to conventional switching schemes for a 16 element linear array with predefined -30dB Taylor weights.

14:30	**Fast Array Thinning Using Global Optimization Methods**	Mo-6

Fernandez-Delgado, M.; Rodriguez-Gonzalez, J. A.; Iglesias, R.; Barro, S.; Ares-Pena, F.
University of Santiago de Compostela, SPAIN

A simple and fast method to accelerate the global optimization approaches used in array thinning is described. This method tabulates the contribution of every array element to the far-field pattern in order to improve the numerical efficiency of the optimization algorithm employed. Experiments using our proposal alongside with a genetic algorithm reduce the search computation time about 90%.

14:30	**A High Gain Array Antenna with Serially Fed Dipole Elements**	Mo-8

LIAO, WEN-JIAO; You, Shen-Je
National Taiwan University of Science and Technology, TAIWAN

A planar array antenna is proposed to maximize its gain performance, which is critical to point-to-point communications. The major drawback with planar array using PCB is the losses in its feeding network. In the proposed design, dipole elements are connected in serial to minimize transmission line lengths and the number of braches, which results in a relatively concise feeding network. The array elements used are bow-tie like dipoles which yield a broad operation band.

14:30	**Dipole Uniform Circular Array Backed by a Cylindrical Reflector**	Mo-10

Cai, Yong; Guo, Y. J.
ICT Centre, CSIRO, AUSTRALIA

A 12-element thin dipole uniform circular array (UCA) is studied using the Method of Moments. The effect of metallic back reflectors on the array performance, in terms of the maximum realized gain, the mutual coupling level, and the synthesized patterns, is investigated. Radial metallic 'partition walls' is proposed to be placed between axially oriented dipoles. The use of the 'partition walls' realizes further gain enhancement and H-plane mutual coupling reduction.

14:30	**Optimal Compromise in the Channels of Monopulse Antennas: Use of Subarrays and Distributions with Common Aperture Tail**	Mo-12

Alvarez-Folgueiras, M.; Rodriguez-Gonzalez, J. A.; Ares-Pena, F.
University of Santiago de Compostela, SPAIN

Given a linear antenna array with an excitation distribution affording an optimal sum pattern, subarray weighting allows the same array also to generate a difference pattern, with minimal alteration of the signal feed circuitry. Previous implementations of this approach have considered the whole array for subarraying. Here we report that the required feeding networks can be simplified by keeping the elements at the edges of the array with common excitations for both sum and difference patterns.

14:30 **Particle Swarm Optimization Applied to Planar Arrays Synthesis Using Subarrays** Mo-14
Lanza, M.; Perez, J.R.; Basterrechea, J.
Universidad de Cantabria, SPAIN

In this work, classical and hybrid Particle Swarm Optimization based schemes have been successfully applied to planar arrays complex synthesis, considering two different situations for the antennas: planar arrays divided or not into subarrays. A preliminary study has been carried out to analyze the performance of the algorithm. Furthermore, representative synthesis results for a planar array to be considered as a 120 degrees sectored antenna for WiMAX applications are also included.

14:30 **Design of 2-Bit Dual-Polarised Unit-Cell for Reflectarray Applications** Mo-16
Pereira, Roger[1]; Gillard, Raphael[1]; Sauleau, Ronan[1]; Potier, Patrick[2]; Le Coq, Laurent[1]; Delestre, Xavier[3]; Soiron, Michel[3]
[1]IETR, FRANCE;
[2]CELAR, FRANCE;
[3]TSA, FRANCE

We introduce here a new configuration of cross-dipole dual-polarised unit-cell for reflectarray applications. This cell is integrated inside a metallic square waveguide. As a proof of concept, we only consider ideal cases where the on and off states of the diodes are represented by ideal short circuits and open circuits, respectively. A passive bredboard has been designed and mesaured at 8.2 GHz. Furthermore the isolation between orthogonal polarisation is insured by cell symmetries.

14:30 **An Eight Element Broadband Antenna for AMPS+GSM Applications** Mo-18
Perikos, G.; Rigelsford, J.
University of Sheffield, UNITED KINGDOM

This paper presents an eight element broadband antenna suitable for AMPS and GSM900 cellular BTS applications. The proposed antenna design is suitable for applications requiring beam steering and results are presented for various elevational tilt angles. Furthermore, the proposed antenna has the advantages of ease of manufacture, low production costs, and is easy to recycle at the end of its useful life.

14:30 **Analyses of an Array of Waveguides with Semitransparent Walls for shaping Flat-Topped Element Patterns** Mo-20
Skobelev, Sergei
Radiophyzika, RUSSIAN FEDERATION

A 2D problem of radiation from an infinite array of waveguides with semitransparent wall sections excited in the TE10 modes is considered. The walls are taken in the form of cylindrical conductor grids. The analysis of the structure is based on the mode-matching method combined with the method of auxiliary sources. Some numerical results characterised both the algorithm and the possibilities of the structure in shaping the flat-topped element patterns are presented.

14:30 **Low-Profile Array of Wire Patch Antennas** Mo-22
zhang, hongjiang
cisteme, FRANCE

A low-profile antenna over a ground plane that radiates a directive lobe in the end fire direction is described in this paper. An array of 16 wire patch antenna (WPA) fed by an integrated 16 ways power divider has been designed. A gain higher than 19.3 dB was achieved in the end fire direction over a 4.5% bandwidth. However, the antenna has been tilted in order to compensate the beam deviation caused by the edge diffraction.

14:30 **Synthesis of Linear Array and Null Steering with minimized Side-Lobe Level Using Particle Swarm Optimization** Mo-24
Abu-Al-Nadi, Dia[1]; Ismail, T. H.[2]; Mismar, M. J.[3]
[1]University of Jordan, JORDAN;
[2]Al_ahlyyia Amman University, JORDAN; [3]Princess Sumaya University for Technology, JORDAN

A new synthesis technique for the linear phased array is developed based on using the array polynomial technique. The array factor is expressed as the product of subpolynomials such that their roots are located on the unit circle . Null steering for interference suppression is obtained by using one subploynomial to steer only one null. The results show that the developed method is an analytical solution that can synthesize the prescribed patterns and exact null locations using phase shifters.

14:30 **An Approach for the Design of Reflectarrays Using CG-FFT and PSO** Mo-26
Barriuso Lopez, Ivan; Perez Lopez, Jesus Ramon; Basterrechea Verdeja, Jose
Universidad de Cantabria, SPAIN

A method applied to the design of reflectarray antennas that combines PSO algorithm, used to carry out the synthesis of the phases at each element, with the CG-FFT method considered to obtain the design curves for the elements, is presented in this work. Radiation patterns for both medium and large size reflectarrays are included, achieving accurate results even with such high-dimensional optimization problems. It also includes a comparison between PSO and other methods (iGA or hybrid schemes).

14:30   **A Circuit Model of Monopole Four-Square Array Antenna on a Finite Ground Plane Including Mutual Coupling Effects**   Mo-28

Yazdanbakhsh, Pedram; Solbach, Klaus
Duisburg-Essen University, GERMANY

In this paper an equivalent circuit-model for the monopole four-square array antenna on a finite ground plane (chassis), considering both the mutual coupling between antennas and coupling between each antenna and Chassis, is designed. With the help of this circuit-model, we then design a Decoupling and Matching Network (DMN) for the monopole four square array antenna.

14:30   **A SIW Slot Array Antenna in Ku Band**   Mo-30

Navarro, D.[1]; Carrera, L.[1]; Baquero, M.[2]
[1]Escuela Politécnica Nacional, ECUADOR;
[2]Universidad Politecnica de Valencia, SPAIN

The design, fabrication and measurement of array antennas in Ku band made in Substrate Integrated Waveguide (SIW) technology are presented. A ten element linear resonant SIW slot array with longitudinal slot element has been designed first. An optimal feeding network has been got with power splitters in SIW.

14:30   **Edge Element Evaluation of Tapered-Slot Elements in Phased Arrays**   Mo-32

Ellgardt, A; Norgren, M.
KTH Royal Institute of Technology, SWEDEN

The edge elements in large phased arrays of tapered-slot elements are analyzed and compared with the infinite array. In this paper the edge effects in a triangular grid tapered-slot array is studied by using finite-by-infinite arrays. The array is infinite in the direction along the edge and finite in the other direction. The S-parameters for three truncations of the tapered slot element are compared with the infinite array solution for the case when the edge is orthogonal to the E-plane.

14:30   **Linear Arrays with Maximally Flat Beams**   Mo-34

Petrolati, Daniele; Angeletti, P; Toso, G
European Space Agency, NETHERLANDS

A detailed theoretical investigation into the synthesis method named "Maximally Flat Beams" proposed by Ksienski for linear periodic arrays is presented. The synthesis objective, which consists in developing a rigorous design procedure aiming at obtaining flat-top beams, is reviewed and deepened.

14:30   **Low Profile Circular YAGI-UDA Array**   Mo-36

Nagy, Lajos
BME, HUNGARY

The paper presents an overview on the development of Circular Yagi-Uda and collinear type of antenna. The main goal of the article is a comparison of directivity and bandwidth of the omnidirectional gained type of antennas. In our analysis, MoM is used to compute the current distribution and directivity of the Yagi antenna. Microstrip technology is used for planar collinear monopole antenna and simulation with ground plane has been performed using Ansoft HFSS 3D simulator.

14:30   **Efficient Numerical Technique for the Analysis of the Actual Influence of a Radiating Element Embedded in a Reflectarray**   Mo-38

DE VITA, F.; DE VITA, P.; FRENI, A.
UNIVERSITY OF FLORENCE, ITALY

In this paper, we present an efficient technique for the design refinement of a reflectarray by the characterization of the "actual" influence of each radiating element when embedded in the antenna structure. The method makes use of the MLayAIM, a fast full-wave formulation suitable for the analysis of electrically large multilayered printed arrays which have one or more planar metallizations and vertical conductors.

14:30   **Aperiodic Phased Arrays for Space Situational Awareness Applications**   Mo-40

Montagna, M.[1]; Dauron, G.[2]; Besso, P.[2]; Bozzi, M.[1]; Perregrini, L.[1]
[1]University of Pavia, ITALY;
[2]European Space Agency ESA ESOC, GERMANY

This paper presents a study of the characteristics of aperiodic arrays for application in the ground-based radar for LEO space surveillance, in the frame of ESA's Space Situational Awareness program. In aperiodic arrays, the unequally element spacing breaks the periodicity of the layout and of the radiation pattern. Given that, their application to the SSA phased array radar could be straightforward: the paper evaluates and discusses related performances and possible thinning procedures.

14:30 **Wideband Dual-Polarization Reconfigurable Elementary Cell for Electronic Steerable Reflectarray at Ku-Band**   Mo-42

Montori, Simone[1]; Cacciamani, Fabrizio[1]; Vincenti Gatti, Roberto[2]; Barba, Mariano[3]; Carrasco, Eduardo[3]; Encinar, Jose[3]; Sorrentino, Roberto[1]
[1]University of Perugia, ITALY;
[2]RF microtech, ITALY;
[3]universidad politecnica de madrid, SPAIN

This paper presents a wideband reconfigurable PIN diode-based radiating element for beam steering reflectarrays. The elementary cell consists of a circular patch coupled to a phase shifting circuit with 1-bit phase resolution (0°/180°). The architecture of the cell is presented and its performance are evaluated by simulation. Dual polarization operation and a flat phase shift response over a 50% relative bandwidth are demonstrated.

14:30 **On the Optimal Synthesis of Shaped Patterns by Means of Uniformly Spaced Linear or Planar Arrays**   Mo-44

Isernia, Tommaso; Laganà, Antonia Rita; Morabito, Andrea Francesco
DIMET, University Mediterranea of Reggio Calabria, ITALY

The paper deals with the power pattern synthesis of circularly symmetric shaped beams via equispaced planar arrays. For a given number of radiating elements, the proposed procedure is able to state a priori whether the constraints can be fulfilled or not, and, in the affirmative case, to determine the needed excitation coefficients. Global optimization schemes are avoided, and examples of practical interest are shown.

14:30 **Printed Antenna for Satellite Communications**   Mo-46

Garcia-Aguilar, A.; Sierra-Perez, M.; Fernandez-Gonzalez, J.M.; Inclan-Alonso, J.M.
Universidad Politecnica de Madrid - UPM, SPAIN

An antenna which has been conceived as a portable system for satellite communications based on the recommendations ITU-R S.580-6 and ITU-R S.465-5 for small antennas is introduced. It is a planar and a compact structure with a size of 40x40x2 cm. The antenna is formed by an array of 256 printed elements covering a large bandwidth at X-Band. It has a circular polarization for transmission and reception bands simultaneously, a radiation pattern with a 3dB beamwidth of 5º and over a 31dBi gain.

14:30 **Beam Switching Reflectarray with MEMS Controls**   Mo-48

Bayraktar, Omer; Aydin Civi, Ozlem; Akin, Tayfun
Middle East Technical University, TURKEY

This paper presents a 26.5 GHz beam switching reflectarray monolithically fabricated with RF MEMS switches. The array is formed using 10x10 aperture coupled microstrip patch antenna elements. RF MEMS switches are implemented on the transmission lines to sustain the beam switching. A prototype of a reflectarray with 90 RF MEMS switches is monolithically produced using an in-house surface micromachining and wafer bonding processes. The measurement result shows that the beam can be switched to ∼40.

14:30 **Microstrip Array Analysis Using a Circuit Model Technique**   Mo-50

Brown, J. E.; Lee, C.S.
Southern Methodist University, UNITED STATES

A method is proposed for microstrip array analysis based on the circuit model technique, for solving finite arrays in a computationally efficient manner. The input impedance is modeled as a series combination of R,L,C circuits for each mode of interest. The modal field distribution from the cavity model of microstrip antennas is used to relate the impedance of the equivalent circuit to the array input impedance.

Time	Title	Abs No
16:40	**Boosting Antenna Research at BRNO University of Technology**	C07P2-1

Raida, Z.; Pokorny, M.; Kovacs, P.; Jilkova, J.; Stumpf, M.; Lacik, J.; Lukes, Z.; Vagner, P.; Drinovsky, J.; Koudelka, V.; Kadlec, P.; Sedenka, V.; Ciganek, J.
Brno University of Technology, CZECH REPUBLIC

In the paper, existing research activities of the Laboratory of Computational Electromagnetics at Brno University of Technology are presented. In order to boost the existing research, the research team applied for the FP7 support under the CAPACITY program, the call FP7-REGPOT-2008-1. The project Advanced Communication Systems and Technologies (ACOST) succeeded in the competition, and the financial support was granted to the team under the contract no. 230126.

Session: **C04P2: Metamaterials Applications - 2**
Type: Convened Session
Date: Monday, April 12, 2010
Time: 16:40 - 18:20
Room: Room 120
Chairs: K. Mahdjoubi

M. Antoniades

Time	Title	Abs No
16:40	**Metamaterial Dual-Band Bandpass Filters Using CRLH Zero-Order-Resonators and Improving its Intermediate Stopband**	C04P2-1

Kahng, Sungtek[1]; Jang, Geonho[2]; Anguera, Jaume[3]
[1]University of Incheon, KOREA, REPUBLIC OF;
[2]Univ. of Incheon, KOREA, REPUBLIC OF;
[3]Fractus, SPAIN

Conventionally, the half-wavelength resonators are used but give rise to the spurious resonance and limitation in practical size-reduction. To circumvent the drawbacks, the concept of the CRLH-type metamaterial structures has been brought up and adopted to make resonance-based components to meet the design challenges[1-5]. This paper presents the design of a dual-band(GSM and ISM) microstrip BPF that comprises stop-band-embedded ZORs and the size-reduction and two desired passbands

| 17:00 | **An Overview on the Design And Properties Of EBG Antennas** | C04P2-2 |

Mahdjoubi, Kourosh[1]; Vu, T.H.[2]; Tarot, A.C.[2]; Collardey, S.[2]
[1]University of Rennes 1, FRANCE;
[2]IETR, University of Rennes 1, FRANCE

EBG antennas have received intensive attention and large investigations during the last decade. Their main drawbacks such as narrow bandwidth, high side lobes, lack of knowledge on input impedance are now quite well studied and partly remedied. Therefore, real industrial applications for these antennas can now be envisaged. In addition to the engineering applications, the EBG antennas have contributed to unify the theoretical studies of several disconnected domains such as leaky-wave, Fabry-Perot (FP) and EBG Antennas theories. The objective of this talk is to present the state of the art on the main properties and applications of the EBG/FP antennas in one hand, and on the bridging theoretical approaches that can be employed for leaky and EBG antennas in the other hand.

| 17:20 | **Behaviour of Subwavelength VS Propagating Holes in Extraordinary Transmission Based Prisms** | C04P2-3 |

Navarro-Cia, M.[1]; Beruete, M.[1]; Falcone, F.[1]; Sorolla, M.[1]; Campillo, I.[2]
[1]Universidad Publica de Navarra, SPAIN;
[2]CIC nanoGUNE Consolider, SPAIN

A comparison is made between a prism made by stacking extraordinary transmission (ET) plates and another constructed by stacking standard perforated plates. From the dispersion diagrams a negative refractive index is predicted for ET plates, being positive for standard plates. The three-dimensional farfield patterns show that main beam is at negative angles and at positive angles respectively. Millimetre wave experiments demonstrate negative refraction and positive refraction in each case.

| 17:40 | **Compact and Flexible Surfaces Using EBG** | C04P2-4 |

Vardaxoglou, Yiannis; Chauraya, A; Bashir, S; Edwards, R. M
Loughborough University, UNITED KINGDOM

Increased interest in the integration of wireless communication systems into wearable products has led to various kinds of body worn antenna structures. [1-5]. Research into On-body devices has inspired many new applications, especially in new generation wireless communication systems for multimedia personal entertainment and medical telemetry. Devices that can be realised on flexible substrates have much to offer in the area of wearables. Some of the advantages of textile antennas include; relatively light weight; flexible (conformal) substrates and simple integration into clothing. Therefore microwave devices, including antennas formed of special fabrics can be considered as a substitute for conventional printed circuit devices.

| 18:00 | **BROADBAND CLOAKING OF STRUTS USING TRANSMISSION-LINE NETWORKS** | C04P2-5 |

Siaka, Francis[1]; Laurin, J-J[1]; Koodiani, S.F.[1]; Demers, Y.[2]; deMaagt, P.[2]
[1]Poly-Grames Research Center, CANADA;
[2]MDA Space Missions, CANADA

In this paper, a broadband cloak designed for an application as an antenna strut is presented. The cloak is using the Transmission-Line Network (TLN) concept introduced in [1-2]. In these papers, cloaking was demonstrated for wide incident angle range. In this paper we modify and optimize the TLN for a broadside angle of incidence. We also study the combination of transmission-line cloaking with hard surfaces cloaking.

Time	Title	Abs No
16:40	**Electrically Small Wire Monopole Antenna with Non-Foster Impedance Element**	A02-1

Song, Keum-Su; Rojas, R. G.
The Ohio State University, UNITED STATES

Electrically small antennas have excessively high radiation quality factors and low radiation resistances. This also implies that these type of antennas are narrow band. Hence it is necessary to add appropriate matching networks between the generator and the antenna. With conventional passive matching networks it is difficult to match over wide frequency bands due to the limitation of the Gain-Bandwidth product. However, it is feasible for matching networks based on Non-Foster elements to overco

| 17:00 | **A Self-Resonant Electrically Small Loop Antenna for Hearing-Aids Application** | A02-2 |

Zhang, J.; Breinbjerg, O.
Technical University of Denmark, DENMARK

Two novel self-resonant electrically small antennas are proposed in this paper, which are designed for hearing aids applications. They are miniaturized by using the capacitive and inductive coupling mechanism between two loops, and the antenna impedance can be matched to a specific value without using any additional matching network and lumped components. One antenna is fabricated and measured in an anechoic chamber. The measurement methods for electrically small antennas are discussed.

| 17:20 | **Chiral Antennas Radiating Circularly Polarized Waves** | A02-3 |

Alitalo, Pekka[1]; Karilainen, A.[1]; Niemi, T.[1]; Simovski, C. R.[1]; Tretyakov, S. A.[1]; de Maagt, P.[2]
[1]TKK Helsinki University of Technology, FINLAND;
[2]European Space Agency (ESA), NETHERLANDS

Combinations of electric and magnetic dipoles radiating circularly polarized waves are studied. The use of a chiral particle is introduced as a means to create a single radiating particle that combines an electric dipole and a magnetic dipole. It is shown both numerically and experimentally that a pair of two such particles, when fed with a 90 degree phase shift, acts as a Huygens' source radiating circularly polarized waves only in one half-space.

| 17:40 | **Electrically Small Magnetic Dipole Antennas with Magnetic Core** | A02-4 |

Kim, O.S.; Breinbjerg, O.
Technical University of Denmark, DENMARK

This work extends the theory of a spherical magnetic dipole antenna with magnetic core by numerical results for practical antenna configurations that excite higher-order modes besides the main TE10 spherical mode. It is shown that one should be particularly aware of the TM11 and TM20 modes, whose resonances spoil the Q in a range of permeability of the core predicted to be optimal by the single-mode theory. Practical ways of suppressing these higher-order modes are presented.

| 18:00 | **Low Profile Small Antenna Using Ferroelectrics Cube Based Artificial Magnetic Conductor** | A02-5 |

ZHANG, F[1]; Lippens, D[2]; Borja, A[3]
[1]Institute of Electronics Microelectronics and Nanotechnologies, University of Lille1, FRANCE;
[2]University of Lille 1, FRANCE;
[3]Universidad de Castilla-La Mancha Campus Universitario, SPAIN

We report on a zero-phase reflection of ferroelectrics cubic ceramics around the magnetic resonance frequency, which can be considered as artificial magnetic conductor (AMC). The performances of a dipole antenna in close to a single layer dielectric AMC were investigated numerically. For this low profile antenna, it is found an enhancement of the directivity by more than twice was achieved owing to the high reflectivity of the AMC layer

Time	Title	Abs No
16:40	**Extremely Low Profile UHF RFID TAG Antennas for Identification of People** Svanda, Milan; Polivka, Milan Czech Technical University in Prague, CZECH REPUBLIC	C28P2-1

Three variants of the very low-profile TAG antennas for UHF RFID of people were designed, as a result of the long?term development. Their performances from the wearability point of view were compared. Their performance properties including identification range are compared in real conditions in buildings corridors.

| 17:00 | **A Prototype 2D Direction Finding System With Passive RFID Tags**
Hislop, G[1]; Lekime, D[2]; Drouguet, M[1]; Craeye, C[1]
[1]Université catholique de Louvain, BELGIUM;
[2]MULTITEL, BELGIUM | C28P2-2 |

This paper presents a prototype direction of arrival system designed to locate passive RFID (Radio Frequency Identification) tags in a commercial warehouse environment. The system design is discussed with focus on a MUSIC based algorithm designed to cater for multiple reflections. Special emphasis is placed on the results of a trial of the system in a warehouse.

| 17:20 | **Sensing the Human Body by Implanted RFID Tags**
Occhiuzzi, C.; Marrocco, G.
University of Roma "Tor Vergata", ITALY | C28P2-3 |

Starting from the physical evidence that passive RFID systems may be used as self-sensing devices, the feasibility of human monitoring by means of implanted tags is here investigated, considering the continuous monitoring of brain edema evolution in patients neurosurgery treated. The sensing capabilities, the backscattering contrast and the communication link are analyzed at different frequency bands. Preliminary experimental results with simplified phantoms corroborate the analysis.

| 17:40 | **A Localization and Position Tracking Solution Utilizing Solar-Powered RFID Tags**
Lakafosis, Vasileios; Vyas, Rushi; Tentzeris, Manos
Georgia Institute of Technology, UNITED STATES | C28P2-4 |

The ability to determine the position of a device in outdoor or indoor environments is becoming the foundation for an ever increasing number of services. This paper demonstrates the implementation of a very low-cost localization and device tracking system on top of a Wireless Sensor Network topology. Its major components, namely the mobile RFID prototype, the fixed wireless infrastructure and the central server, are described and an initial evaluation of the accuracy of the system is presented.

Session: **Mo-Poster Session P1: Mobile Propagation**
Type: Poster
Date: Monday, April 12, 2010
Time: 16:40 - 18:20
Room: Foyer 2
Chairs: R. Dubrovka
               J. Poutanen

Time	Title	Abs No

16:40 Spectral Properties of Modulated Signal in the Doppler Domain in Urban Radio Channels with Fading   Mo-49

Blaunstein, Nathan[1]; Katz, Dmitry[2]; Hayakawa, Masashi[3]
[1]Ben Gurion University of the Negev, Be'er-Sheva, ISRAEL;
[2]Ben-Gurion University of the Negev, Be'er-Sheva, ISRAEL;
[3]University of Electro-Communications, Tokyo, JAPAN

In this work, we examine propagation of frequency modulated radio signals in the urban environments for different elevations of base station antennas, based on the stochastic approach. We investigate the spectral properties of signal power variations in the frequency domain and describe them based on the Doppler-spread spectrum of signal power. In the framework of the stochastic approach, the correlation function, the Ricean K-parameter, and the scale of correlation are analyzed.

16:40 Modeling the Evolution of Number of Clusters in Indoor Environments   Mo-51

Poutanen, Juho; Haneda, K.; Salmi, J.; Kolmonen, V.-M.; Vainikainen, P.
Aalto University School of Science and Technology, FINLAND

In this paper the number of multipath clusters is studied based on nine dynamic indoor channel measurements. Cluster lifetimes and visibility regions are analyzed. The results reveal that the number of clusters is larger in line-of-sight (LOS) than in non-line-of-sight (NLOS) scenarios and that the radii of the visibility regions are smaller in NLOS than in LOS. Accordingly, the number of active clusters changes more rapidly in NLOS than in LOS scenarios.

16:40 Target Location and Tracking Using Hybrid Sensor Networks   Mo-53

Palaniappan, R.; Wahid, P.
University of Central Florida, UNITED STATES

Sensor networks have revolutionized data gathering capabilities and information processing in diverse environments. In this paper we address two fundamental issues; localization and tracking, using a hybrid sensor network. Simulation results using our proposed algorithm show that it is robust in localization and tracking of targets in indoor environments. We have also demonstrated that by using a small set of mobile nodes we can extend the coverage of the sensor grid over a large area.

16:40 Issue of IEEE 802.20 Vehicular-A Delay Profile Model on Estimating Received Signal Level Variation of Wideband Signal   Mo-55

Kameda, S.[1]; Oguma, H.[1]; Izuka, N.[2]; Asano, Y.[2]; Yamazaki, Y.[2]; Takagi, T.[1]; Tsubouchi, K.[1]
[1]Tohoku University, JAPAN;
[2]SoftBank Telecom Corp., JAPAN

This paper estimates a received signal level variation in a mobile broadband wireless access system using IEEE802.20 vehicular-A delay profile model. The simulation results show that wider signal bandwidth yields a narrower variation range of the received signal level when the bandwidth is narrower than 3 MHz. We consider that the profile model is appropriate to calculate the received signal level variation when the signal bandwidth is narrower than 3 MHz.

16:40 Channel Characterization for Intra-Vehicle WSN in the ISM Bands   Mo-57

D'Errico, Raffaele; Rudant, L.; Keignart, J.
CEA, LETI, MINATEC, FRANCE

In this paper we present a characterization of the propagation channel for in-car wireless sensor networks. Measurements were performed in two ISM bands at 2.4 GHz and 868 MHz. The effect of surrounding environment as well as antenna orientation and emplacement are investigated.

16:40 Fading Channel Modelling for Fixed Terminal in Outdoor NLOS Condition   Mo-59

Ohta, Yoshichika[1]; Fujii, T[2]
[1]Softbank Telecom Corp. / Japan, JAPAN;
[2]Softbank Telecom Corp., JAPAN

Mobile terminals used in the stationary condition experience a level variation different from that found in the moving condition. Therefore, it is very important to study the fading characteristics of static usage. This paper clarifies the generalized fading characteristics of mobile terminals in outdoor NLOS environments when they are used in the stationary condition; only surrounding objects such as cars move. A general empirical formula of the autocorrelation function of the received level.

16:40 | **Arrival Angular Profile Modeling at Mobile Station for Cellular Systems** | Mo-61

Omote, Hideki; Ohta, Yoshichika; Fujii, Teruya
Softbank Telecom, JAPAN

In this paper, we proposed an arrival angular profile model at the MS that was derived from our proposed physical time-spatial path model. We measured the arrival angular profiles at an MS in suburban and urban area. Compared with the measurement results, we show that the proposed arrival angular profile model can well match the field measurement results if the parameters are set to appropriate values.

16:40 | **Studies of Propagation Loss in Semi-Confined Environments Using Parabolic Equations for Large Angels of Propagation** | Mo-63

Cavalcante, Gervasio; Souza, João; Magno, Fatima; Cazzolino, Klaus; Costa, Jesse
UFPA, BRAZIL

In this article the propagation loss in mobile cellular systems in semi-confined environment using parabolic equations is studied. The proposed model uses approximations for small and large angles of propagation and its results are validated through a campaign of measurement. The semi-confined environment is represented by a street with trees and buildings. The results compared with the experimental results and by ray tracing model showed good agreement, with a less computational effort.

16:40 | **Multiple Element Antenna Placement and Structure Studies in Subway Environments** | Mo-65

Alonso, J
Universitat Poliècnica de Catalunya, SPAIN

Public subway transport networks require reliable high data reate wireless communication systems. In this work the authors present a method to assess the impact of the position inside the tunnel and the diversity configuration of the antennas of the considered MIMO system on the maximum theoretical capacity of the radio-channel inside subway tunnel

16:40 | **Results from MIMO Channel Measurements and Comparison to the Extended Saleh-Valenzuela Model** | Mo-67

Ferreira, I.; Mota, S.; Rocha, A.
University of Aveiro, PORTUGAL

This paper presents an overview about Multiple-Input, Multiple-Output (MIMO) systems and its capabilities to provide high data rates and quality of service. To maximize the gains achieved with MIMO systems, a detailed characterization of the channel is needed so a MIMO channel model will be presented and, based on data collection, a performance analysis will be made. The evaluated model presented here is the extended Saleh-Valenzuela model.

16:40 | **Antenna Radiation Pattern Influence on UWB Ranging Accuracy** | Mo-69

Dashti, Marzieh[1]; Laitinen, Tommi[2]; Ghoraishi, Mir[3]; Haneda, Katsuyuki[2]; Toivanen, Juha[2]; Takada, Jun-ichi[1]; Vainikainen, Pertti[2]
[1]Tokyo University of Technology, JAPAN;
[2]Aalto University School of Science and Technology, FINLAND;
[3]Tokyo Institute of Technology, JAPAN

UWB technology has become an attractive choice for indoor localization. Pulse based UWB is found to be suitable for overcoming the signal ToA ambiguities due to multipath. Much work has been done on UWB ToA estimation. However the effect of radiation patterns of antennas have not be considered. This paper investigates the effect of antenna directivity on the detection of the direct path in a typical indoor scattering environment. It is shown that ranging error is reduced by using directional antennas.

16:40 | **Simplified model of the convex obstacles transition zone diffraction for carrier UWB signal propagation** | Mo-71

Gorniak, P.; Bandurski, W.
Poznan University of Technology, POLAND

We propose the way of deterministic UWB channel modeling in the channel with convex obstacles in cascade. We describe the channel by its impulse response. With the usage of some vital approximations of the expressions occurring in amplitude term and slope term of the impulse response of two convex obstacles, we describe the procedure of obtaining the simplified closed form impulse response. We propose also the extension of the procedure to more than to convex obstacles in cascade.

16:40 | **A Statistical Radio Coverage Prediction Approach for Cooperative Control in Relay Based Cellular Networks** | Mo-73

Jiang, P; Bigham, J; Dubrovka, R; Wu, J
Queen Mary University of London, UNITED KINGDOM

In this paper, the radio coverage issue is analyzed for the potential risks of the cooperative control when applied in realistic environment. A statistical model is proposed for radio coverage prediction, where the cooperative control feature is used for the precision of prediction model improvement. The prediction model is verified with theoretical and simulated radio coverage comparisons and survey data for prediction accuracy is also discussed.

16:40 **Development and Evaluation of an Open Source Wireless Planning Software** Mo-75

Liong, ZJ; Ahmad, R.B; Soh, PJ; Ting, K.N
Universiti Malaysia Perlis, MALAYSIA

An open-source GIS software, was pre-programmed with a simulation plug-in to another open-source software named "MapWindow GIS". It provides a low cost solution to wireless planning with the advantage of GIS functionality such as coordinate system, buildings topology and the ability of doing spatial analysis. In order to produce more accurate simulations, the free space propagation model and Ray Tracing Methods were developed as plug-ins, and investigated by considering reflected/transmitted ray

16:40 **Investigation of the Chest-Ear Radio Propagation Channel** Mo-77

Kvist, Søren; Jakobsen, K.B.
Technical University of Denmark, DENMARK

The path gain ($|S21|$) between antennas on the chest and at the ear is presented as a function of the position of the antenna on the chest. A monopole antenna and a printed Inverted-F Antenna (IFA) are considered for placement on the chest. The path gain is found by HFSS simulations as well as measurements. The results are analyzed and discussed.

16:40 **Effect of Propagation Phenomena on MIMO Capacity of Wireless Systems between 3 and 10 GHz** Mo-79

Malhouroux-Gaffet, Nadine[1]; Pajusco, P[2]; Haddad, E[3]
[1]France Telecom, FRANCE;
[2]Telecom Bretagne, FRANCE;
[3]Orange Labs, FRANCE

Multiple Input Multiple Output (MIMO) Antenna systems promise high spectral efficiency over multipath channels. But accurate wideband MIMO channels models are required to optimize these new radio access schemes. This paper focuses on the MIMO channel capacity versus different propagation channel parameters such as frequency or antenna type. This study is based on both experimental and simulated results in a residential environment.

16:40 **Measurement Based Propagation Channels for Terrestrial Digital Television Broadcasting Systems.** Mo-81

Montalban, J.; Velez, M.; Sancho, R.; Prieto, G.; Arrinda, A.; de la Vega, D.; Angueira, P.
University of the Basque Country UPV/EHU, SPAIN

In this paper, we propose a novel method to validate channel estimations based on two different analysis that compare the similarity between the real signal measurements and the values obtained after processing the theoretical transmitted signal through the estimated channel. The merit of this technique is its simplicityand the possibility to identificate with one parameter the quality of our estimation. The performance is evaluated over a real Gaussian channel.

16:40 **Clustering Characterization for UWB Indoor Communications** Mo-83

Geng, Suiyan[1]; Vainikainen, Pertti[1]; Geng, Suiyan[2]
[1]Helsinki University of Technology, FINLAND;
[2]Aalto University School of Science and Technology, FINLAND

The UWB indoor channels can be generally classified as single- and multi- cluster channels. The multipath components (MPCs) are associated with uniform distribution and limited angular spread in the two channels. Moreover, the modified multi-cluster model is compared with the classical Saleh-Valenzuela model. It is shown that the modified cluster model is better in fitting measurement data and the parameters in the model physically indicate cluster properties of propagation channels.

16:40 **Comparison of Macrocell Propagation Channels at 2.2 and 3.8 GHz** Mo-85

Lacoste, Frédéric; Carvalho, F.; Scot, G.; Ros, B.
CNES, FRANCE

This paper presents experimental propagation results inferred from measurements carried out in macrocell configuration at 2.2 GHz and 3.8 GHz in two typical French cities. In particular, path loss and shadowing parameters are analysed.

16:40 **Mobile WiMAX: System Performance on a Vehicular Multipath Channel** Mo-87

Colda, Rebeca Maria; Palade, T.; Puschita, E.; Vermesan, I.; Moldovan, A.
Technical University of Cluj-Napoca, ROMANIA

The paper addresses the downlink performance of a fully compliant mobile WiMAX system operating at 2.3 GHz, on a vehicular multipath fading channel. The evaluation of the system's performance was done starting from the quality of service requirements imposed by certain types of applications. The results are expressed in terms of the most suited coding scheme, the achievable link throughput and operating range, the required receiver sensitivity and the modulation scheme switching points.

16:40 **Influence of Propagation Models in 802.11p Car-to-Car Network Simulations** Mo-89
Ferreiro-Lage, J. A; Aguado-Agelet, F.; Galvez, J.; Rubinos, O.; Ferreiro-Lage, J.A
University of Vigo, SPAIN

This study presents the importance of propagation models in car-to-car simulations. It shows both their behaviour when using different propagation models and the possibility to auto adapt a propagation model in a simulation depending on the zone (urban, highway…). Also, it shows how diverse models can be reduced to one, optimizing the network performing in the simulation.

16:40 **Auto-Calibrated MIMO-OFDM Channel Sounder for 3D Spatial Channel Characterization** Mo-91
Mora-Cuevas, J.; Cuellar, L.; de Haro-Ariet, L.
Technical University of Madrid, SPAIN

This paper presents an improved test-bed designed for analyzing the spatial behaviour of wideband indoor channels using MIMO-OFDM systems. A 3D antenna positioning system (3-DAPS) is specifically designed for obtaining 3D spatial data. A RF calibration module is designed and implemented to track the frequency response of all RF chains of transmitter and receiver. The average of the pseudo-spectrum MUSIC over all frequencies improves the resolution of the spatial spectrum.

16:40 **The MultiEXCELL Model For The Prediction Of The Radio Interference Due To Hydrometeor Scattering** Mo-93
Capsoni, C.; Luini, L.; D'Amico, M.
Politecnico di Milano, ITALY

This paper presents a physically-based methodology for the prediction of the intersystem radio interference due to hydrometeor scattering. Local precipitation phenomena are modelled through a set of synthetic rain fields generated by the MultiEXCELL model, whilst the coupling-by-scattering mechanism relies on the simplified bistatic radar equation (BRE). The model's performance is evaluated against the comprehensive ITU-R DBSG3 database.

16:40 **Numerical Examination of EM Wave Shadowing by Human Body** Mo-95
Yokota, Mitsuhiro[1]; Ikegami, T.[2]; Ohta, Y.[3]; Fujii, T.[3]
[1]University of Miyazaki, JAPAN;
[2]Univ. of Miyazaki, JAPAN;
[3]Soft bank Mobile Corp., JAPAN

Scattering by a lossy dielectric cylinder is examined numerically to confirm the modeling as human body.The transmitted power is calculated and compared with the experimental results. The effect of the shape e.g. the elliptical cylinder and the elliptical cylinder with circular cylinders is examined. By comparison with the experimental results, it is shown that the equivalent diameter of human body is appropriate. The frequency characteristics of the equivalent diameter are shown.

Session: **Mo-Poster Session M1: Antenna Measurements**
Type: Poster
Date: Monday, April 12, 2010
Time: 16:40 - 18:20
Room: Foyer 2
Chairs: T. Laitinen
X. Zeng

Time	Title	Abs No

16:40 **Antenna Polarization Mismatch in Body Area Network Communications**   Mo-52
Yekeh Yazdandoost, Kamya; Hamaguchi, Kiyoshi
NICT, JAPAN

In any wireless communications, antennas and propagation are key concerns. Their importance becomes more significant for in/on-body wireless applications because, antenna should be part of device and it should be placed inside or on surface of body tissue. Therefore, due to presents of body tissues, there is strong effect on antenna characteristics and as a result on propagation. This paper discusses on polarization mismatch due to body movements between in/on-body Tx and Rx antennas.

16:40 **Intracranial Pulsation Detected by Ultra-Wideband Radar:Detectability Analysis Using Synthetic Signals**   Mo-54
Thiel, Florian[1]; Kreiseler, D.[2]; Seifert, F.[2]
[1]Physikalisch-Technische Bundesanstalt (PTB), GERMANY;
[2]Physikalisch-Technische Bundesanstalt, GERMANY

We have established a combined magnetic resonance (MRI) / ultra-wideband radar (UWB) prototype demonstrating the absence of any mutual interference between both systems, proving the feasibility of the UWB radar method to monitor respiratory and myocardial displacements in a 3 T scanner. It is well known that simultaneous intracranial oscillation also occur, induced by respiration and myocardial contraction. Hence, it is only consequent to ask whether these oscillations are detectable by UWB rad

16:40 **Study on the Sensitivity of Image Reconstruction to the Measurement Uncertainty in Microwave Tomography**   Mo-56
Zeng, X; Fhager, A; Persson, M
Chalmers University of Technology, SWEDEN

We investigated the effects of measurement uncertainty on the image reconstructions for different breast models. Three different contrast levels between the background tissue and tumor were chosen. It was shown that the reconstruction of lower contrast breast model was more sensitive to the measurement uncertainty. For a breast model with contrast as low as 1.1 : 1, an amplitude uncertainty of 0.2 dB or a phase uncertainty of 2 degrees would result in an unsuccessful reconstruction.

16:40 **New Measurement Methode of the Reflection Phase Coefficient of High Impedance Surface**   Mo-58
Ratajczak, Philippe[1]; Baracco, J.M.[2]; Brachat, P.[1]
[1]Orange Labs, FRANCE;
[2]Mardel, FRANCE

This paper presents a new technique to measure the reflection phase coefficient of High Impedance Surface structures. The proposed technique, which is simple to implement and requires little measurement time, has been validated with measurements performed on an active HIS used in the design of a reconfigurable active reflector antenna.

16:40 **Broadband Antenna Measurement Comparisons**   Mo-60
Huang, Yi[1]; Loh, T[2]; Foged, L[3]; Lu, Y[4]; Boyes, S[4]
[1]Univ of Liverpool, UNITED KINGDOM;
[2]NPL, UNITED KINGDOM;
[3]SATIMO, ITALY;
[4]University of Liverpool, UNITED KINGDOM

In this paper, we report some recent findings obtained by three organisations using different facilities to measure seven selected UWB antennas. It is shown that the measured circuit parameters (such as the input impedance and return loss) are normally very similar, but the measured field parameters (such as the radiation pattern, gain and efficiency) could be very different. The reasons for the discrepancies are investigated and some recommendations new reaults are also presented in the paper.

16:40 **Microwave Imaging using Amplitude-Only Data** Mo-62

Rubæk, Tonny; Zhurbenko, Vitaliy
Technical University of Denmark, DENMARK

This paper discuss how the performance of an imaging system is affected when the phase information of the measurements are removed from the data, leaving only amplitude information as input for the imaging algorithm. Simulated data are used for this purpose, and the images resulting from using amplitude-only data are compared with images obtained using the same data sets in which the phase information has been retained.

16:40 **Time Course of Compensatory Mechanism After GSM 900 MHz Radiation on Cerebral Activity Using a** Mo-64
Picrotoxin-Model in Rats

López-Martín, Elena; Carballo-Quintás, Manuel; Martinez-Silva, Isabel; Cadarso-Suarez, Carmen; Jorge-Barreiro, Francisco J.; Alvarez-Folgueiras, Marcos; Ares-Pena, Francisco J.
University of Santiago de Compostela, SPAIN

This study investigated the effects of mobile-phone-type radiation on the cerebral activity of seizure-prone animals. The experimental set-up used for exposure of small animals allows direct measurement of the power absorbed by the animal. The results showed that the compensatory mechanism of radiation in brain tissues depends on the time in every neuronal expression of c-fos. But the glia population had a limited response in several areas or regions for same level of radiation.

16:40 **Spectral response of a multi-layered sphere applied in microwave breast imaging** Mo-66

Zhu, Guangran; Popovich, Milica
McGill University, CANADA

We examine the tumor response using a multi-layered dielectric sphere under a plane wave excitation. Our aim is to explore the design space and use the results to choose the upper and lower bounds of various parameters for more complex numerical and experimental investigations. Our analysis shows that the tumor response is -125 dB for a 1-mm tumor inside tissue with <30% of adipose content and -55 dB for a 5-mm tumor inside tissue with >85% of adipose content.

16:40 **Angular Plane Wave Spectrum Analysis of TM Modes in a 2d Reverberation Chamber Using A Root-** Mo-68
Music Based Method

Nafkha, Kamel[1]; Mengue, S[2]; Richalot, E[3]; Picon, O[3]
[1]Université Paris Est Marne-la-vallée, FRANCE;
[2]Universite Paris Est Marne la Vallee, FRANCE;
[3]Universite Paris Est Marne la Valle, FRANCE

The electric field within a reverberation chamber (RC) is expanded on plane waves using a high resolution method based on Root-MUSIC algorithm. This method applied to electric field cartographies issued from FDTD simulations gives accurate results in the case of a RC with a fixed stirrer. By moving the stirrer we demonstrate that whereas DOA are slightly affected by the stirrer rotation, the plane wave powers are strongly sensitive to the stirrer position at low frequency.

16:40 **Natural Coupling Distance for Human Exposure to Electromagnetic Fields** Mo-70

Garcia-Fernandez, M. A.; Valenzuela-Valdes, J. F.; Sanchez-Hernandez, D.
Universidad Politecnica de Cartagena, SPAIN

A human head is exposed to 4 W of power at 5725 MHz (the maximum EIRP for WiMAX Band C). Peak SAR values and its effects on temperature increase have been observed. A natural coupling distance between the antenna and the human head, and the skull being a protection for thermal stress due to EMF exposure have been confirmed, suggesting that a combined EM-thermal basic restriction would represent more accurate safety limits, reducing the uncertainties for deriving the reference levels.

16:40 **Whole-Body Averaged SAR Measurement Based on Electric Field Distributions on External Cylindrical** Mo-72
Boundary

Hikage, T.; Kawamura, Y.; Nojima, T.
Hokkaido University, JAPAN

The purpose of this study is to establish a whole-body averaged specific absorption rate (WB-SAR) estimation method using the power absorbed by humans using cylindrical-external field scanning technique. In this paper, we develop the experimental set-up for WB-SAR estimation using human phantom made of tissue-equivalent material and scaled model. Additionally, measured results of WB-SAR of standing human for 2GHz far-field exposure are shown.

16:40 **Coupling Waveguide Array for a Patch Array Calibration Scanner** Mo-74

Humpfer, H.; Wansch, R.
Fraunhofer IIS, GERMANY

This document presents the development of novel coupling devices for the verification and the calibration of each patch element in a large patch array antenna. Different options have been compared. This results in an array of waveguides with an integrated planar circuit board feed.

16:40   **Determination of Phase Centers of Ultra-Wideband Antennas**   Mo-76

Schwarz, Ulrich[1]; Zhukov, V.[2]; Stephan, R.[1]; Hein, M.A.[1]
[1]Ilmenau University of Technology, GERMANY;
[2]Moscow Energetic Institute, RUSSIAN FEDERATION

This paper summarizes some fundamental aspects in terms of phase centers and suitable algorithms as well as measured characteristics of ultra-wideband double-ridged horn antennas, which are intended for use in bio-medical radar applications. The limitations of this approach and the relevance of an accurate determination of phase centers are discussed.

16:40   **Broadband Antenna FDTD Modeling for EMC Tests**   Mo-78

Jauregui, R; Heras, M.; Silva, F.
Universitat Politècnica de Catalunya (UPC), SPAIN

This paper describes the modeling and analysis to modeling EMC immunity test by means of computer simulation with Finite Difference Time Domain (FDTD) method. To ensure the integrity of the results the log-periodic antenna was simulated separately and then included in a more complex model. Despite the many limitations of both the numerical models and the measurements, the models provide a satisfactory representation of the electrical field radiated by the antenna.

16:40   **A Customized Measurement System for the Assessment of Electromagnetic Interference caused by Plasma Plumes**   Mo-80

Sarri, Antonio[1]; Cioni, Riccardo[2]; Fittipaldi, Domenico A.[2]; Marliani, Filippo[3]
[1]IDS Ingegneria Dei Sistemi S.p.A, ITALY;
[2]IDS Ingegneria dei Sistemi SpA, ITALY;
[3]ESA-ESTEC, NETHERLANDS

This paper presents a customized measurement system for the assessment of the electromagnetic interference caused by plasma plumes, mainly in terms of spurious modulation effects, generated by the plasma channel saturation and depletion, and related effects on noise and inter-modulations. The goal of the experiments is to obtain a comprehensive set of experimental data to validate and complement theoretical and prediction data about plasma plume-induced modulation phenomena.

16:40   **Compact Planar Monopole for Broad Band Applications**   Mo-82

Monti, Giuseppina; Tarricone, Luciano; Corchia, Laura; Valentino, Luca
University of Salento, ITALY

The paper presents a compact monopole well suited for broad band applications. Numerical and experimental results are reported demonstrating that the proposed design strategy guarantees a bandwidth broader than 60% and very compact dimensions.

16:40   **Multi-Purpose 3D Spherical System for Electromagnetic Tests**   Mo-84

Poyatos, D.; Escot, D.; Aguilar, J.A.; Montiel, I.
INTA, SPAIN

A new indoor facility for mono and bi-static electromagnetic measurements has been developed and built at INTA, Spain. The system has been designed to be versatile enough to carry out different tests such as near-field antenna measurements, material absorption measurements and electromagnetic characterization of materials. Furthermore, the facility allows the researchers to investigate in the field of near-field to farfield transformation for radar cross section analysis. The paper describes the novel concept behind the falicity and presents preliminary measurement results on different applications.

Time	Title	Abs No

08:30 **An Experiment and Preliminary Results for Narrow- and Wideband Land Mobile Satellite Propagation at K-band** — P01P1-1

Schönhuber, M.[1]; Teschl, F.[1]; Hovinen, V.[2]; Kyröläinen, J.[2]; Peréz-Fontán, F.[3]; Prieto-Cerdeira, R.[4]
[1]JOANNEUM RESEARCH, AUSTRIA;
[2]University of Oulu, FINLAND;
[3]University of Vigo, SPAIN;
[4]European Space Agency, NETHERLANDS

Capacity shortages in satellite mobile services are to be expected. To understand higher frequencies a mobile experiment has used narrow- and wideband test signals. Preliminary results indicate excellent qualitative plausibility and information value. Ongoing quantitative analyses include comparisons to literature. Focus is a statistical analysis to set up a channel simulator predicting behaviour under the measured scenarios' conditions. It is planned to submit results for standardization.

08:50 **Calculation of Interference from Fixed Services to a Deep Space Earth Station** — P01P1-2

Valtr, P.; Martellucci, A.
European Space Agency, ESA/ESTEC, NETHERLANDS

This paper aims at methodology of calculation of interference from terrestrial services to a deep-space earth station. Certain radiowave propagation issues related to calculation of the interference are addressed. The purpose of the analysis is to determine the possible level of interference in 32 GHz frequency band with respect to the reliability of operation of deep space missions. The results are given in form of statistical distribution of interference levels.

09:10 **Comparisons of Different Approaches for ILS Simulation** — P01P1-3

Thain, A[1]; Estienne, J-P[1]; Peres, G[1]; Spitz, B[2]; Evain, L[3]; Kumar, M[3]
[1]EADS Innovation Works, FRANCE;
[2]ENAC, FRANCE;
[3]Airbus SAS, FRANCE

The recent ILS localiser prediction tool, ATOLL, has been employed to study a range of different scenarios. Simulations produce similar results to measurements performed on a glideslope mast and a taxiing Airbus A380 aircraft. A study on simple rudder-sized plates demonstrates the limits of the PO method. Simulations performed on cranes show a strong dependence upon the angle of the jib. The effects of multiple inter-crane interactions are seen to been insignificant for these geometries.

09:30 **Extreme-Value Statistics of Attenuation and Rainfall in Slant Path Sites in Brazil** — P01P1-4

Miranda, Erasmus[1]; Pudwell, M.[1]; Souza, R.[1]; Pontes, M.[2]; Silva Mello, L.[2]; Rodrigues, M.[2]; Pina, T.[2]
[1]INMETRO, BRAZIL;
[2]CETUC-PUC/Rio, BRAZIL

This paper presents results from the statistical analysis of extreme events of rainfall induced attenuation and measured rainfall rate in 4 sites in Brazil. The extreme values of attenuation and rainfall are obtained form the time series of measured data on a daily basis. Distribution functions of extreme attenuation and rainfall values were tested against 2 extreme value distributions and, in the case of rainfall, the lognormal. Both extreme values of attenuation and rainfall were found to follow a Weibull distribution.

09:50 **The Use of Signals of Opportunity for the Measurement of Atmospheric Refractivity** — P01P1-5

Watson, Robert[1]; Coleman, Christopher[2]
[1]University of Bath, UNITED KINGDOM;
[2]University of Adelaide, AUSTRALIA

This paper discusses the feasibility of a novel technique for measuring atmospheric refractivity by the reception and processing of digital radio and television signals (DAB & DVB T). This technique is step towards the realization of a wide-area water vapour sensor network made possible by the soon-to-be widespread availability of digital broadcast signals. The paper presents an error analysis and preliminary results.

10:10 **MISO and SIMO Measurements of the Land Mobile Satellite Propagation at S-Band** — P01P1-6

Lacoste, Frédéric[1]; Carvalho, F.[1]; Fontan, F.P.[2]; Nunez, A.[2]; Fabbro, V.[3]; Scot, G.[1]
[1]CNES, FRANCE;
[2]University of Vigo, SPAIN;
[3]ONERA, FRANCE

This paper presents experimental propagation results inferred from Multiple-Inputs-Single-Output (MISO) and Single-Input-Multiple-Outputs (SIMO) Land Mobile Satellite measurements carried out at 2.2 GHz. In particular, statistical combining gains provided by spatial and polarization diversity techniques are analysed depending on the environment.

Session:	**C03P1: Frequency-reconfigurable antennas - 1 (organized by COST IC0603 ASSIST)**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 119
Chairs:	J. Perruisseau
	C. Christodoulou

Time	Title	Abs No
08:30	**Novel Wide Tunable Dual-Band Reconfigurable Chassis-Antenna for Future Mobile Terminals**	C03P1-1

Hu, Z. H.[1]; Kelly, J. R.[1]; Song, C. T. P.[2]; Hall, P. S.[1]; Gardner, P.[1]
[1]University of Birmingham, UNITED KINGDOM;
[2]Quintel Technology Limited, UNITED KINGDOM

This paper presents a novel reconfigurable chassis-antenna for use in current and future wireless communication systems. The antenna uses a pair of coupling elements which give independent and versatile dual frequency and bandwidth reconfiguration, using a number of external matching circuits. Simulations suggest that the antenna has a total tuning range of 2854 MHz (from 442 MHz to 2896 MHz). An equivalent circuit has been developed for the two port chassis-antenna.

| 08:50 | **Reconfigurable Multilayer Patch Antennas Based on Metamaterials** | C03P1-2 |

Sanchez-Fernandez, Carlos J.[1]; Quevedo-Teruel, Oscar[1]; Ng Mou Kehn, Malcolm[2]; Rajo-Iglesias, Eva[1]
[1]Universidad Carlos III de Madrid, SPAIN;
[2]National Chiao Tung University, SPAIN

Along this document, the reconfigurability possibilities of a dual band microstrip patch antenna based on short-circuited SRR is studied. Since the antenna presents a narrow bandwidth, reconfigurability techniques has been implemented to extend the effective bandwidth of the device. The proposed antenna has a multilayer configuration where the feeding line and the radiating layer are located at different levels. The final reconfigurable version has been implemented by using varactor diode.

| 09:10 | **Reducing Complexity and Improving the Reliability of Frequency Reconfigurable Antennas** | C03P1-3 |

Costantine, J.; Tawk, Y.; Christodoulou, C.G.; Abdallah, C.T.
Electrical and Computer Engineering Department, University of New Mexico, UNITED STATES

In this paper the complexity and reliability of frequency reconfigurable antennas are presented. A new approach for decreasing the complexity of reconfigurable antennas while maintaining the reliability of such structures is discussed. An example is given to prove the validity of the proposed approaches.

| 09:30 | **Recent Developements On Reconfigurable Band-Filtering Antennas** | C03P1-4 |

Perruisseau-Carrier, Julien; Pardo-Carrera, Pablo
Centre Tecnologic de Telecomunicacions de Catalunya (CTTC), SPAIN

This paper presents very wideband bow-tie slot antennas with reconfigurable band-rejection filtering within the band. The antennas can be operated with 3 different rejection frequencies and in an all-pass mode, using Pin diodes. The fully operational reconfigurable antennas are presented and characterized in terms of return loss, radiation patterns, and efficiency. The application, circuit model, and design of the antennas are also discussed.

| 09:50 | **Reconfigurable UWB Antenna Operating in Two Different Sub-bands** | C03P1-5 |

Davidovic, M. D.[1]; Nikolaou, S.[2]; Vryonides, P.[3]; Kolundzija, B.[1]; Nikolic, M.[1]
[1]School of Electrical Engineering, SERBIA;
[2]Frederick Research Center, CYPRUS;
[3]Frederick University Cyprus, CYPRUS

In this paper a novel design of a wideband antenna that can operate in two complementary UWB sub-bands is presented. The proposed antenna is a dual layer design, consisting of a microstrip feed line with embedded PIN diodes on the back side of the board, and a circular slot with an elliptical patch within on the front side. It can be switched between two states, one covering the lower frequency range 3.1-6 GHz, and the other one covering the upper frequency range 6-10.6 GHz.

Time	Title	Abs No
08:30	**2GHz Channel Measurement in the Urban Environment and the Investigation of Channel Dynamic Properties**	C01P1-1

Kitao, K; Saito, K; Imai, T; Okano, Y; Miura, S
NTT DOCOMO, JAPAN

Recently, channel models that consider time variant behavior have became important to evaluate the dynamic radio resource assignment techniques such as automatic modulation control (AMC), rank adaptation, and scheduling which are currently under investigation for LTE and IMT-Advanced systems. In this manuscript, we provide 2GHz channel measurements in a typical urban environment and investigate the dynamic channel property of the environment.

08:50	**Performance of Transmission-Time Optimized Relaying Schemes in Real-World Channels**	C01P1-2

Sánchez González, Fernando[1]; Bandemer, Bernd[2]; Matz, Gerald[3]; Oestges, Claude[4]; Kaltenberger, Florian[5]; Czink, Nicolai[1]
[1]FTW, AUSTRIA;
[2]Stanford University, UNITED STATES;
[3]Vienna University of Technology, AUSTRIA;
[4]Universite Catholique du Louvain, BELGIUM;
[5]Eurecom, FRANCE

In this paper, we compare the achievable data rates of several relaying schemes using measurements at 2.45 GHz. We distinguish between the availability of instantaneous channel state information and average channel SNR information. Our data analysis indicates that (i) the deployment of relays can improve ergodic data rate at least twofold, and (ii) instantaneous channel knowledge enables at most 8.7% increase in spectral efficiency over average channel knowledge.

09:10	**Estimating MIMO Capacities from Broadband Measurements in a Cellular Network**	C01P1-3

Jaeckel, Stephan; Jungnickel, Volker
Fraunhofer Heinrich Hertz Institute, GERMANY

We provide a new method to evaluate capacities from channel soundings. Measurements are done in a network using 3 sites at an ISD of 750 m. We emulate a virtual 2x2 setup with omnidirectional coverage and apply an adaptive thresholding method to denoise the data. This approach gains 10 dB of SNR. At a fixed SNR of 10 dB, our setup achieves 5.7 bps/Hz. Including the received power, best server capacities are calculated to 15 bps/Hz while the corresponding SISO setup only achieves 7.6 bps/Hz.

09:30	**Modeling of Cooperative MIMO Channels in Urban Areas**	C01P1-4

Jandura, Carsten[1]; Kaeske, Martin[2]; Voigt, Jens[3]; Fettweis, Gerhard P.[1]
[1]Dresden University of Technology, GERMANY;
[2]Ilmenau University of Technology, GERMANY;
[3]Actix GmbH, GERMANY

This paper shows an approach to compare the results of the ray tracing simulations with processed channel sounding measurements at specific points in an urban environment As result we can conclude that carefully performed Geometrical Optics based ray-tracing simulations are a suitable prediction model to reflect main characteristics of these scenarios.

09:50	**Slowing Manhattan MIMO Channels**	C01P1-5

Ling, Jonathan; Chizhik, D.
Alcatel-Lucent, UNITED STATES

This paper discusses the application of a beam forming algorithm that slows temporal variations of measured MIMO channels. A measurement campaign is described which surveyed a section of Manhattan using a low base transmitter. The data were processed to obtain angular spectra. The spectra were then used to generate synthetic channels for algorithm evaluation. With 4 antennas the beam forming approach was found to improve channel coherence time by a factor of 2.

Session:	**C36P1: AMTA Session: New algorithms for antenna diagnosis technique - 1**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 121
Chairs:	M. Sierra Castaner
	L. Foged

Time	Title	Abs No
08:30	**Antenna Characterization Using the Sources Reconstruction Method**	C36P1-1

Alvarez Lopez, Yuri; Las-Heras, Fernando; Rodriguez-Pino, Marcos
Universidad de Oviedo, SPAIN

The following contribution describes the Sources Reconstruction Method for antenna diagnostics and near-field to far-field transformation (NF-FF) method. The SRM is based on the Equivalence Principle, that allows to replace the Antenna Under Test by an equivalent model that radiates the same electromagnetic fields. An interesting SRM capability is related to phaseless field measurements in two or more acquisition surfaces, allowing NF-FF transformations.

08:50	**Applicability of IsoFilter^{TM} Selectivity to Antenna Diagnostics**	C36P1-2

Hess, D.W.; McBride, S.
MI Technologies, UNITED STATES

We have devised a method for identifying the locations and strengths of an antenna's radiation sources that is an alternative to conventional back-projection. This alternative method utilizes the antenna's measured far-field radiation pattern and successive spherical modal analyses to ascertain the relative strength of the antenna's sources, as a function of position, that give rise to the far field.

09:10	**Applications of sources reconstruction techniques: theory and practical results**	C36P1-3

Cano, F.; Sierra-Castañer, M.; Burgos, S.; Besada, J. L.
Technical University of Madrid, SPAIN

In this paper, four new applications of sources reconstruction techniques (also called diagnostic techniques) are presented. Classical applications of such techniques are errors detection, like phase errors in arrays or conformal errors in reflectors. But also and it has been said, they can be used as the basis to other applications whose aim is to improve the measurement results in anechoic chambers or non anechoic environments.

09:30	**Near-Field Ultra-Wideband Imaging with Two-Dimensional Sparse MIMO Array**	C36P1-4

Zhuge, X.; Yarovoy, A
Delft University of Technology, NETHERLANDS

The feasibility of utilizing the concept of effective aperture for designing sparse MIMO array for UWB near-field imaging is investigated. 2-D MIMO array is designed based on the method with extension using the principle of separable aperture functions. The real 2-D aperture array is compared with its effective aperture measured with SAR technique. The array performances demonstrate the potential of UWB near-field imaging system with 2-D multi-static array configurations.

09:50	**Investigation of Antenna Pattern Synthesis Through Higher Order Inverse Equivalent Current Method**	C36P1-5

Ismatullah,; Eibert, T.F.
TUM, GERMANY

In the realm of near-field far-field transformation, inverse equivalent current method has recently gained significant popularity. In the present contribution, nearly orthogonal hierarchical vector basis functions complete to full first order with respect to the curl space are utilized for the discretization of inverse equivalent surface currents defined on flat triangular domains. Various numerical examples are presented for the comparison of results with low order and higher order modeling.

Session:	**C31: Transformation electromagnetics and its applications**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 122-123
Chairs:	R. Mittra
	Y. Hao

Time	Title	Abs No
08:30	**Boundary Versus Core Conditions for the Control of Electromagnetic Waves by Electromagnetic Transformations**	C31-1

Lippens, Didier; Croënne, Charles
IEMN, FRANCE

We report on the possibility of controlling the radiation pattern of a quasi-point source antenna with a high directivity by means of artificial metamaterial-based cloaks. The demonstration of high directivity via the engineering of core effective parameters, with performances comparable to those obtained by conventional techniques such as parabolic mirrors, is carried out numerically by means of electromagnetic transformations. Two consecutive cartographic space transformations are performed in practice with an intermediate curved space.

08:50	**Bandwidth Performance of a Simplified Cloak Realized by Non-Magnetic Dielectric Cylinders**	C31-2

Bao, Di; Kallos, Efthymios; Argyropoulo, Christos; Hao, Yang
Queen Mary, University of London, UNITED KINGDOM

A design for broadband scattering reduction of metallic objects based on non-magnetic dielectric cylinders is proposed, and their bandwidth performance is examined. The devices are functional in the presence of a ground plane as well as directionally in free space between 4 - 10 GHz. The required all-dielectric permittivity distribution for the cloak is achieved by manipulating the dimensions of periodically distributed dielectric cylinders.

09:10	**A Systematic Approach to Determining the Constitutive Parameters of Metamaterials in the Context of Transformation Electromagnetics**	C31-3

Martini, E.; Cigni, G.; Sardi, G.M.; Caminita, F.; Maci, S.
University of Siena, ITALY

A novel systematic method for the retrieval of the constitutive electromagnetic parameters of metamaterials is presented. The analysis is focused on the important class of metamaterials consisting of a stack of planar periodic structures. A complete characterization of the effective medium is obtained by retrieving all the components of the permeability and permittivity tensors and accounting for both spatial and time dispersion.

09:30	**Verification of Cloak Designs Based on Transformation Optics via Rigorous Numerical Simulation**	C31-4

Mittra, R.[1]; Huang, Neng-Tien[2]
[1]EMC Lab, Penn State University, UNITED STATES;
[2]Communication Engineering Department, Yuan Ze University, Chung-Li, TAIWAN

In this paper we present the results of numerical experiment, using a FDTD-based parallel-enabled package GEMS, on the cloaking structure, designed by using split rings as basic elements, from a recently published paper by Smith et al. We excite a cylindrical object, covered by the cloak, designed as described in the above reference and investigate how it scatters off the cloaked object and to what extent it faithfully reproduces the original wavefront once it has traveled past the object.

09:50	**Transformation Circuits**	C31-5

Grbic, Anthony[1]; Gok, Gurkan[2]
[1]Univerisity of Michigan, UNITED STATES;
[2]University of Michigan, UNITED STATES

Earlier transmission-line based metamaterials were limited to having effective material parameters that are diagonal in the Cartesian basis. In contrast, this paper presents transmission-line metamaterials with arbitrary, tensorial effective material parameters. The proposed metamaterials can provide extreme control of electromagnetic fields along a surface or radiating aperture, and therefore will find application in antennas and microwave devices.

Session:	**C33P1: Millimeter wave integrated/reconfigurable antennas, devices and systems - 1**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 124
Chairs:	R. Sauleau
	M. Ando

Time	Title	Abs No
08:30	**Double-Layer Slotted Waveguide Array Antennas with Corporate-Feed by Diffusion Bonding of Laminated Thin Metal Plates**	C33P1-1

Hirokawa, J.; Zhang, M.; Miura, Y; Ando, M.
Tokyo Institute of Technology, JAPAN

We demonstrate two types of double-layer slotted waveguide arrays by diffusion bonding of laminated thin metal plates. Etching metal plates gives high precision and diffusion bonding gives perfect electrical connection in slotted waveguide arrays. A 38GHz antenna with partially corporate feed gives 73.2% peak efficiency with 33.9dBi at 38.5GHz in measurement at this moment. A 60GHz antenna with full corporate feed gives more than 32dBi and 80% efficiency over about 5GHz bandwidth.

08:50	**Multi-Beam Leaky Wave Pillbox Antenna for Millimetre-Wave Applications**	C33P1-2

Ettorre, M.; Sauleau, R.
University of Rennes 1, IETR, FRANCE

A novel multi-beam leaky-wave pillbox antenna is presented. The antenna system is based on three main parts: feeding part, quasi-optical system and radiating part. The radiating and input parts are placed in two different substrates connected by the quasi-optical system. A printed leaky-wave antenna made by an array of slots is used for the radiating part. The low profile, compactness and efficiency of the proposed antenna make it a very promising solution for millimetre-wave applications.

09:10	**Integration of Linearly- and Circularly- Polarized Arrays in Packages for 60-GHz Radios in LTCC Technology**	C33P1-3

Sun, M.[1]; Zhang, Y. P.[2]; Ong, L. C.[1]; Guo, Y. X.[1]; Karim, M. F.[1]
[1]Institute for Infocomm Research, SINGAPORE;
[2]Nanyang Technological University, SINGAPORE

Two integrated antenna array prototypes are presented for 60GHz radios in LTCC technology. The linearlypolarized prototype is a grid array antenna in a ball grid array package. It provides an elegant solution for the future singlepackage 60GHz radio. The circularly-polarized prototype is a 4x4 patch array integrated with a LNA. It forms an active 60GHz receiving antenna. Both prototypes are tested and performances are presented.

09:30	**60 GHz Antennas in HTCC and Glass Technology**	C33P1-4

Lanteri, J.[1]; Dussopt, L.[1]; Pillard, R.[2]; Gloria, D.[2]; Yamamoto, S. D.[2]; Cathelin, A.[2]; Hezzeddine, H.[2]
[1]CEA/LETI MINATEC, FRANCE;
[2]ST-Microelectronics, FRANCE

This paper presents a 60 GHz antenna structure built on glass and flip-chipped on a ceramic module. A single antenna and a two antenna array have been fabricated and demonstrated good performances. The single antenna shows a return loss below -10 dB and a gain of 6-7 dBi over a 7 GHz bandwidth. The array shows a gain of 7-8 dBi over a 3 GHz bandwidth.

09:50	**Radiation Characteristics of a Planar Monopole Antenna Integrated with a 60GHz Band WPAN Module Using Organic Substrates**	C33P1-5

Yoshida, Satoshi; Kameda, Suguru; Takagi, Tadashi; Tsubouchi, Kazuo
Tohoku University, JAPAN

A planar monopole antenna was designed for 60GHz band ultra-small and low-cost front-end modules using organic substrates.Maximum actual gain of 5.1dBi at 63GHz was measured even though single element and very easy structure antenna was used.Although lossy substrate was used for cost reduction, the antenna patterned on organic substrates for 60GHz band module had enough potential for being used as a low-cost and simple construction antenna for 60GHz band wireless personal area network modules.

Session:	**C21P1: Diffuse scattering in mobile propagation - 1**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 125
Chairs:	S. Torrico
	V. Degli Esposti

Time	Title	Abs No
08:30	**Angular Dispersion of Radio Waves Due to Rough Surface Scattering in Mobile Channels**	C21P1-1

Kwakkernaat, MRJAE[1]; Herben, MHAJ[2]
[1]TMC Electronics, NETHERLANDS;
[2]Eindhoven University of Technology, NETHERLANDS

An approach is presented to model the dispersive effects, caused by scattering on surfaces which have "random" irregularities, directly at the receiver. The results of simulations and measurements show that the method can be used to model the dispersive effects of rough surface scattering in a manner similar to using the reflection reduction factor for Gaussian surfaces, except that the reduced power in the specular direction is distributed in the angular domain.

| 08:50 | **Millimeter Wave Scattering and Attenuation Prediction from a Canopy of a Tree – Radiative Transport Theory** | C21P1-2 |

Torrico, Saul[1]; Lang, Roger[2]
[1]Comsearch, UNITED STATES;
[2]The George Washington University, UNITED STATES

The radiative transport theory has been used to compute the attenuation produced by a canopy of a tree containing random located leaves and branches at millimeter wave frequencies. Using this approach, the forward scattering approximation is used to simplify the solution of the radiative transport equation. Results show that by only considering the coherent intensity the excess loss is over estimated due to an ensemble of random located lossy-dielectric discs and branches.

| 09:10 | **Incorporating Diffuse Scattering in Geometry-based Stochastic MIMO Channel Models** | C21P1-3 |

Salmi, J.[1]; Poutanen, J.[2]; Haneda, K.[2]; Richter, A.[3]; Kolmonen, V.-M.[2]; Vainikainen, P.[2]; Molisch, A. F.[1]
[1]University of Southern California, UNITED STATES;
[2]Helsinki University of Technology, FINLAND;
[3]Nokia Research Center, FINLAND

A model for incorporating the influence of the diffuse scattering in the MIMO radio propagation channel to the popular geometry-based stochastic channel models (GSCM) is introduced. The proposed model is based on a superposition of clusters, each of which contributes as a multivariate random variable having a Kronecker structured covariance matrix. These covariance matrices are built from parametric models for the angular, delay, polarization as well as temporal channel properties.

| 09:30 | **Evaluation of Diffuse Scattering Contribution for Delay Spread and Crosspolarization Prediction in an Indoor Scenario** | C21P1-4 |

Mani, Francesco; Oestges, Claude
UCLouvain, BELGIUM

This paper presents the results of radio channel measurements and ray tracing simulations in an indoor environment. A model for diffuse scattering is implemented in a pre-existing ray tracing tool. Simulations results show that this implementation is important to improve crosspolarization ratio prediction accuracy. For delay spread, the improvement is restricted to deep non-line-of-sight areas.

| 09:50 | **Low-Complexity Geometry-Based Modeling of Diffuse Scattering** | C21P1-5 |

Czink, Nicolai[1]; Kaltenberger, Florian[2]; Zhou, Yi[3]; Bernadó, Laura[1]; Zemen, Thomas[1]; Yin, Xuefeng[3]
[1]FTW, AUSTRIA;
[2]EURECOM Institute, FRANCE;
[3]Tongji University, CHINA

Modelling diffuse components in geometry-based radio channel models is computationally very complex. It usually requires adding a large number of complex exponentials. To overcome this complexity constraint, we propose to use the simulation method from Kaltenberger et al. [1]. We demonstrate the low-complexity approach by modeling the diffuse components of the vehicular radio channel. Our new implementation reduces simulation time by a factor of 30.

Session:	**A03P1: Array design 1**
Type:	Antennas Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 127
Chairs:	M. Okoniewski
	A. Cardama

Time	Title	Abs No
08:30	**A Novel Circular-Polarized Array Antenna Based on Substrate Integrated Waveguide for Satellite Communication**	A03P1-1

Seo, T. Y.; Jung, E. Y.; Kang, J. H.; Lee, J. W.; Lee, T. K.; Lee, W. K.
Korea Aerospace University, KOREA, REPUBLIC OF

A circular-polarized array antenna having a novel feeding structure like a substrate integrated waveguide(SIW), SIW-based power divider, and sequentially rotated cavity-backed single element is proposed for satellite communication. The bandwidth enhancements in terms of CP generation and broadband impedance matching characteristics are accomplished by using a fixed phase shifter and simple shorting via between the top patch and bottom ground plane.

08:50	**An Array Lens for Circular Polarization with Emphasis on Aperture Efficiency**	A03P1-2

Phillion, R.; Okoniewski, M.
University of Calgary, CANADA

An antenna consisting of a horn and a large flat lens is presented. The lens is composed of an array of 349 circularly-polarized elements. Each element creates a phase shift that not only compensates for the spatial delay between the horn and the lens, but also directs the major lobe away from broadside. The maximum aperture efficiency is measured to be 48% at 12.9 GHz. The side-lobe and cross-polarization levels are both below -20 dB.

09:10	**A Circularly Polarized Broadside Scanning Patch Array**	A03P1-3

Cameron, T. R.; Sutinjo, A. T.; Okoniewski, M.
University of Calgary, CANADA

A series-fed microstrip traveling wave circularly polarized antenna array is designed to allow frequency scanning through broadside. The antenna is modeled as a periodic leaky-wave structure. The design uses a single corner-fed offset patch per cell as radiating elements with compensation sections. A prototype of the design verified the approach, achieving broadside radiation. Furthermore, the extracted leaky-wave number properly predicts the behavior seen in radiation measurements.

09:30	**Design of Printed Dipole Array with Reflector**	A03P1-4

Floc'h, jean marie[1]; Denoual, JM[1]; Renaudin, P[2]
[1]IETR, FRANCE;
[2]Scorvitech, FRANCE

We propose a technique to reduce the back side radiation of printed antenna array. This new structure is compact and has a very simple feeding network. We present several simulated and measured array.

09:50	**CANCELLED**	A03P1-5
10:10	**Pencil Bean Patterns Obtained by a Planar Array of Parasitic Dipoles Fed by Only One Active Element**	A03P1-6

Marcos, Alvarez-Folgueiras; J. Antonio, Rodríguez-González; Ares-Pena, Francisco J.
University of Santiago de Compostela, SPAIN

The geometry of a planar array of parasitic dipoles is optimized to modify the pattern of an active dipole above a ground plane, in order to obtain a pencil beam of moderate gain and bandwidth without requiring a complex feeding network. As an example of application, a pencil beam pattern radiated by a planar array of parasitic dipoles fed by only one active dipole at 1.645 GHz is shown.

Time	Title	Abs No

08:30   **A Hybrid Space-Spectral Domain Approach For Quasi-3D Structure Analysis In Multilayered Media**   A04-1
Vaupel, Thomas
Fraunhofer FHR, GERMANY

This contribution presents a method of moments (MoM) approach based on a surface/volume integral equation formulation for the characterization of quasi-3D structures in multilayered media based on extended spectral Green's functions. With asymptotic subtraction techniques the whole quasi-3D structure can be analyzed with the same performance than pure planar structures, furthermore the vertical currents can be arbitrary discretized and can cross an arbitrary number of dielectric layers.

08:50   **Adaptive Refinement of Higher Order Method of Moment Applied to Surface Integral Equations**   A04-2
Kostic, M.[1]; Kolundzija, B.[2]
[1]WIPL-D d.o.o., SERBIA;
[2]Dept. of EE, Univ. of Belgrade, SERBIA

Optimal choice of expansion orders is crucial for efficient use of higher order basis functions in MoM solution of SIEs. In this paper it is shown that accuracy of a solution can be estimated using residuum of the system of linear equations. An iterative procedure is proposed for determination of a minimum set of basis functions and illustrated on two examples. In each iteration patches having insufficient order of expansion are detected and their orders increased in the next iteration.

09:10   **Efficient Wide-Band EM Simulation Based upon Domain Decomposition and Interpolation of MoM-Generated Impedance Matrix**   A04-3
Noga, A.; Karwowski, A.
Silesian University of Technology, POLAND

This paper briefly introduces the MoM-based computationally efficient technique combining the domain decomposition and Z matrix interpolation supported by an adaptive frequency sampling for the wide-band performance evaluation of antennas/scatterers. Numerical examples demonstrate the usefulness and effectiveness of the technique and the offered saving in terms of both CPU time and memory storage relative to the direct MoM approaches.

09:30   **Extension of the Hybrid FEBI-MLFMM-UTD Method to Finite Curved Objects**   A04-4
Balasubramanian, Manushanker
Fraunhofer Institute for High Frequency Physics and Radar Techniques, GERMANY

In this paper the hybrid Finite Element Boundary Integral (FEBI), the Multilevel Fast Multipole Method (MLFMM) and the Uniform Theory of Diffraction (UTD) method are extended to treat large curved objects by UTD. This work has been done at the post processing stage of the hybrid method. The various examples considered to evaluate this extension are introduced, the obtained results and the further modifications required are presented.

09:50   **On the Double Potential Integrals Arising in the Method of Moments and their Analytic-Numeric Hybrid Treatmet**   A04-5
Lopez-Pena, S.; Polimeridis, A.G.; Mosig, J.R.
EPFL-LEMA, SWITZERLAND

A simple anlytical approach, which is based on a novel integral transformation, to calculate the free space static potential integral linked to uniform source distributions over arbitrary oriented flat polygons is presented. The resulting anlytical expression is numerically integrated within a Method of Moments-Galerkin framework. Generalized Cartesian product rules built on the double exponential formula are used to mitigate drawbacks linked to singularities in the potential derivatives.

10:10   **Wide-Band Evaluation of Antennas Using Adaptive Stoer-Bulirsch Algorithm and Vector Fitting Combined with Mom**   A04-6
Karwowski, Andrzej[1]; Wojcik, Dariusz[2]
[1]Silesian University of Technology, POLAND;
[2]Silesian University of Technology, POLAND

This paper briefly introduces and examines a robust macromodeling approach for rational approximation of frequency domain responses. The approach combines the Neville-type Stoer-Bulirsch rational interpolation algorithm with adaptive-frequency-sampling technique and vector fitting. The frequency domain integral equation approach combined with the Method-of-Moments is employed as a full-wave electromagnetic simulation tool to generate the required frequency samples.

Session:	**A05: Medical applications**
Type:	Antennas Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 129
Chairs:	R.M. Edwards
	M. Liberti

Time	Title	Abs No
08:30	**Focusing Effects of Metallic Rim-Less Spectacles at Mobile Communication Frequencies on the Energy Absorbed in the Head**	A05-1

Panagamuwa, C. J.; Whittow, W. G.; Edwards, R. M.
Loughborough University, UNITED KINGDOM

This paper studies the SAR inside the head due to metallic rim-less spectacles when the head is irradiated by a source in front of the face. The study concentrates on the 1800 to 2100MHz bands. Simulations were carried out using the homogeneous SAM phantom and a heterogeneous head model developed from the Visible Human Project. SAR measurements were carried out using a DASY4. The measurements and simulations show that the metallic crossbar can increase the peak 1g SAR inside the head by 5 times.

08:50 Breast Surface Construction Algorithm for a Multi-Static Radar-Based Breast Imaging System A05-2
Sarafianou, M.; Gibbins, D. R.; Craddock, I. J.; Klemm, M.; Leendertz, J. A.; Preece, A.; Benjamin, R.
University of Bristol, UNITED KINGDOM

The estimation of the skin reflection is a crucial step towards successful breast tumour detection. This paper investigates the two-dimensional improved version of an existing general purpose technique for estimating target objects of arbitrary shape. The ability of the proposed method in estimating the breast skin location is tested over a wide range of realistic FDTD-based scenarios with results demonstrating accurate estimation of the breast skin location.

09:10 Guidelines for Effective Microwave Breast Imaging: an Accurate Numerical Assessment Against 3D Anthropomorphic Phantoms A05-3
Catapano, Ilaria[1]; Crocco, L.[1]; Di Donato, L.[1]; Angiulli, G.[2]; Isernia, T.[2]; Morabito, A.[3]; Tringali, S.[2]; Bucci, O. M.[4]
[1]National Research Council, ITALY;
[2]University Mediterranea of Reggio Calabria, ITALY;
[3]University Mediterranea of Reggio Calabria - Dep. of Informatics, Mathematics, Electronic and Transp, ITALY;
[4]University of Naples Federico II, ITALY

The design of an experimental setup for microwave breast imaging is critical, since it may affect the complexity of the involved inverse scattering problem and the reliability of the screening. However, the choice of the medium wherein the breast is immersed, the number of antennas and the frequency range are to some extent a degree of freedom. We propose some guidelines to set the matching fluid and provide a numerical assessment of their effectiveness against 3-D anthropomorphic phantoms.

09:30 Investigation of Novel Microstrip Antennas for an Implantable Retinal Prosthesis. A05-4
bahrami, siroos[1]; cheldavi, ahmad[2]
[1]Iran university of science and technology, IRAN, ISLAMIC REPUBLIC OF;
[2]Iran University of Science and Technology, IRAN, ISLAMIC REPUBLIC OF

In this paper, we investigate compact microstrip antennas as a data-telemetry transmitting and implantable receiving antenna in a dual-unit retinal prosthesis. Compact triangular microstrip antenna is explored in an effort to enhance intraocular element bandwidth at microwave frequency 2.45 G Hz. The performance of intraocular and extraocular antennas were simulated and further examined by fabricating and characterizing the performance in a transmit/receive system inside eye phantoms.

09:50 Review of Radiofrequency Exposure Systems for in Vitro Biological Experiments A05-5
Paffi, Alessandra[1]; Apollonio, F.[1]; Liberti, M.[1]; Pinto, R.[2]; Lovisolo, G. A.[2]
[1]ICEmB at Sapienza University of Rome, ITALY;
[2]Section of Toxicology and biomedical sciences, ENEA Casaccia, Rome, ITALY

In this work, the radiofrequency exposure systems for in vitro experiments, published in the last ten years, have been reviewed and classified. Classification is based on the experimental protocol, whether off-line or real-time systems. Moreover, according to their reference electromagnetic structure, systems have been divided in radiating, propagating and resonant. For each of these families, the main general features have been presented and discussed.

Time	Title	Abs No
08:30	**Branches Modelling In Forest Electromagnetic Propagation And Scattering at L and P Bands.**	P02-1

Borderies, Pierre; Villard, Ludovic
ONERA, FRANCE

In usual models for forests electromagnetic scattering , branches are often represented by straight homogeneous cylinders of finite length. According to the category of tree under consideration, this assumption may be reasonable or unduly exaggerated according to the way branches are curved or exhibit a section evolution. In this case, there is the possibility of representing a long, curved branch into smaller straight ones, but the electromagnetic computation may be affected by this way of representation. The present paper treats these points numerically using Finite Differences in Time Domain for these shape effects, including curvature and thinning effects.

| 08:50 | **Combined Effects of Wind Speed and Wind Direction on Received Signal Strength in Foliated Broadband Fixed Wireless Links** | P02-2 |

Chua, T. H.[1]; Wassell, I. J.[1]; Abd Rahman, T.[2]
[1]University of Cambridge, UNITED KINGDOM;
[2]Universiti Teknologi Malaysia, MALAYSIA

Temporal variation of the received signal strength (RSS) in fixed wireless links resulting from the combined effects of wind speed, wind direction and movement of foliage is investigated. Measurement campaign at 5.8 GHz reveals that: (a) RSS can be positively or negatively correlated with wind speed, depending on the physical foliage profile; (b) Wind direction may affect the degree of correlation between RSS and wind speed; (c) Wind direction may affect the mean level of the RSS distribution.

| 09:10 | **Foliage Penetration up to Millimeterwave Frequencies** | P02-3 |

Essen, Helmut[1]; Nuessler, D.[2]; von Wahl, N.[2]; Heinen, S.[2]; Sieger, S.[2]
[1]Fraunhofer Institute For High Frequency Physics and Radar Techniques, GERMANY;
[2]Fraunhofer Institute for High Frequency Physics and Radar Techniques, GERMANY

Within a project for forest fire observation investigations upon the transmission of foliage at millimeterwave frequencies were conducted. Attenuations in dependence of frequency and state of foliage were measured during long term experiments covering all relevant stages of foliage development. In addition results of radiometric measurements on open fire through vegetation are discussed.

| 09:30 | **Modified Equivalent Current Approximation (MECA) Applied to Radioelectric Coverage Evaluation in Rural Scenarios** | P02-4 |

Gutierrez-Meana, J[1]; Martinez-Lorenzo, J.A.[2]; Rappaport, C[2]; Las-Heras, F[1]
[1]Universidad de Oviedo, SPAIN;
[2]Northeastern University, UNITED STATES

The application of the deterministic Modified Equivalent Current Approximation (MECA) method to the evaluation of radioelectric coverage in rural scenarios is presented. MECA extends the Physical Optics approximation (PO) for non-PEC materials based on the determination of induced equivalent currents on the interface between two media. After some validation examples, the power density in an electrically large rural enviroment is shown and compared with the empirical COST 231 method.

| 09:50 | **On the Applicability of the dRET Model to the Thrunk Layer** | P02-5 |

Fernandes, Telmo[1]; Leonor, Nuno[2]; Caldeirinha, Rafael[3]; Richter, Juergen[4]; Al-Nuaimi, Miqdad[5]
[1]Polytechnic Institute of Leiria/Institute of Telecommunications-DL, PORTUGAL;
[2]IPL/IT-DL, PORTUGAL;
[3]IPL-IT-DL, PORTUGAL;
[4]Univ. of Glamorgan, UNITED KINGDOM;
[5]Univ. Of Glamorgan, UNITED KINGDOM

This paper presents a method to model the scattered signal from a regular formation of cylinders, both dielectric and metallic, at micro and millimetre wave frequencies.

| 10:10 | **A Comparison of Radioelectric Propagation in Mature Forests at Wireless Network Frequency Bands** | P02-6 |

Cuiñas, Iñigo; Gay-Fernandez, José Antonio; Alejos, Ana; García Sánchez, Manuel
Universidade de Vigo, SPAIN

The improvement in terms of battery life and low consumption devices drives the growing development of wireless sensor networks. The main problem of deploying a wireless sensor network is the deficit of propagation studies in a peer to peer configuration at forests. These studies are necessary to perform an estimation of the range coverage. Two propagation studies are presented, in order to obtain a general propagation equation.

Session:	**M01: Antenna Measurements**
Type:	Measurement Session
Date:	Tuesday, April 13, 2010
Time:	08:30 - 10:30
Room:	Room 133-134
Chairs:	D.J. Rochblatt
	S. Blanch

Time	Title	Abs No

08:30 — **Calibration and Performance Measurements of Tthe NASA Deep Space Network Antennas Upgrade for Ka-Band (26-GHz)** — M01-1

Rochblatt, David[1]; Baines, G.[2]; Vazquez, M.[3]; Sotuela, I.[3]; Snedeker, C.[4]; Ridgway, T.[4]; Schredder, M[5]; LaBelle, C[6]
[1]Jet Propulsion Laboratory, UNITED STATES;
[2]Raytheon, AUSTRALIA; [3]INSA, SPAIN;
[4]ITT, UNITED STATES; [5]ITT Industries Systems Division, UNITED STATES;
[6]JPL, UNITED STATES

The NASA, Deep Space Network (DSN) has recently installed equipment to support high-data-rate missions (within 2 million kilometers of Earth) with simultaneous S-band uplink, S-band downlink and Ka-band (26-GHz) downlink. The S-band links are required for traditional TT&C support to the spacecraft, while the Ka-band link is intended for high-data-rate science returns. The initial support is required for the James Webb Space Telescope (JWST) in 2013.

08:50 — **Characterization of Small Antennas for Hearing Aids by Several Measurement Techniques** — M01-2

Pivnenko, S.[1]; Zhang, J.[1]; Khatun, A.[2]; Laitinen, T.[2]; Carlsson, J.[3]
[1]Technical University of Denmark, DENMARK;
[2]Aalto University School of Science and Technology, FINLAND;
[3]Chalmers University of Technology, SWEDEN

Characteristics of electrically small loop antennas were measured by different techniques and the results were compared in-between. The techniques employed were: a single-probe spherical near-field technique, a multi-probe spherical near-field technique, a reverberation chamber, and a Wheeler cap technique. The results were compared with regard to the measurement accuracy, measurement speed, and applicability for characterization of small antennas in complex application environment.

09:10 — **Comparative Investigation of SGH Performance Prediction Formulars, Measurements and Numerical Modelling** — M01-3

Foged, Lars Jacob[1]; Giacomini, Andrea[1]; Scialacqua, Lucia[1]; Isman, Noah[2]; Morbidini, Roberto[1]
[1]SATIMO, ITALY; [2]Orbit/FR, ISRAEL

Standard Gain Horns (SGH) often find use in modern antenna measurements. They are utilized frequently either as measurements antenna or as reference antenna in antenna gain measurements by comparison or substitution method. In this paper the accuracy of the NRL gain tables are investigated by comparison with a full wave numerical method based on FDTD and measurements in different antenna test ranges.

09:30 — **Calibration Methods for Wideband Forward RCS Measurements** — M01-4

Larsson, C; Gustafsson, M; Kristensson, G
Lund University, SWEDEN

Calibration is an important part in all radar cross section measurements. Two different approaches to the calibration of forward and extinction cross section measurements are therefore evaluated and discussed in this paper. The first method is the commonly used calibration method employing a calibration target with a known cross section while the second calibration method does not require a calibration target. It is concluded that the method utilizing a calibration target is the most accurate method.

09:50 — **Small Antennas Impedance and Gain Characterization Using Backscattering Measurements** — M01-5

Bories, Serge[1]; Hachemi, M.[2]; Haj Khlifa, K.[2]; Delaveaud, C.[2]
[1]CEA Leti, FRANCE;
[2]CEA leti, FRANCE

Experimental characterization of small antennas presents a practical problem when the measurement cable is placed in the reactive zone. By changing the current distribution, the cable disturbs the Antenna Under Test (AUT) impedance. The antenna backscattering measurement technique is applied for deriving the input impedance, gain and RCS of cableless electrically small antennas. The "structural mode" backscatter and its role on the results accuracy are analysed.

10:10 — **Two Port Small Antenna Characterization Through Impedance Modulation** — M01-6

Monsalve, B.; Blanch, S.
UPC, SPAIN

Small antennas characterization is tightly influenced by the measurement equipment as well as the scenario. To avoid these perturbing factors and obtain the complete S-parameter matrix of the antenna under test a wireless measurement setup has been developed. In this paper a contactless and autonomous small communication device is presented as a system able to characterize two port antennas based on the RCS measurement method.

Session:	**P01P2: Effects of Terrain and Wind Turbines on Propagation**
Type:	Propagation Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 113
Chairs:	M. Calvo Ramón
	X. Fabregas

Time	Title	Abs No
11:00	**Analysis of the Effects from Lateral Variations of Irregular Terrain Based on a Three-dimensional Parabolic Equation**	P01P2-1

Nunes da Silva, Marco Aurélio[1]; Nunes da Silva, Marco Aurélio[1]; Costa, Emanoel[1]; Liniger, Markus[2]
[1]CETUC PUC-Rio, BRAZIL;
[2]LiniKomm GmbH, SWITZERLAND

The effects from lateral variations of irregular terrain on the propagation of radio waves are considered by the representation of the vector fields in terms of two scalar Hertz potentials in spherical coordinates based on a three-dimensional parabolic equation.

11:20	**Analyses of the Frequency and Time Variation of Radio Signals Scattered by a Wind Turbine**	P01P2-2

Etayo, I[1]; Satrustegui, A[1]; Yabar, M[1]; Lopez, A[2]; Falcone, F[2]
[1]Acciona Energia, SPAIN;
[2]Universidad Publica de Navarra, SPAIN

In this paper, the effect on radiopropagation of VHF and UHF signals when interacting with Wind Turbines is presented. Due to the large size of the Wind Turbines, simulation of the Radar Cross Section is performed, taking into account the movement of the blades. In-house finite element code simulations as well as field measurements are presented, showing that frequency dispersion due to the blade movement is present.

11:40	**Differents Aspects of the Interferences Caused By Wind Farms Over Tv Signals**	P01P2-3

Calo, Alejandro[1]; Calvo, Miguel[2]; de Haro y Ariet, Leandro[2]; Blanco-González, Pedro[3]
[1]Universidad Politécnica de Madrid, SPAIN;
[2]Universidad Politecnica de Madrid, SPAIN;
[3]Iberdrola S.A, SPAIN

One of the environmental effects of wind farms is that wind turbines act as scattering devices of the electromagnetic RF waves and thus, may cause interferences to different telecommunication services around them. To carry on with a previous work, the model of the nacelle and the whole wind turbine is shown and validated. Finally, a wideband terrain-sensitive channel response model has been developed from narrow-band model.

12:00	**Impact Analysis of Wind Turbines Blockage on Doppler Weather RADAR**	P01P2-4

Belmonte, Aniceto; Fabregas, Xavier
Technical University of Catalonia, SPAIN

The split-step solution to the parabolic wave equation describing beam propagation permits examination of the signal degradation in a Doppler weather radar caused by wind turbines blockage under general atmospheric conditions and at arbitrary transmitter and receiver configurations. At radar wavelengths, an understanding of turbine and terrain obscuration effects is essential for deciding the reliability of radar measurements affected by blockage.

12:20	**Partial Treatment of Wind Turbine Blades With Radar Absorbing Materials (RAM) For RCS Reduction**	P01P2-5

Rashid, L[1]; Brown, A K[2]
[1]The University of Manchester, UNITED KINGDOM;
[2]University of Manchester, UNITED KINGDOM

This paper will address the key challenges when trying to efficiently apply radar absorbing materials (RAM) to certain parts of the wind turbine blades to significantly reduce the scattering of radar signals and mitigate their impact on radar systems. Modeling of the radar cross-section (RCS) is presented for a generic 40 meter blade wind turbine before and after applying RAM to different parts of the blade. The results of modeling possible solutions of partially RAM treated blades are compared.

12:40	**Propagation Model for Estimating VOR Bearing Errors in the Presence of Windturbines**	P01P2-6

Morlaas, Christophe; Chabory, Alexandre; Souny, Bernard
ENAC, FRANCE

Windturbines near VOR ground station can yield bearing errors in the azimuth estimation. We propose a model that combines the parabolic equation and the physical optics approximation to predict these errors. It accounts for a hilly terrain, and a model of windturbines that includes dielectric blades. All the hypotheses made in the model are carefully justified by means of numerical simulations. This model is employed iIn a realistic test case.

Session:	**C03P2: Frequency-reconfigurable antennas - 2(organized by COST IC0603 ASSIST)**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 119
Chairs:	J. Perruisseau
	C. Christodoulou

Time	Title	Abs No
11:00	**Analysis of Varactor Diode-Tuned Frequency Agile Antennas**	C03P2-1

Hum, Sean
University of Toronto, CANADA

In this paper, we present the design and analysis of a differentially-fed frequency-tunable patch antenna employing varactor diodes that achieves a 1.8-3.2 GHz frequency tuning range. An equivalent circuit model is developed which is shown to rapidly and accurately predict both port and radiation characteristics of the antenna, with emphasis on the effect of the tuning diode losses on antenna performance. Predictions are compared to both full-wave simulations and experimental measurements.

11:20	**Frequency-Reconfigurable Mobile Terminal Antenna with MEMS Switches**	C03P2-2

Valkonen, R.[1]; Luxey, C.[2]; Holopainen, J.[1]; Icheln, C.[1]; Vainikainen, P.[1]
[1]TKK Helsinki University of Technology, FINLAND;
[2]Universite de Nice-Sophia Antipolis, FRANCE

In this paper a frequency-reconfigurable mobile terminal antenna with a tuning range of one octave is presented. The antenna is based on a capacitive coupling element (CCE) and switching between two separate matching circuits controlled with RF MEMS switches. The tuning concept using MEMS is compared with similar tuning cases using HEMT switches. The MEMS tuning circuit outperforms the transistor switch based circuits in both efficiency and linearity.

11:40	**A Distributed Antenna Tuning Unit Using a Frequency Reconfigurable PIXEL-Antenna**	C03P2-3

Grau Besoli, Alfred[1]; Grau Besoli, A[1]; De Flaviis, F[2]
[1]Broadcom Corporation, UNITED STATES;
[2]University of California at Irvine, UNITED STATES

In this work we present the design and performance analysis of a distributed antenna tuning unit using a frequency reconfigurable PIXEL antenna. The proposed tuning unit is distributed in the sense that it brings together the antenna and the traditional reconfigurable matching network (typically implemented with inductors and switched capacitors) into a reconfigurable antenna. Results on the impedance tuning capabilities are presented.

12:00	**MEMS Integrated Reconfigurable Antenna for Cognitive Public Safety Radios**	C03P2-4

Khoshniat, A.[1]; Mopidevi, H.[1]; Damgaci, Y.[1]; Rodrigo, D.[2]; Jofre, L.[2]; Cetiner, B. A.[1]
[1]USU, UNITED STATES;
[2]UPC, SPAIN

The frequency reconfigurable volumetric PIFA presented in this paper is designed to switch between two US public-safety bands, one operating at 700MHz and the other having a bandwidth of 17% around 850MHz- in effect covering a range from 800MHz to 900MHz. The reconfigurability is limited to only the ground and patch layers as an aim to minimize the number of MEMS switches used. The radiation pattern of the antenna maintains its shape over the specified bands.

Session:	**C01P2: MIMO Performance Evaluation - 2**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 120
Chairs:	B.K. Lau
	G.F. Pedersen

Time	Title	Abs No

11:00 **Effectiveness of a Fading Emulator in valuating the Performance of MIMO Systems by Comparison with a Propagation Test**   C01P2-1

Yamamoto, Atsushi[1]; Sakata, Tsutomu[2]; Hayashi, Toshiteru[3]; Ogawa, koichi[2]; Nielsen, Jesper[4]; Pedersen, Gert[4]; Takada, Jun-ichi[5]; Sakaguchi, Kei[5]
[1]Panasonic Corporation/Japan, JAPAN;
[2]Panasonic Corporation, JAPAN;
[3]Panasonic Mobile Communications Corporation, JAPAN;
[4]Aalborg University, DENMARK;
[5]Tokyo Institute of Technology, JAPAN

This paper presents a MIMO spatial fading emulator, used to represent a street microcell environment. In this paper, we used the emulator to measure the 2-by-2 MIMO characteristics of four handset arrays with two monopoles in a multipath environment with one spatial cluster of incoming waves. This demonstrates that the emulator is effective in evaluating the MIMO performance in a multipath propagation environment.

11:20 **Impact of Number of Probe Antennas for MIMO OTA Spatial Channel Emulator**   C01P2-2

Okano, Yoshiki; Kitao, Koshiro; Imai, Tetsuro
NTT DOCOMO, INC., JAPAN

We investigate the impact of the number of probe antennas for a spatial channel emulator taking an antenna correlation as the criterion employing the power angular spectrum of uniform and cluster model. We clarify that probe antennas should be appropriately aligned in terms of the numbers depending on an spacing of antennas under test. We also present the MIMO OTA results for three channel models employing the practical antenna configuration mounted on the mobile phones as antennas under test.

11:40 **The Multipath Simulator for Over the Air Testing**   C01P2-3

Welinder, J[1]; Fast, L[1]; Bohlin , T[2]; Manholm, L[3]; Fast, L[1]; Bohlin, T[2]; Manholm, L[3]; Welinder, J[1]; Fast, L[1]; Bohlin, T[2]; Manholm, L[3]
[1]SP Technical Reserach Institute of Sweden, SWEDEN;
[2]Sony Ericsson, SWEDEN;
[3]Ericsson, SWEDEN

The multipath simulator (MPS) is a test environment that can emulate various propagation conditions including Rayleigh fading. It might be used for antenna measurements, drive tests of communication equipment and performance testing of cellular radio equipment. An experimental system has been built to demonstrate basic properties.

12:00 **Simulation Based Comparison of Metrics and Measurement Methodologies for OTA Test of MIMO Terminals**   C01P2-4

Feng, Yifei; Krewski, Aleksander; Schroeder, Werner L.
RheinMain University of Applied Sciences, GERMANY

This paper reports about about the delopment of a simulation tool for comparing different spatial OTA measurement setups among each other and against established channel models. Focus is on the influence of the number and geometrical arrangement of probes on throughput statistics observed for different MIMO antenna patterns. Initial results for a few simplified measurement setups are reported.

12:20 **MIMO OTA Test Concept with Experimental and Simulated Verification**   C01P2-5

Kyosti, P.; Nuutinen, J-P.; Jamsa, T.
Elektrobit, FINLAND

This paper verifies the capability of a MIMO over-the-air (OTA) test method to create an appropriate propagation environment in an anechoic chamber. The evaluated propagation characteristics are amplitude distribution of fading coefficients, power delay profile, Doppler spectrum, and spatial auto-correlation. Both simulation and measurement results are collected and compared to a theoretical and reference model characteristics. The reference radio channel models are 3GPP SCM(E), and IEEE 802.11

Session:	**C36P2: AMTA Session: New algorithms for antenna diagnosis technique - 2**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 121
Chairs:	M. Sierra Castaner
	L. Foged

Time	Title	Abs No
11:00	**Phaseless Diagnostics for Non-Rectangular Near-Field Antenna Measurement Systems**	C36P2-1

Razavi, S; Rahmat-Samii, Y.
University of California Los Angeles (UCLA), UNITED STATES

An iterative phaseless technique is developed for the non-rectangular planar near-field systems. It alleviates the problem of probe co-rotation with the antenna under test during the measurement. Therefore it will preserve the hardware simplicity, a key feature of the non-rectangular planar near-field systems. The capability of this method in reconstruction of the near-field phase has been examined through simulations. The diagnostic ability of this method is also examined.

11:20	**Back-Projection to the Aperture of a Planar Phased Array from Data Obtained with a Spherical Near-Field Arch**	C36P2-2

Hess, D.W.; McBride, S.
MI Technologies, UNITED STATES

We describe two theoretical bases for a back-projection algorithm: (1) Fourier inversion of the mathematical expression for the far electric field in terms of the aperture electric field and (2) Fourier inversion of the complete vectorial transmitting characteristic of Kerns' scattering matrix. We demonstrate that approaches (1) and (2) yield identical back-projection algorithms. We report on back-projection measurements of a phased array from spherical near-field measurements with a large arch

11:40	**CANCELLED**	C36P2-3

12:00	**On the Diagnosis of Arbitrary Geometry Fully Active Arrays**	C36P2-4

Buonanno, A.; D'Urso, M.
SELEX Sistemi Integrati, ITALY

A comparison between two new solution strategies for detecting faulty elements in phased arrays is proposed. The two methods are tested against experimental data. The deterministic approaches assume as input amplitude and phase of near-field distribution and allow to determine the position of the faulty elements. The results confirm the usefulness of the proposed techniques, highlighting the advantages and the disadvantages of the methods.

12:20	**Advanced Antenna Diagnostics based on Equivalent Currents**	C36P2-5

Foged, L. J.[1]; Mioc, F.[1]; Sabbadini, M.[2]; Araque Quijano, J.L.[3]; Vecchi, G.[3]
[1]SATIMO, ITALY;
[2]ESTEC, NETHERLANDS;
[3]University of Torino, ITALY

This paper discuss recent advances in antenna diagnostics from measured field data. The method proposed is based on field representation using equivalent magnetic and electric sources on arbitrary shaped geometries enclosing the antenna under test. This paper briefly outlines the standard formulation and shows the need of enhancement for the general case of fully blind reconstruction. The validation of the method is illustrated with synthetic and measured examples.

Session: **C16: Satellite navigation channel modelling focusing on multipath and interference**
Type: Convened Session
Date: Tuesday, April 13, 2010
Time: 11:00 - 13:00
Room: Room 122-123
Chairs: F. Perez-Fontán
                U-C. Fiebig

Time	Title	Abs No

11:00 **Characterization of the C-Band Wideband Satellite-to-Indoor Channel for Navigation Services** — C16-1

Perez Fontan, F.[1]; Nuñez, A[1]; Hovinen, V[2]; Schönhuber, M[3]; Teschl, F.[3]; Prieto Cerdeira, R[4]; Kyrolainen, J[2]; Roivainen, A[2]
[1]UNIVERSITY OF VIGO, SPAIN; [2]CWC, U OF OULU, FINLAND;
[3]Joanneum Research, Graz, AUSTRIA; [4]ESA, NETHERLANDS

A measurement campaign has been carried out for characterizing satellite-to-indoor links at C-Band. Measurements have been performed using a helicopter embarking both a CW transmitter and a wideband channel sounder operating at about 5.2 GHz. The receivers were placed within several buildings The helicopter hovered at given fixed positions (azimuths and elevations) to cover a wide range of possilbe angles.

11:20 **Building Penetration Loss Measurements For Satellite-to-Indoor Systems: Preliminary Results** — C16-2

Kvicera, M.[1]; Horak, P.[1]; Korinek, T.[1]; Zela, J.[2]; Simunek, M.[1]; Pechac, P.[1]
[1]CVUT FEE, Department of Electromagnetic Field, CZECH REPUBLIC;
[2]ELSY s. r.o., CZECH REPUBLIC

The paper presents preliminary results obtained from an extensive measurement campaign aimed at building penetration loss. We have concentrated on three different factors affecting this loss – the elevation, the frequency and the floor number of the investigated building. Results for two different measurement sites at 2.0 GHz and 5.0 GHz inside an old brick three-storey office building located in Prague are provided together with a description of the measurement system.

11:40 **Modeling of Multipath Propagation Components Caused by Trees and Forests** — C16-3

Schubert, F. M.[1]; Fleury, B. H.[2]; Robertson, P.[1]; Prieto-Cerdeira, R.[3]; Steingass, A[4]; Lehner, A[4]
[1]German Aerospace Center (DLR), Institute of Communications and Navigation, GERMANY;
[2]Aalborg University, Institute of Electronic Systems, DENMARK;
[3]European Space Agency, ESA/ESTEC, NETHERLANDS;
[4]German Aerospace Center (DLR), GERMANY

This paper proposes a model for the simulation of a vehicle traveling through a rural environment. The canopies of trees and forests cause a strikingly time-variant channel impulse response (CIR). The proposed approach models individual multipath components and the resulting small-scale fading of forests in terms of infinitesimal point-source scatterers which are spread out in a cuboidal canopy volume. Output of the proposed model is compared with channel sounding measurements.

12:00 **Comparison of the Satellite-to-Indoor Broadband Channel at 1.51 GHz and 5.2 GHz** — C16-4

Jost, Thomas[1]; Wang, Wei[1]; Urda-Munoz, Jesus[1]; Fiebig, Uwe-Carsten[1]; Perez-Fontan, Fernando[2]
[1]German Aerospace Center (DLR), GERMANY;
[2]University of Vigo, SPAIN

In order to compare satellite-to-indoor wave propagation characteristics between L-band and C-band for satellite navigation DLR conducted a measurement campaign in June 2008. The measurements were performed at 1.51GHz and at 5.2GHz with a broadband signal of 100MHz bandwidth. Results are given in terms of received energy, mean delay, root-mean-square delay spread and number of paths depending on various transmitter heights and receiver locations.

12:20 **Airborne Measurements of DME Interferers at the European Hotspot** — C16-5

Steingass, Alexander; Denks, Holmer; Hornbostel, Achim
DLR Oberpfaffenhofen, GERMANY

In March 2009 the German aerospace centre (DLR) has measured DME interference over the European DME hot spot in various altitudes. The aim of these measurements was to determine the interference situation in the GALILEO E5 and GPS L5 bands caused by distance measuring equipment (DME) stations on the ground. First results at the hot spot show a strong reception in low altitudes of a small number of stations. By increasing the altitude the number of visible stations is increased dramatically.

12:40 **Multipath and Interference Modelling in Complex GNSS Scenarios** — C16-6

Italiano, A.[1]; Principe, F.[1]; Cioni, R.[1]; Perago, R.[2]
[1]IDS S.p.A., ITALY;
[2]ENAV S.p.A., ITALY

This present paper describes the techniques and methodologies adopted by IDS in modelling complex GNSS scenarios such as airport sites, where local/ground augmentation system siting problems need an evaluation of the positioning signal degradation caused by multipath effects and interfering emissions. An overview is given of the main results achieved during a validation campaign, starting from basic laboratory tests, up to comparison with data measured in actual airport environments.

Session: **C33P2: Millimeter wave integrated/reconfigurable antennas, devices and systems - 2**
Type: Convened Session
Date: Tuesday, April 13, 2010
Time: 11:00 - 13:00
Room: Room 124
Chairs: R. Sauleau
M. Ando

Time	Title	Abs No

11:00 **Polarization Reconfigurable MEMS-CPW Antenna for Mm-Wave Applications** C33P2-1

Balcells, J.[1]; Damgaci, Y.[2]; Cetiner, B. A.[2]; Romeu, J.[1]; Jofre, L.[1]
[1]Universitat Politècnica de Catalunya, SPAIN;
[2]Utah State University, UNITED STATES

A polarization reconfigurable MEMS-integrated coplanar patch antenna for mm-wave applications is presented. The polarization of the field radiated by this reconfigurable antenna can be configured into right-handed circular polarization (RHCP), left-handed circular polarization (LHCP) or linear polarization (LP). This is accomplished by the activation/deactivation of RF-MEMS switches. The consistency of the simulated results was successfully checked with measurements.

11:20 **Recent Advances in Submillimetre Wave FSS Technology for Passive Remote Sensing Instruments** C33P2-2

Dickie, R[1]; Cahill, R[1]; Mitchell, N[1]; Gamble, H[1]; Fusco, V[1]; Munro, Y[2]; Rea, S[2]
[1]Queen's University Belfast, UNITED KINGDOM;
[2]EADS Astrium, UNITED KINGDOM

In this paper we report on the design, manufacture and measured performance of two Frequency Selective Surfaces (FSS) which generate high pass filter responses with <0.5 dB loss centred at 448 GHz and 664 GHz. The FSS were constructed from silicon on insulator (SOI) wafers using precision micromachining and plating processes. Quasi-optical transmission measurements in the 113 – 700 GHz range yield spectral transmission coefficients which are in close agreement with the numerical predictions.

11:40 **Advantages of Rapid Bipolar Planar Near-field Scanner for Millimeter-Wave Antenna Measurement** C33P2-3

Brockett, T; Rahmat-Samii, Y.
University of California Los Angeles (UCLA), UNITED STATES

This paper will describe and elaborate on the advantages of the bipolar scanner for millimeter-wave antenna measurement, including at introduction of new scanning modes that can dramatically reduce measurement time over alternative scanning modes. Representative measurements using our millimeter-wave bipolar planar near-field antenna measurement system will show the capabilities of the bipolar scanner and verify its viability for efficient and accurate millimeter-wave antenna measurements.

12:00 **Optical Measurement of Millimeter-Wave Antenna for Imaging Concealed Cracks on Concrete Surface** C33P2-4

Togo, H.[1]; Mochizuki, S.[1]; Oka, S.[2]; Toyoda, I.[3]; Kukutsu, N.[1]; Kado, Y.[1]
[1]NTT Microsystem Integration Laboratories, JAPAN;
[2]NTT Access Network Service Systems Laboratories, JAPAN;
[3]NTT Network Innovation Laboratories, JAPAN

We have developed a handy near-field imaging system (Crack Scan) to nondestructive inspect decrepit concrete structures. 77-GHz band Vivaldi tapered slot antenna is characterized with our developed optical electric-field sensor. Antenna patterns and near field measured with the sensor indicate that the antenna with substrate cutting and corrugation produce high directivity and provide the useful guidelines to improve the spatial resolution of Crack Scan.

12:20 **Millimeter-Wave Integrated Waveguide Antenna Arrays and Beamforming Networks for Low-Cost Satellite and Mobile Systems** C33P2-5

Wu, K.[1]; Cheng, Y. J.[2]; Djerafi, T.[1]; Chen, X. P.[1]; Fonseca, N.[3]; Hong, W.[2]
[1]Ecole Polytechnique, CANADA;
[2]Southeast University, CHINA;
[3]CNES, FRANCE

This paper overviews the state-of-the-art of SIW techniques in the design and realization of innovative and low-loss millimeter-wave antenna arrays and BFNs for low-cost satellite and mobile systems. Novel classes of antenna and BFN techniques on the basis of this concept of SICs are demonstrated to offer unprecedented performances. Different structures and architectures are studied for space-/ground-based applications. High-density integration and high-volume manufacturing issues are addressed.

Session:	**C21P2: Diffuse scattering in mobile propagation - 2**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 125
Chairs:	S. Torrico
	V. Degli Esposti

Time	Title	Abs No

11:00 — **Application of Reflection on Curved Surfaces and Roughness on Surface in Ray Tracing for Tunnel Propagation** — C21P2-1

Kishiki, Y.[1]; Takada, J.[1]; Ching, G. S.[2]; Lertsirisopon, N.[2]; Kawamura, M.[2]; Takao, H.[3]; Sugihara, Y.[3]; Matsunaga, S.[3]; Uesaka, F.[3]
[1]Tokyo Institute of Technology, JAPAN;
[2]Kozo Keikaku Engineering Inc., JAPAN;
[3]JGC CORPORATION, JAPAN

In ray tracing simulations, curved surfaces and edges are difficult to handle. In this work, a new ray tracing method which models the reflection on the curved surface was implemented. Path gain simulation results are then compared with measurements made inside an arched tunnel. Next, the effect of rough surface is introduced in the ray tracing simulation, and simulation results are compared with measurement data

11:20 — **Diffuse Phenomena in Edge Scattering for Mobile Wireless Networks Design** — C21P2-2

Franceschetti, Giorgio[1]; Iodice, Antonio[2]; Natale, Antonio[2]; Riccio, Daniele[2]
[1]University Federico II, Napoli, Italy, ITALY;
[2]University Federico II, ITALY

Design of mobile networks requires considering the scattering phenomena from each building within the considered area. Diffuse scattering can be introduced to model the effect of roughness for each building. Scattering from a rough edge is here presented. The obtained formula is analytically derived in closed form and compared to the conventional formula available for the case of straight edge.

11:40 — **Time Evolution of Dense Multipath Statistics** — C21P2-3

Richter, A.[1]; Salmi, J.[2]; Kolmonen, V.-M.[1]
[1]Aalto University, FINLAND;
[2]University of Southern California, UNITED STATES

In this paper the spatial variation of dense multipath (DMC) in radio channels is analysed. It is shown that the angular distribution of DMC is only weakly coupled between both link ends. The influence of partial shadowing of DMC on one link-end on its angular distribution on the other link-end is analyzed. Furthermore, the influence of scenario transitions, from non line-of-sight to line-of-sight or obstructed line-of-sight, on the angular characteristic of DMC is demonstrated.

12:00 — **A Model for Forward-Diffuse Scattering Through a Wall** — C21P2-4

Fuschini, F.; Degli-Esposti, V; Vitucci, E.
University of Bologna, ITALY

In this paper a novel model for forward diffuse scattering of indoor walls is presented which is suitable for integration in ray-based prediction tools for indoor environment. The model extends the already-available Effective-Roughness (ER) diffuse-scattering model in a straight-forward way. The model is checked against measurements on a wall sample and it is shown to sensibly improve the accuracy of the prediction of the overall scattering pattern of the wall

12:20 — **Propagation over a Parabolic Valley: Model Comparison to Data** — C21P2-5

Chizhik, Dmitry; Drabeck, L.; MacDonald, W. M.
Bell Laboratories, Alcatel-Lucent, UNITED STATES

The effect of terrain variation is examined in the case of a transmitter (base station) placed above clutter, while the mobile receiver is immersed in clutter. Asymptotic formulae derived for a parabolic valley are compared to measurements of received power across a deep valley formed by the Columbia River in Oregon. Mean errors of less than 1 dB were found, a marked improvement over standard terrain-unaware models that produce a mean error of 30 dB.

Session: **A03P2: Array design 2**
Type: Antennas Session
Date: Tuesday, April 13, 2010
Time: 11:00 - 13:00
Room: Room 127
Chairs: A. Neto
                C. Craeye

Time	Title	Abs No

11:00 — **A Novel Printed-Circuit-Board Feeding Structure for Common-Mode Rejection in Wide-Scanning Connected Arrays of Dipoles** — A03P2-1

Cavallo, D.[1]; Neto, A.[2]; Gerini, G.[1]; Micco, A.[3]
[1]TNO Defence, Security and Safety / Eindhoven University of Technology, NETHERLANDS;
[2]TNO Defence, Security and Safety, NETHERLANDS;
[3]University of Sannio, ITALY

A novel Printed-Circuit-Board (PCB) solution to avoid common-mode resonances in connected arrays is proposed. It consists in a loop-shaped circuit that rejects common-mode propagation and allows designing of linear and dual polarized arrays of connected dipoles, with cross-polarization levels lower than −17 dBs for elevation angles in the range ±45° and for all azimuths, over more than 30% relative bandwidth. Full-wave simulations are presented to validate the design.

11:20 — **Comparison of Single-Ended and Differential-Mode Beamforming of Checkerboard Focal Plane Array** — A03P2-2

Hay, S G
CSIRO ICT Centre, AUSTRALIA

We analyze the efficiency of a connected checkerboard phased array feed being investigated in the Australian Square Kilometer Array (SKA) Pathfinder. Both rotationally symmetric and offset-fed reflectors are considered. The array is assumed to be loaded with single-ended amplifiers and we compare single-ended and differential beamforming of the amplifier outputs.

11:40 — **Fan and Pencil Beam Aperture Coupled Patch Antenna Array with Low Side Lobe Level** — A03P2-3

M.P. Aghdam, Karim[1]; Faraji-Dana, Reza[2]; A. E. Vandenbosch, Guy[1]; De Raedt, Walter[3]
[1]K.U.Leuven, BELGIUM;
[2]University of Tehran, IRAN, ISLAMIC REPUBLIC OF;
[3]IMEC, BELGIUM

In this paper two antenna arrays with Fan and Pencil beams in one embodiment are presented to cover the 9 − 10.5 GHz frequency band. The minimum obtained gain is 15 dBi for Fan-beam and 23 dBi for pencil beam with SLL better than 20 dB in entire frequency bandwidth. The beam widths are 80° × 10° and 10° × 10° for Fan beam and Pencil beam arrays, respectively.

12:00 — **Multilayer Vivaldi Antenna for 60 GHz Applications** — A03P2-4

Plettemeier, D.; Jenning, M.; Liang, T.-J.
Dresden University of Technology, GERMANY

Ultra wide band communications in the mm-wave and sub-mm-wave range offer the possibility to integrate antennas inside the chip package or directly onchip. This paper introduces a compact novel array concept for ultra wide band antenna systems based on planar stacked Vivaldi structures. It is applicable to system-in-package (SiP), or in a slightly modified version, directly to system-on-chip (SoC) solutions. Following the trends in the consumer market, a center frequency of 60 GHz was chosen.

12:20 — **Series of Narrow Wall Windows to Feed Partially-Dielectric-Filled Oversized-Rectangular Waveguide with Slot Array** — A03P2-5

Samardzija, Miroslav; Hirokawa, Jiro; Ando, Makoto
Tokyo Institute of Technology, JAPAN

A series of narrow wall windows is presented for excitation of a quasi plane wave in a slotted partially-dielectric-filled oversized-rectangular waveguide. Its 3-dimensional analysis model is simplified by solving separately two 2-dimensional structures which are orthogonally uniform. A 12 narrow wall window array in measurements suppress reflection below −15dB at 61.25GHz and excites a quasi-TEM wave with ripple less than 3dB and 30 deg.

12:40 — **Simulation of large circular antenna arrays using the Array Scanning Method** — A03P2-6

Sarkis, Remi; Craeye, Christophe
UCL, BELGIUM

In this paper we present a numerical method for the simulation of large circular antenna arrays using Array Scanning Method (ASM) to reduce the mathematical problem from an (N*M)x(N*M) system to N(MxM) systems where N is the number of elements in the array and M is the number of basis functions in the antenna mesh. This technique will be applied to study the resonance modes of a circular array of 90 dipoles, and we will use it to study a circular array of connected wideband Vivaldi antennas.

Session:	**A06: Electromagnetic theory and numerical techniques**
Type:	Antennas Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 128
Chair:	J.M. Tomayo
Chair:	E. Ubeda

Time	Title	Abs No

11:00   **3D Scattering by an Array of Rods using the Gaussian Beam Formalism Coupled to the Scattering Matrix Method**   A06-1

Sokoloff, J.[1]; Varault, S.[1]; Bolioli, S.[2]
[1]UNIVERSITE PAUL SABATIER, FRANCE;
[2]ONERA, FRANCE

An innovative method is proposed to compute the field scattered by an array of rods illuminated by a 3D regular field. The incident field is described as a sum of few Gaussian beams. The scattered field is derived with the Scattering Matrix Method introducing a paraxial approximation on each elementary incident Gaussian beam. Numerical and experimental tests reveal a good trade-off between the accuracy and the computational effort.

11:20   **A SBR Code with GO-PO for Calculating Scattered Fields from Coated Surfaces**   A06-2

Weinmann, F.; Nitschkowski, J.
Fraunhofer FHR, GERMANY

This paper studies the enhancement of a ray tracing code based on the well-known Shooting-and-Bouncing-Rays (SBR) technique for calculating scattered fields of arbitrary objects, whose surfaces are coated with a dielectric multi-layer structure. For efficient modeling, effective reflection factors are taken instead of tracing multiple reflections inside the layers. The approach is validated by comparison to reference data for several simulation objects.

11:40   **Fourier Series Expansion Method for Floquet-Mode Analysis of Photonic Crystal Waveguides Formed by Circular Cylinders**   A06-3

Watanabe, K; Nakatake, Y
Fukuoka Institute of Technology, JAPAN

This paper presents a formulation of Floquet-modes propagating in two-dimensional photonic crystal waveguides formed by circular cylinders. The formulation is based on the Fourier series expansion method with the help of the recursive transition-matrix algorithm (RTMA) for the scattering analyses of cylinder arrays. The present formulation uses the expansion bases that have symmetric properties because the periodicity cell has a structural symmetry, and reduces the computation cost.

12:00   **Nystrom-Type Method for Simulation of 2-D Dielectric Resonator Antennas**   A06-4

Smotrova, Elena[1]; Sauleau, Ronan[2]; Nosich, Alexander[3]
[1]IRE NASU, UKRAINE;
[2]IETR, Universite de Rennes 1, FRANCE;
[3]UEB, FRANCE

We consider arbitrarily shaped 2-D dielectric resonator and associated eigenproblem. It is reduced to the coupled boundary integral equations, whose discrete form is built using the Nyström-type algorithm with accuracy limited by the cavity contour smoothness. The eigenfrequencies are found as roots of the corresponding determinantal equation. Modal fields in the near and far zones are investigated for a spiral cavity. The same method can be used to simulate dielectric resonator antennas.

12:20   **Simulation and Performance Prediction for the Radiation Patterns of Few-Moded and Multi-Moded Corrugated Horns**   A06-5

Peacocke, Tully; Murphy, J.A.
National University of Ireland Maynooth, IRELAND

In this paper we are concerned with reliable simulations of the general power transmission through, and performance of multi-moded horn assemblies of a type commonly used in CMB experiments, their sensitivity to manufacturing tolerances, and the possibility of obtaining essentially identical performance by replacing the cavity-like assembly with smooth walled equivalents. We summarise the method and show the results of simulations and measurements.

Session:	**A07: Terahertz antennas**
Type:	Antennas Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 129
Chairs:	A. Polemi
	C. del Rio

Time	Title	Abs No
11:00	**Antenna in the Terahertz Band for Radioastronomy Applications**	A07-1

Andrés García, B.[1]; García Muñoz, L.E.[1]; Camara Mayorga, I.[2]; Segovia Vargas, D.[1]; Güsten, R[2]
[1]Universidad Carlos III de Madrid, SPAIN;
[2]Max Planck Institute for Radioastronomy, GERMANY

A submillimeter ultra-wideband Tapered Slot Antenna (TSA) is presented. The operation frequency band goes from 0.6 THz to 2 THz, with symmetric radiation patterns from 0.9 THz to 1.8 THz. Good gaussicity levels are achieved (above 80%) and the substrate width limitation has been overcomed by the use of a dielectric wedge over a Gallium Arsenide wafer, where the photonic excitation is placed.With the designed TSA, a phased array with three elements is also presented.

11:20	**Development of a THz Photoconductive Horn Antenna**	A07-2

Huang, Yi[1]; Li, D[2]; Shen, Y[2]; Vickers, A[3]
[1]The University of Liverpool, UNITED KINGDOM;
[2]University of Liverpool, UNITED KINGDOM;
[3]Essex University, UNITED KINGDOM

The conventional THz photoconductive antenna has a relatively omni-directional radiation pattern and not all the radiated power can be used in a typical THz system. This paper is aimed at developing a photoconductive horn antenna with a uni-directional pattern thus more radiated power from the antenna can be collected at the desired direction. Both theoretical and numerical approaches are employed to aid the optimised design which has a directivity of 18.7 dBi.

11:40	**Propagating and Radiating Properties of Broadband Hollw Core Fibers in Terahertz Spectral Region**	A07-3

Polemi, A; Vincetti, L; Setti, V
University of Modena, ITALY

In this paper Hollow Core Microstructured Fibers consisting of a regular arrangement of dielectric tubes are numerically investigated in order to obtain highly directive aperture antennas for Terahertz applications. The good aperture field distribution allow to obtain high coupling with freely propagationg gaussian beams, narrow beamwidth and low side lobe level over a wide range of frequencies. An array configuration of fibers arranged in a hexagonal lattice have been also investigated.

12:00	**Resolution Capabilities of Future THZ Cameras**	A07-4

Del Río, Carlos; Lizarraga, Juan
Public University of Navarra, SPAIN

In this paper we propose a method that reduces significantly the number of detectors needed for achieving certain resolution by means of diffraction that paradoxicaly is its main limiting factor in current imaging devices. The method uses diffraction as a way of achieving spatial diversity and as an anti-aliasing LPF. Decimation is used to reduce the number of detectors.

12:20	**Time Domain Simulation of Carbon Nanotube Dipoles at Low-Terahertz Band**	A07-5

PANTOJA, M. F.[1]; BRETONES, A. R.[1]; GARCIA, S. G.[1]; MARTIN, R. G.[1]; WERNER, D. H.[2]; WERNER, P. L.[2]
[1]UNIVERSIDAD DE GRANADA, SPAIN;
[2]PENN STATE UNIVERSITY, UNITED STATES

This communication presents a procedure for the analysis of carbon nanotube (CN) antennas directly in the time domain. The time-domain electric-field integral equation (TD-EFIE) for thin-wires, including external loads, is the procedure in which is based. Appropriate loads are calculated to match the physical response of single-walled carbon nanotube (CN) media to external electromagnetics fields. The time-domain formulation provides physical insight into characteristic effects of CN dipoles.

Session:	**P03: UWB Propagation**
Type:	Propagation Session
Date:	Tuesday, April 13, 2010
Time:	11:00 - 13:00
Room:	Room 130
Chair:	W. Wiesbeck
Chair:	L. Jofre

Time	Title	Abs No
11:00	**Long Range Wideband Channel Measurements at 81-86 GHz Frequency Range**	P03-1

Kyrö, M.; Ranvier, S.; Kolmonen, V.-M.; Haneda, K.; Vainikainen, P.
Aalto University School of Science and Technology, FINLAND

This paper presents a long range channel measurement system at 81 – 86 GHz frequency range along with initial channel characterization results. The measurement system enables channel measurements with link distances of several hundreds of meters. The channel measurements were performed in two different scenarios which were roof-to-street and street canyon measurement. The paper includes analysis of the frequency and impulse responces of the measured radio channels.

11:20	**Antenna for the Application in UWB-Monopulse-Radar Technique**	P03-2

Adamiuk, Grzegorz; Heine, Christoph; Wiesbeck, Werner; Zwick, Thomas
Karlsruhe Institute of Technology, GERMANY

Angular resolution and range resolution are two very important characteristics of a radar system. A very high range resolution requires an enormous bandwidth, which is available with Ultra-Wide-Band (UWB) technology. Good angular resolution can be achvied with the monopulse radar principle. This paper presents an UWB antenna with integrated feeding network for UWB-monopulse radar.

11:40	**Directional Hybrid Channel Model for Ultra-Wideband MIMO Systems**	P03-3

Janson, Malgorzata; Pontes, J.; Zwick, T.; Wiesbeck, W.
Universität Karlsruhe (TH), GERMANY

In this paper a hybrid ray tracing/statistical channel model for the ultra-wideband (UWB) frequency range is proposed. The conventional ray tracing model is complemented with randomly distributed point scatterers placed on the surface of objects in the scenario model. The wave propagation in such scenario is calculated in a deterministic way and preserves the directional properties of the channel.

12:00	**On the Frequency Dependence of UWB Indoor Channel Parameters: 3D Ray Tracing and Measurement.**	P03-4

Haddad, E.[1]; Malhouroux, N.[1]; Pajusco, P.[2]; Ney, M.[2]
[1]France Telecom Orange Labs, FRANCE;
[2]Telecom Bretagne, FRANCE

In this paper, measurements and 3D ray tracing predictions of multiple input multiple output (MIMO) ultra wideband (UWB) channel parameters in a residential area are presented. The evolution of the predicted parameters (the delay spread and the azimuth and elevation angular spreads) with the number and type of interactions of the simulated channel is also presented. Then, we focus on the frequency dependence of the predicted parameters and compare it with the measurement.

12:20	**Influence of Channel Modeling on V2X Physical Layer Performance**	P03-5

Ivan, I.[1]; Besnier, P.[2]; Crussiere, M.[2]; Bunlon, X.[1]; Le Danvic, L.[1]; Drissi, M.[2]
[1]Renault, FRANCE;
[2]IETR, FRANCE

For the computer performance evaluation of the Vehicle to Vehicle and Vehicle to Infrastructure (V2X) communication system, the propagation channel modeling plays an essential role. In this paper, we present simulation results of the V2X receiver while employing some of the propagation channel models available in the literature. After a brief comparison, we highlight the channel parameters that influence the most the performance of the system's physical layer.

Session: **M02: Cellular and Mobile Measurements**
Type: Measurement Session
Date: Tuesday, April 13, 2010
Time: 11:00 - 13:00
Room: Room 133-134
Chairs: M. Mazanek
R.G. Rojas

Time	Title	Abs No

11:00   **Broadband Axial Excitation of Fabry-Perot Resonator**   M02-1
Cerny, Petr; Korinek, Tomas; Piksa, Petr; Zvanovec, Stanislav; Mazanek, Milos
Czech Technical University, CZECH REPUBLIC

The paper presents the broadband axial excitation of the FP resonator as well as its comparison with the standard radial excitation (via a dielectric foil) and two types of axial excitations (electric and inductive coupling) are discussed. The resonator was designed for the frequency range 18 - 80 GHz. For the broadband measurement of the emission spectra, the excitation for the frequency range 18 – 26.5 GHz was proposed. Moreover, the excitations was measured and evaluated up to 40 GHz.

11:20   **Electromagnetic Characterization Method for On-Wafer Magnetic Dielectric Thin Film Materials**   M02-2
Lee, J. S.[1]; Rojas, R. G.[2]
[1]The Ohio State University, UNITED STATES;
[2]The Ohio State Univerisyt, UNITED STATES

This paper introduces a new characterization method for on-wafer magnetic dielectric thin film materials. For this class of materials, it is necessary to determine both ¥år and ¥ìr from the measured characteristic impedance and propagation constant of transmission lines. This new method uses two transmission lines of the same length but with different characteristic impedances. Simulated results are presented which show very good agreement with exact values of ¥år and ¥ìr.

11:40   **External Calibration of GPR Antennas Accommodated on a Rover**   M02-3
Benedix, W.-St.[1]; Plettemeier, D.[1]; Wolf, K.[1]; Ciarletti, V.[2]; Hamran, S.-E.[3]; Corbel, C.[2]
[1]Dresden University of Technology, GERMANY;
[2]Centre d'Etudes des Environnements Terrestre et Planétaires, Vélizy, FRANCE;
[3]Forsvaret forskningsinstitutt, Kjeller, NORWAY

This paper describes an external calibration of an antenna system that is used for rover based GPR-Systems. The used antenna system consists of two identical crossed double Vivaldi structures. After the description of the radar system, the electrical properties of the antenna system are characterized. The influence of the rover chassis is shown with the help of some simulated footprints. After explanation of the calibration in detail, it is applied to practical measurements.

12:00   **Reliability of Specific Absorption Rate Measurements in the Head Using Standardized Hand Phantoms**   M02-4
Douglas, M.G.[1]; Derat, B.[2]; Li, C-H.[1]; Liao, X.[3]; Ofli, E.[3]; Chavannes, N.[1]; Kuster, N.[1]
[1]IT'IS Foundation, SWITZERLAND;
[2]Field Imaging, FRANCE;
[3]Schmid & Partner Engineering AG, SWITZERLAND

This study presents an analysis of the influence of the hand on the SAR in the head of mobile telephone users, and it examines the reliability of standardized hand phantoms for SAR measurements.

12:20   **TRP Measurement System by Compact Field Simulator**   M02-5
Arai, Hiroyuki[1]; Tanaka, T[2]
[1]Yokohama National University, JAPAN;
[2]Microwave Factory Co., Ltd., JAPAN

This paper presents a compact TRP measurement system by the field simulator developed for the cellular phone test facility. We present the concept of proposed system and demonstrate and discuss random propagation characteristics inside the simulator.

Session:	**C09P1: Lens and reflector antennas - 1**	
Type:	Convened Session	
Date:	Tuesday, April 13, 2010	
Time:	14:30 - 16:10	
Room:	Room 119	
Chairs:	R. Sauleau	
	A. Neto	

Time	Title	Abs No
14:30	**Optical and Modal Features of Hemielliptic Dielectric Lenses**	C09P1-1

Boriskin, A.V.[1]; Sauleau, R.[2]; Nosich, A.I.[1]
[1]IRE NASU, UKRAINE;
[2]IETR, University of Rennes 1, FRANCE

Hemielliptic lenses, that are essential building blocks of many mm-wave and THz antennas, are capable of supporting the half-bowtie resonances (HBT) that can strongly affect performance of integrated lens antennas. Paper illustrates the interplay between the optical and modal (resonant) features in the behaviour of hemielliptic lenses and highlights the drastic influence the latter has on the radiation characteristics of such antennas. The ways for minimization of the HBT impact is discussed.

| 14:50 | **MM-Wave Lens Antenna with an Integrated LTCC Feed Array for Beam Steering** | C09P1-2 |

Ala-Laurinaho, J.[1]; Karttunen, A.[1]; Säily, J.[2]; Lamminen, A.[2]; Sauleau, R.[3]; Räisänen, A. V.[1]
[1]Aalto University School of Science and Technology, FINLAND;
[2]VTT Technical Research Centre of Finland, FINLAND;
[3]IETR, FRANCE

Electrical beam steering is demonstrated using a lens antenna integrated with an LTCC feed array at 77 GHz. The Teflon lens antenna is an extended hemispherical lens with diameter of 100 mm. The feed array has eight patch antenna elements, which are in a linear configuration. The demonstrator has been measured using a planar near-field scanner. The measured results are compared with simulation results based on a ray-tracing simulation.

| 15:10 | **Extended Hemispherical Silicon Lens Excited by a Leaky Wave Waveguide Feed** | C09P1-3 |

Llombart, N.[1]; Chattopadhyay, G[2]
[1]Caltech, UNITED STATES;
[2]JPL, UNITED STATES

In this contribution, we present the design of an extended silicon lens excited with a leaky wave waveguide feed. The antenna concept and the analysis method have been validated through simulations with CST as well as with measurements of a prototype at 575GHz. The long term goal is to develop new antenna technology for future integrated terahertz heterodyne arrays.

| 15:30 | **An Innovative Multibeam Antenna Based on an Active Aperiodic Lens** | C09P1-4 |

Ruggerini, G[1]; Toso, G[2]; Angeletti, P[2]
[1]Space Engineering, ITALY;
[2]European Space Agency, NETHERLANDS

An aperiodic constrained active lens generating a multiple spot contiguous beams coverage is presented. The antenna is optimized in terms of number of elements, dimensions and weight, and power amplifiers efficiency. This type of antenna may represent an interesting solution based on a single aperture in order to replace traditional on-board antennas based on multi reflector dishes.

| 15:50 | **A Circularly Polarized Dielectric Lens Antenna Designed by a Holographic Principle** | C09P1-5 |

Minatti, G.; Caminita, F.; Maci, Stefano
Universita di Siena, ITALY

This paper presents a new type of circularly polarized dielectric-lens antenna designed by using a holographic principle. Prototype design guidelines and simulation results are presented and discussed.

Session:	**C24P1: Fast solvers and method of moments matrix compression techniques - 1**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	14:30 - 16:10
Room:	Room 120
Chairs:	J.M. Rius
	F. Cátedra

Time	Title	Abs No

14:30 — **Interpolation Scheme for Efficient Computation of the Reaction Terms in the Characteristic Basis Functions Method (CBFM)** — C24P1-1

Della Giovampaola, C.[1]; Mittra, R.[2]; Du, K.[2]; Toccafondi, A.[1]
[1]Dept. of Information Engineering, University of Siena, ITALY;
[2]Electromagnetic Communication Lab., Pennsylvania State University, UNITED STATES

In this paper we present a technique to accelerate the evaluation of the mutual coupling between blocks when using the Characteristic Basis Functions Method (CBFM) to compute the electromagnetic scattering by PEC structures. The scatterer is modelled by NURBS surfaces. A Lagrange interpolation method is used together with a sampling scheme which takes into account the relative distance between the blocks.

14:50 — **Direct MoM Solution Of Electrically Large Problems With N2 Complexity** — C24P1-2

Heldring, A.[1]; Rius, J.M.[2]; Tamayo, J.M.[1]
[1]universitat politecnica de catalunya, SPAIN;
[2]Universitat politecnica de catalunya, SPAIN

A new fast direct (non iterative) method for the solution of electromagnetic scattering and radiation problems with the MoM is presented, the Multiscale Compressed Block Decomposition. The computational complexity of the method is theoretically shown to be N^2. The monostatic RCS of the NASA almond at 75 GHz is computed for 1,000 incidence angles, using over one million RWG basis function, with an overall computation time of 72 hours.

15:10 — **Supercomputing Challenges in Electromagnetics** — C24P1-3

Taboada, J. M.[1]; Landesa, L.[1]; Obelleiro, F.[2]; Rodriguez, J. L.[2]; Araujo, M. G.[2]; Bertolo, J. M.[2]; Mourino, J. C.[3]; Gomez, A.[3]
[1]University of Extremadura, SPAIN;
[2]University of Vigo, SPAIN;
[3]Supercomputing Center of Galicia, SPAIN

The Fast Fourier Transform (FFT) extension of the conventional Fast Multipole Method (FMM) has demonstrated that it reduces the matrix vector product (MVP) complexity while preserving the propensity for parallel scaling of the single level FMM. An efficient hybrid MPI/OpenMP parallel implementation of the FMM-FFT and, subsequently, an improved nested scheme of the algorithm have been employed successfully for the solution of challenging problems with hundreds of millions of unknowns.

15:30 — **Analysis of numerical integration in the evaluation of hyper-singular integrals in Galerkin surface integral equation formulations via the direct evaluation method** — C24P1-4

Tamayo, J.M.[1]; Polimeridis, A.G.[2]; Rius, J.M.[1]; Heldring, A.[1]; Mosig, J.R.[2]
[1]Universitat Politecnica de Catalunya, SPAIN;
[2]Ecole Polytechnique Federale de Lausanne, SWITZERLAND

Some aspects of the direct evaluation method for the computation of hyper-singular 4-D integrals, arising in the Galerkin discretization of surface formulations, are analyzed. Using a series of coordinate transformations combined with a re-ordering of the integrations, the integrand not only is regularized but also it is casted in a convenient form in order to perform two dimensions analytically. The importance of the re-ordering will be outlined, even if no analytical integration is performed.

15:50 — **Matrix Compression Technique Based on the Multilevel Characteristic Basis Function Method** — C24P1-5

García, E[1]; Delgado, C[1]; Tayebi, A.[2]; Gomez, J.[2]; Catedra, F.[2]
[1]University of Alcalá, SPAIN;
[2]University of Alcala, SPAIN

An efficient procedure for the solution of large electromagnetic problems using Mehtod of Moments (MoM) rigorous analysis is presented in this work. Computational burden of the method is overcome using a technique that reduces the number of the unknowns and, hence, the matrix size. It is based in the generation of Characteristic Basis Functions (CBFs) over large arbitrary surfaces using a multilevel scheme using a Multilevel Scheme

Time	Title	Abs No
14:30	**Slot Arrays on Integrated Micromachined Waveguides**	A08-1

Costanzo, Sandra[1]; Di Massa, G.[1]; Venneri, I.[1]; Borgia, A.[1]; Mazzarella, G.[2]; Montisci, G.[2]; Casula, A.[2]
[1]University of Calabria, ITALY;
[2]University of Cagliari, ITALY

This paper presents an integrated platform with microstrip lines and rectangular waveguides machined on the same substrate. A planar fabrication technique with excellent mechanical tolerances is applied to realize the integrated structure, with the machined waveguide used as feeding line for a slot array. A synthesis procedure is specifically developed to fix the dimension and the positions of the radiating slots. Both numerical and experimental validations are presented on a linear array.

| 14:50 | **A Novel Phase Only Excitation Law for Omnidirectional Arrays** | A08-2 |

Petrolati, Daniele; Angeletti, P; Toso, G
European Space Agency, NETHERLANDS

A new class of excitation sequences (PAT Codes) for feeding large linear omnidirectional arrays is presented. PAT Codes succeed in obtaining Radiation Patterns with excellent omnidirectional characteristics avoiding, at the same time, power utilization inefficiencies due to amplitude tapering. PAT Code-fed arrays exhibit good control of omnidirectionality both on average and locally, avoiding the presence of deep dips or peaks typical of other feeding sequences (e.g., Frank Code).

| 15:10 | **Shape Optimization of Conformal Array Antennas** | A08-3 |

Jacobsson, Per; Rylander, T
Chalmers University of Technology, SWEDEN

We perform shape optimization for conformal array antennas, where two dependent objectives are considered: (i) good beam-forming capability; and (ii) low active reflection coefficient. The result is a family of designs optimized for low active reflection coefficient as a function of phase modes used for beam forming. The members of the family of designs can be used in the setting of optimizing an antenna system, where different characteristics of the antenna may be desired in different situations.

| 15:30 | **Source Reconstruction in Antenna Synthesis** | A08-4 |

Araque Quijano, Javier Leonardo; Vecchi, Giuseppe
Politecnico di torino, ITALY

This work presents application of the ESR technique for array element positioning. which is useful in antenna synthesis. When it is applied to measured data, fields radiated by equivalent currents shows that conventional formulation of ESR, when applied to measured fields, to some degree allows locating primary radiators. (thus enabling synthesis), and the procedure is illustrated with practical examples that demonstrate the potential of ESR as an aid in synthesis/design.

| 15:50 | **Linear Array with Photoconductive Attenuators** | A08-5 |

Haupt, Randy; Flemish, J.
Pennsylvania State University, UNITED STATES

This paper describes the design, construction, and testing of an 8 element broadband array with photoconductive attenuators at each broadband monopole element. The photoconductive attenuators are controlled by an IR LED and vary between on and off with a small reflection coefficient and small insertion loss. Test results for the elements and array are presented. Low sidelobe Chebyshev amplitude tapers are demonstrated by controlling the illumination of the photoconductive weights.

Session: **C18P1: Antennas for satellite applications - 1**
Type: Convened Session
Date: Tuesday, April 13, 2010
Time: 14:30 - 16:10
Room: Room 124
Chair: C. Mangenot

Time	Title	Abs No

14:30 **Test Results for the Multiple Spot Beam Antenna Project "Medusa"**   C18P1-1
Schneider, Michael; Hartwanger, Christian; Sommer, Ernst; Wolf, Helmut
Astrium GmbH, GERMANY

The paper describes the performance and test results achieved for a passive multiple spot beam satellite antenna with overlapping beams in Ka-band. The antenna had been designed, manufactured and tested in the frame of the DLR granted R&D program "Medusa". S-parameter and pattern test results on BFN, feed array and antenna level are presented and compared to the performance predictions.

14:50 **Optimizing a Corrugated Horn for Telecommunication and Tracking Missions Using a New flexible**   C18P1-2
Horn Design Software
Pressense, J.1; Frandsen, P.E.2; Lumholt, M.2; Delepaux, F.1; Frandsen, A.2; Salghetti Drioli, L.3
1Thales Alenia Space France, FRANCE;
2TICRA, DENMARK;
3ESA-ESTEC, NETHERLANDS

A new design approach and an associated software tool for conical corrugated horn antennas has been developed in a joint TICRA-Thales Alenia Space-ESA project. The software is developed such that it supports the user in designing a horn antenna in a natural way with stepwise refinements both in geometry, in optimization parameters selection and in design requirements definition. The techniques have been validated on a case where a new optimized horn has been designed, manufactured and meassured.

15:10 **Recent Developments in Ka-Band Satellite Antennas for Broadband Communications**   C18P1-1
Amyotte, E; Demers, Y; Hildebrand, L; Forest, M; Riendeau, S; Sierra-Garcia, S; Uher, J
MacDonald, Dettwiler & Associates Ltd., CANADA

This document presents a summary of the latest developments in Ka-band satellite antennas at MDA. It covers high-performance dual-band multibeam antennas used in geostationary missions as well as low-cost dual-band gimballed Ka-band antennas used in non-geostationary constellations.

15:30 **Design and Prototyping of a Microstrip Transmit-Receive Array Antenna for Mobile Ku-Band**   C18P1-4
Satellite Terminals
Manrique, R1; Torres, R2; Dominguez, C3; Tiezzi, F3; Mosig, J.R.2
1Departamento de Ingeniería de Comunicaciones (DICOM), Universidad de Cantabria, SPAIN;
2Laboratory of Electromagnetics and Acoustics (LEMA), Ecole Polytechnique Fédérale de Lausanne (EPFL), SWITZERLAND;
3JAST SA; PSE-EPFL BAT: C, CH-1015 Lausanne, SWITZERLAND

A persistent disadvantage of microstrip array antennas is their potentially high level of inter-element mutual coupling, especially if reception and transmission radiating patches are combined on the same aperture plane. The present work explores a new technique to reduce this limitation, based on a patch pattern optimized for this kind of situation. A transmit-receive array that operates in Ku band is designed, built and measured to demonstrate the effectiveness of the proposed solution.

15:50 **Dual-Band Multiple Beam Antenna System Using Hybrid-Cell Reuse Scheme for Non-Uniform**   C18P1-5
Satellite Communications Traffic
Wang, Jim; Rao, Sudhakar
Lockheed Martin Space System, UNITED STATES

An advanced dual-band antenna system suitable for broadband satellites providing higher EIRP, higher G/T, and improved copolar isolation among frequency reuse beams. The antenna system employs a hybrid-cell frequency reuse scheme instead of conventional fixed cell reuse (4-cell or 7-cell) in order to efficiently use spectrum based on traffic demands. It is shown that about 1.0 dB EIRP improvement, 2.0 dB G/T improvement, and 3.0 dB improvement in C/I when compared to conventional antenna.

Session:	**Tue-Poster Session A3: Compact Antennas**
Type:	Poster
Date:	Tuesday, April 13, 2010
Time:	14:30 - 16:10
Room:	Foyer 2
Chairs:	M. Martínez-Vazquez
	G. Toso

Time	Title	Abs No
14:30	**A Compact Hybrid Internal MIMO Antenna for LTE application**	Tue-1

Yu, Yeonsik[1]; Kim, Giho[2]; Ji, Jeongkeun[2]; Seong, Wonmo[3]
[1]E.M.W. Antenna Corporation, REPUBLIC OF KOREA;
[2]E.M.W. Antenna Corporation, KOREA, REPUBLIC OF;
[3]E.M.W. antenna corporation, KOREA, REPUBLIC OF

A compact internal MIMO antenna for LTE band is designed. The proposed MIMO system consists of two antenna elements and a hybrid coupler. A high isolation and reasonable antenna efficiency were obtained in interest frequency band

| 14:30 | **Wideband,Balanced-FED 60 GHz Antennas for Integrated Transceivers on LTCC Substrate** | Tue-3 |

Martínez-Vázquez, Marta[1]; Holzwarth, S.[1]; Oikonomopoulos-Zachos, C.[1]; Rivera, A.[2]
[1]IMST GmbH, GERMANY;
[2]U. Carlos III, SPAIN

This paper presents novel antennas on DuPont 943 LTCC substrate with a balanced feed, designed to operate in the 60 GHz frequency range, foreseen for future high data rate WLAN systems and broadband multimedia applications. These antennas display not only good matching and radiation properties, but also the use of LTCC material allows for a high degree of integration with different RF circuits.

| 14:30 | **Design of IFS Patch Antenna Using PSO Optimalization** | Tue-5 |

Capek, Miloslav; Hazdra, Pavel
Czech Technical University in Prague, FEE, CZECH REPUBLIC

Paper describes usage of the fractals employed as a planar microstrip patch antennas. Efficient design of patches will be shown. After fractal pre-design, one can start to optimize the IFS collage by using the PSO algorithm. Optimization loop works generally with any number of optimalization conditions. Resonant frequencies are calculated with cavity model in Comsol Multiphysics environment. Finally we discuss the radiation pattern calculation and usage of theory of characteristic modes as well.

| 14:30 | **Integration Of RFID Technology Into Reconfigurable Aperture Coupled Patch Array (RACPA) Antenna System** | Tue-7 |

Jamlos, Mohd Faizal; Abd Rahman, Tharek; Kamarudin, Muhammad Ramlee; Ali, Mohd Tarmizi; Md Tan, Md Nor; Saad, Puteh
University technology of Malaysia, MALAYSIA

RSSI as a high quality distance estimator is used as parameter of localization system. The switch configuration of PIN diode for a particular distance is determined relying on the level of RSSI. Depending on the quality of RSSI based localization system, it has capability to make fairly accurate estimating as to location of the RFID tag. This research has successfully proven taken advantage of the mobility of the RFID tag by applying it to the problem of conventional switching beam array system.

| 14:30 | **A High Gain Planar Antenna With Improved Bandwidth Using a Fabry-Pérot Resonator** | Tue-9 |

Mirbach, M.; Menzel, W.
University of Ulm, GERMANY

A high gain Fabry-Pérot cavity antenna with broadband performance is presented. A thinned array of microstrip patch antennas is used to feed the cavity formed by a metal ground plane and a partially reflective surface (PRS). The bandwidth enhancement is achieved by the use of an optimized PRS structure. Two different PRS are examined, both consisting of periodic metallo-dielectric arrays printed on a double layer and a novel single layer setup, respectively. Measurement results are presented.

| 14:30 | **Numerically Efficient Design Optimization of a Printed 2.45 GHz Yagi Antenna** | Tue-11 |

Koziel, Slawomir; Ogurtsov, Stanislav
Reykjavik University, ICELAND

Simulation-driven design of a 2.45 GHz quasi-Yagi antenna is presented that exploits a coarse-discretization antenna model and surrogate-based optimization algorithm. The design objectives include maximum directivity of the principal polarization, input impedance, side lobe level, and front-to-back ratio. The computation cost of the design process is low because most of the operations are performed on the coarse-discretization model. The high-fidelity simulation is only used for verification.

14:30   **Interference of Antenna and RF Front-End in an Integrated Radio**   Tue-13

Enayati, A.[1]; Brebels, S.[2]; Vasylchenko, A.[2]; Deraedt, W.[2]; Vandenbosch, G. A. E.[3]
[1]IMEC, KU Leuven, BELGIUM;
[2]IMEC, BELGIUM;
[3]KU Leuven, BELGIUM

Two antenna arrays with maximum beam steerability are designed. A simple patch element is chosen for the array in PCB technology while a cavity-backed element is designed in MCM. Using these arrays, the interaction between the field radiated by the arrays and the RF front-end integrated with the arrays is investigated. The study shows that the cavity-backed configuration is more immune to the interference by a factor of two.

14:30   **Automated Synthesis of Shaped Beam Antenna Patterns with Implied Cross Coupling**   Tue-15

Reck, Christoph[1]; Berold, U.[2]; Schmidt, L.-P.[1]
[1]University of Erlangen-Nuremberg, GERMANY;
[2]iAd GmbH, GERMANY

In the following a numerical method to synthesize arbitrary antenna beamshapes of a phase and amplitude controlled array is described. A 25 year old method by Orchard, Elliot et al. is extended to include cross coupling between array elements as well as the single element characteristics. It is shown that the resulting beamshape provides a closer fitting to the desired beamshape function than the original approach at a reasonable computational burden.

14:30   **Frequency Selective Coupler for W Band Based on Power Transfer in Dielectric Rod Waveguides**   Tue-17

Pousi, J. P.; Dudorov, S. N.; Lioubtchenko, D. V.; Räisänen, A. V.
Aalto University School of Science and Technology, Radio Science and Engineering, FINLAND

If two dielectric waveguides are placed close enough cross-talk can appear between them. A complete power transfer occurs between two identical waveguides at some special cases. This paper presents a frequency selective coupler based on this phenomenon for W band. The coupler is made of rectangular GaAs waveguides.

14:30   **A Compact Ultra-Wideband Double Balun Feeding Network on a Single Layer PCB**   Tue-19

Zietz, C.; Armbrecht, G.; Rolfes, I.
Leibniz Universität Hannover, GERMANY

An ultra-wideband passive double balun realized on a single layer printed circuit board is presented. The baluns consist of a Wilkinson power divider and a 180° phase shifter each. An analytical estimation of the worst case return loss is first performed, determining the maximum admissible reflection coefficients of the individually designed subcomponents. Key measurement results include a return loss better than 10 dB and a phase difference between the balanced ports between 165° and 205°.

14:30   **Reusing Antenna Radiator and Amplifier for FM and Other Complementary Bands in Mobile Terminals**   Tue-21

Kaikkonen, Andrei; Lindberg, Peter; Irmscher, Stefan
Laird Technologies, SWEDEN

Antenna solutions for reusing a resonant active FM antenna radiator and LNA for other complementary high frequency bands such as GPS, BT, LTE, WCDMA (Receive Diversity) and T-DMB for simultaneous operation are presented. In addition, results for compact NFC, FM, BT and GPS antenna module are shown.

14:30   **A Miniature Circularly Polarization Patch Antenna Using E-Shaped Shorting Strip**   Tue-23

So, K. K.; Wong, H.; Luk, K. M.; Chan, C. H.; Xue, Q.
City University of Hong Kong, CHINA

A circularly polarization patch antenna with the use of E-shaped parasitic shorting strips is presented in this paper. A capacitive and an inductive loading effect to the patch can be varied by using parasitic shorting strip elements, which are studied and found out that the size of patch antenna can be reduced. Good impedance matching and radiation characteristics can be maintained.

14:30   **Compact Two-Arm Slot Spiral Array Antenna without Bulun**   Tue-25

Shun-Shi, Zhong
Shanghai University, CHINA

A compact circularly-polarized slot spiral antenna with three couples of two-arm slot spiral elements is presented. The balun is not needed in the proposed array antenna by using a serial feeding approach. The monodirectional radiation pattern is achieved by means of a thin back cavity. The simulated and measured results show that the proposed array antenna has good performances of the axial ratio and radiation patterns.

| 14:30 | **Development of an Electromagnetic Macro-model for Reconfigurable Array Application** | Tue-27 |

ZAKKA EL NASHEF, G.; TORRES, F.; EL SAYED AHMAD, A.; MONEDIERE, T.; THEVENOT, M.; MONS, S.; N'GOYA, E.; QUERE, R.
XLIM, FRANCE

This paper presents the development and the experimental characterization of an electromagnetic array macro-model, taking into account the strong mutual coupling between the microstrip antennas. This macro-modeling approach allows the calculation of necessary weights, in order to obtain an optimum radiation pattern (high gain with low side lobes levels), while taking into account the calculated matching impedance of each antenna in the array according to the frequency and the pointing angle.

| 14:30 | **Modeling of Magnetic and Conductive Heterostructures for Computation of Microstrip Antenna Characteristics** | Tue-31 |

GRANGE, F[1]; DELAVEAUD, C[1]; MAHDJOUBI, K[2]
[1]CEA-LETI, FRANCE;
[2]IETR, FRANCE

A recently developed thin film anisotropic magnetodielectric material is investigated as substrate for slot-fed patch antenna. This article aims to analytically determine radio electric parameters of magneto-conductive thin films for a patch antenna substrate application. We discuss the effect of magneto-dielectric substrates on the impedance properties of microstrip antennas. Study focuses on the impact of substrate conductivity on the patch antenna resonant frequency.

| 14:30 | **Different Feeding Mechanisms for Aperture Coupled Patch Arrays** | Tue-33 |

Hertl, Ivo; Strycek, Michal
VOP-026 Sternberk, s.p., CZECH REPUBLIC

The paper presents results of comparison of different feeding alignments in quad elements circularly polarised aperture coupled patch antenna arrays. Antennas were designed with parallel and combined feeding. Impedance matching, gain and axial ratio were investigated in more than 10% bandwidth.

| 14:30 | **CANCELLED** | Tue-35 |

| 14:30 | **Wireless Data Transmission within an Aircraft Environment** | Tue-37 |

Pinto, J; Wright, B. H.; Lewis, R. A.; Lewis, G. M.; Lord, J. A.
BAE SYSTEMS ATC, UNITED KINGDOM

Current air vehicles utilise wiring looms for the transfer of power and data throughout the structure for condition monitoring, avionics, radar, communications and a host of other applications. This wiring adds mass and complexity to such platforms. The use of wireless systems to perform some of these functions therefore presents the opportunity to improve in-flight efficiency and reduce the time required for maintenance. Civil airliner and military rotorcraft cases are considered here.

| 14:20 | **Matching of Microstrip Patch Array Antenna with Reflectors.** | Tue-39 |

Fernández Anitzine, Ignacio[1]; Romo Argota, Juan Antonio[2]; Antón, Beatriz[2]
[1]University of Basque Country, SPAIN;
[2]University of the Basque Country, SPAIN

This paper presents an impedance matching technique for microstrip patch array antennas based on reflectors. The proposed structure consists of microstrip reflectors and square patches inset fed by a corporate-feed network that goes through the reflectors to connect the square patches. In this new design, the parasitic patches are joined lengthwise in order to create a single reflector for the whole antenna that enhances significantly the bandwidth and improves return loss at working frequency.

| 14:30 | **Wideband Microstrip Antenna with Inclined Radiation Pattern for C-Band Airborne Applications Design and Measurement.** | Tue-41 |

BOUAZIZ, Sofiene; ALI, Ahmed; HEBIB, Sami; AUBERT, Hervé
LAAS-CNRS, FRANCE

This paper presents the design and experimental validation of an original single layer planar wideband microstrip antenna for C-band airborne applications. This antenna printed on a 787μm-thick substrate exhibits wideband performance and inclined radiation patterns. The measured results are in good agreement with the simulated ones in terms of bandwidth (more than 15% impedance bandwidth at 7.1GHz) and radiation pattern requirements.

14:30   **Quasi-cross slot SIW antennas**   Tue-43

Moradi, Gholamreza[1]; Shamaei, Mehran[1]; Tavakoli, Ahad[2]
[1]Amirkabir Univ. of Technology, IRAN, ISLAMIC REPUBLIC OF;
[2]Amirkabir University of Technology, IRAN, ISLAMIC REPUBLIC OF

In this paper a cross slot SIW antenna is proposed that is so broadband and has reduced surface waves than routine existing planar structures. Also as SIW could be implemented by PCB technology, the whole structure is fabricated on the same substrate and therefore reducing size and profile and lessening cost can be achieved. The antenna is designed at Ku-band and has about 13% bandwidth, 8.5 dBi directivity.

14:30   **On the Computation of the Beam Coupling Factor in Large Irregular Arrays**   Tue-45

Gonzalez, D[1]; Craeye, C[1]; Angeletti, P[2]; Toso, G[2]; Roederer, A.[3]
[1]Universite' Catholique de Louvain, BELGIUM;
[2]European Space Agency, NETHERLANDS;
[3]Technical University of Delft, NETHERLANDS

This paper presents two different approaches for the efficient computation of beam coupling factors in antenna arrays. First, an analytical expression is derived for simple radiation patterns with sin (è) variation. Then, an efficient approach is presented for the numerical computation of such quantities in larger arrays. This approach is based on the combination of the Macro Basis Function technique with the Method-of-Moments. Both impedance and scattering matrices formulations are considered.

14:30   **Microstrip Antenna Diplexer for Wireless Communications**   Tue-47

Zayniyev, D; Budimir, D
University of Westminster, UNITED KINGDOM

In this paper we present a dual-band antenna integrated with diplexer. Compact microstrip diplexer was designed using pseudo-interdigital stepped impedance bandpass filters with improved stopband. Multi-resonator microstrip-fed patch antenna designed to resonate at 2.4 GHz and 5.3 GHz was integrated with diplexer. As a result of integration 20 dB separation of the channels has been achieved. The proposed system can be used in novel architectures for WiMAX RF Front-End.

14:30   **Characteristic Mode Analysis of Electrically Large Conformal Bifilar Helical Antenna**   Tue-49

Strojny, B. T.; Rojas, R. G.
The Ohio State University, UNITED STATES

A characteristic mode analysis of an electrically large bifilar helix is presented in this paper. Characteristic mode analysis is typically performed on electrically small to intermediate size antennas for simplicity. When the antenna becomes electrically large, there are many modes and it is difficult to identify the dominant modes. A procedure for determining the important characteristic modes is outlined in this paper and applied to a bifilar helix.

14:30   **A Compact Antenna Based on Split Ring Resonator**   Tue-51

El Mrabet, O[1]; Aznabet, M[1]; Falcone, F[2]; M, Essaaidi[1]; Sorolla, M[2]
[1]Abdelmalek Essaadi University, MOROCCO;
[2]UPNA, SPAIN

In this paper, a novel configuration for a compact planar antenna based on the use of Split Ring Resonators (SRR) is proposed. Excitation of the SRR element is performed by adequately placing the access microstrip lines with respect to the confinement plane of the split rings. Full wave simulation results have been compared with measured values, showing good agreement. The final result is a low cost implementation of a planar miniaturized antenna, with a broad range of applications.

14:30   **Transmission Line Model for Meander Antennas**   Tue-53

Onofrio, Losito[1]; Michele, Gallo[1]; Vincenzo, Dimiccoli[2]; Barletta, Domenico[3]; Bozzetti, Michele[1]
[1]Politecnico di Bari, ITALY;
[2]ITEL Telecomunicazioni s.r.l., ITALY;
[3]Itel Telecomunication srl, ITALY

Nowadays valuable and efficient numerical methods allow an empirical approach in the design of high-frequency antennas with numerical techniques in time- or frequency-domain demanding high computational efforts and long-time processing. With reference to a meander antenna, this paper highlights the computational improvement achievable by applying a transmission line model to the definition of an initial geometry, to be numerically optimized, the sizes of which are nearly to the final ones.

14:30   **Study of Mutual Coupling on Mobile Phone PCB with Shielding Using FDTD**   Tue-55

Li, C.-H.[1]; Futter, P.[2]; Tudosie, G.[2]; Chavannnes, N.[2]; Kuster, N.[1]
[1]IT'IS Foundation, SWITZERLAND;
[2]SPEAG, SWITZERLAND

The coupling mechanisms between the active traces and a victim trace with two victim ports on a real phone PCB model was investigated with FDTD simulation in this paper. The studied scenarios include the PCB with a full shielding, perforated shielding and no shielding. According to the simulation results of the real PCB, a simplified model is developed to study the coupling mechanisms with different configurations of the shielding.

Session:	**Tue-Poster Session A4: Multiband & Wideband 1**
Type:	Poster
Date:	Tuesday, April 13, 2010
Time:	14:30 - 16:10
Room:	Foyer 2
Chairs:	S. Pennock
	E. Salonen

Time	Title	Abs No
14:30	**Optimized Dimensions of Ultra Wideband Quasi-Complementary Antenna with Switching Capability**	Tue-2

Sonkki, M.[1]; Ferrando-Bataller, M.[2]; Antonino-Daviu, E.[2]; Salonen, E.[1]
[1]University of Oulu, CWC, FINLAND;
[2]Universidad Politecnica de Valencia, iTEAM, SPAIN

An auto-complementary antenna and quasi-complementary antennas are studied to find an optimized structure for UWB frequency range. When the optimized case is found, the antennas are split to half as a monopole, and the monopole is added to the end of the ground plane of a portable device. As a final step, a switching capability is studied by using open circuit to achieve frequency response around 1 GHz.

| 14:30 | **Design & Characterization of an Antenna System for UWB-MIMO Communications Systems** | Tue-4 |

NAJAM, Ali Imran; Duroc, Y.; Tedjini, S.
Grenoble INP, FRANCE

In this paper, an antenna system is designed and analyzed for UWB-MIMO communication systems. The proposed planar antenna system consists of two different antenna elements integrated on the same substrate. The presented antenna system works in the range of 3.1-10.6 GHz. The parameters like reflection coefficient, gain, mutual coupling, correlation and total active reflection coefficient have been simulated to verify the functionality of the antenna system having dimensions of 30 mm x 85 mm.

| 14:30 | **Wideband Multielement Antenna With Symmetrical Chassis Coupling** | Tue-6 |

Sonkki, Marko[1]; Antonino-Daviu, E.[2]; Ferrando-Bataller, M.[2]; Salonen, E.[1]
[1]University of Oulu, CWC, FINLAND;
[2]Universidad Politecnica de Valencia, iTEAM, SPAIN

Symmetrically implemented and fed patch antenna structure is studied. The structure is including totally for patches, where adjacent pairs in both ends of the mobile chassis are fed with the same amplitude and phase. In a case symmetrical feeding, the mutual coupling between the excited antennas is counted. This is important in mobile terminals where space is a limiting criterion.

| 14:30 | **Design of an Internal Broadband Antenna Using Zeroth Order Resonator for Mobile Terminals** | Tue-8 |

Kim, Giho; Yu, Yeonsik; Ji, Jeongkeun; Seong, Wonmo
E.M.W. Antenna Corporation, KOREA, REPUBLIC OF

An internal broadband IFA antenna for mobile is proposed. The designed internal antenna consists of L-shaped zeroth order resonator and folded first order Inverted-F element and has a comparatively small volume of 45 mm ¡¿ 10 mm ¡¿ 1 mm. The proposed antenna can achieve the wide bandwidth for GSM band.

| 14:30 | **Design and Analysis of an Optimized Cavity-Backed Zigzag Archimedean Spiral Antenna** | Tue-10 |

Rahman, N[1]; Sharma, A[1]; Afsar, M. N.[1]; Cheung, R[2]; Palreddy, S[2]
[1]Tufts University, UNITED STATES;
[2]Microwave Engineering Corporation, UNITED STATES

This paper presents a two-arm, zigzagged Archimedean spiral antenna with an optimized cavity. A multilayer dielectric absorber has been introduced in the cavity to facilitate unidirectional operation of the antenna. Precise microwave instrumentation has been used to experimentally determine the complex permittivity data of the absorbing materials. Based on this data, a genetic algorithm optimization procedure has been applied to derive the most favourable geometry of the absorbing cavity.

| 14:30 | **Microstrip Log Periodic Array Antenna for Mimo Application** | Tue-12 |

Lotfi Neyestanak, Abbas Ali[1]; Azadi, Mohammad Reza[2]
[1]IRIEE, IRAN, ISLAMIC REPUBLIC OF;
[2]Islamic Azad University, IRAN, ISLAMIC REPUBLIC OF

In this paper, we introduce a compact low cost dual band adaptive planar phased array for MIMO systems . The lower band of the antenna ranges from 2.360 to 2.510 GHz, while the upper band covers from 5.000 to 5.450 GHz with an average gain of 3.5 dBi. The antenna system consists of an array of two elements in two layers and a ground wall to improve isolation characteristic. The proposed antenna exhibits low mutual coupling (less than -25dB) between elements with good bandwidth.

| 14:30 | **CANCELLED** | Tue-14 |

| 14:30 | **A Novel Broadband and High Gain Antenna for GSM,UMTS, and LTE Wi-MAX Applications** | Tue-16 |

Abbak, Mehmet[1]; Akduman, Ibrahim[1]; Karakus, Cahit[2]
[1]Istanbul Technical University, TURKEY;
[2]Istanbul Culture University, TURKEY

This paper describes the proposed novel broadband and high gain suspended plate antenna and its feeding structure. Simulations are performed using EM software, further suspended plate antenna is realized and validated by measurements. From the network analyzer and anechoic chamber measurements of the proposed antenna, impedance bandwidth of 58% is obtained between the frequencies of 1.735GHz and 3.145GHz, and measured antenna gain is range between 6.4dBi to 9.3dBi for the given frequency band.

| 14:30 | **Small Size Microstrip Slot Antennas for Ultra-Wideband Communications** | Tue-18 |

Kimouche, Hocine; Abed, Djamel; Atrouz, Brahim
Ecole Militaire Polytechnique, ALGERIA

The design and analysis of novel printed slot antenna, fed by microstrip line, for Ultra Wide Band communication systems is presented. Detailed simulation and experimental investigations are conducted to understand its behaviour and optimize for UWB operation. The designed antenna has a wide operating bandwidth of over 126% (2.4-10.6 GHz) for -10dB return loss. In addition to being small in size, the antenna presents stable far-field radiation characteristics in the entire operating bandwidth.

| 14:30 | **Extremely Wideband Rectangular Monopole Antenna with Modified Microstrip Feed** | Tue-20 |

Liu, J[1]; Esselle, K[1]; Zhong, S[2]
[1]Macquarie University, AUSTRALIA;
[2]Shanghai University, CHINA

A printed rectangular monopole antenna design with an enhanced, extremely wide, 30:1 bandwidth is presented in this paper. The antenna has been designed for printing on Rogers 4350 substrate with a dielectric constant of 3.48. The bandwidth enhancement is achieved by introducing a trident-shaped feed interface to the radiation patch. By the introduction of this feed interface and optimising, it was possible to the increase the 2:1 VSWR bandwidth from 0.82-7.8 GHz to 0.82-25 GHz.

14:30	**CANCELLED**	Tue-22
14:30	**CANCELLED**	Tue-24
14:30	**Estimating the Performance of Matching Circuits for Antennas**	Tue-26

Rahola, J.
Optenni Ltd, FINLAND

The performance of impedance matching networks consists of two parts: impedance mismatch and losses in the matching components. This paper shows how these can be computed using the power wave definition of S parameters. The performance is measured by $|S21|^2$. In practical applications, due to component losses, the impedance bandwidth may have to be larger than the operational bandwidth of the system due to increasing component losses near the edges of the system band.

| 14:30 | **A Bandwidth-Improved Slotted Circular Microstrip Antenna (CMSA) for High Altitude Platform Stations (HAPS)** | Tue-28 |

Abdul Aziz, Muhammad Ezanuddin[1]; Malek, M.F.[1]; Soh, P.J.[1]; Ahmad, R.B.[2]
[1]Universiti Malaysia Perlis (UniMAP), MALAYSIA;
[2]Universiti Malaysia Perlis, MALAYSIA

A circular microstrip antenna (CMSA) for 5850 -7075 MHz Malaysia HAPS is presented. The structure consists of complementary circular split ring resonators (CCSRR) placed in each circular structure for bandwidth and gain improvement. Application of a lower dielectric permittivity microwave laminate and a larger thickness was proven to be favourable. A HAPS antenna with bandwidth of more than 2.0 GHz, centred at 5850 MHz was successfully implemented.

| 14:30 | **2,4 and 6-Element Modified Batwing Antennas for Digital Terrestrial Broadcasting Antennas** | Tue-30 |

Kawakami, Haruo
Antenna Giken Co., Ltd., JAPAN

This paper is 2, 4 and 6-element modified with reflector as an antenna for digital terrestrial broadcasting. The batwing element is arranged and is coupled in parallel, and the feed interval is half-wave length. Simple power supply construction and high-gain and wide-band characteristics were obtained by choosing the wavelength. This antenna is sufficiently usable also as the transmitting and receiving antenna for digital terrestrial broadcasting.

| 14:30 | **Wiband E-Shaped Patch Antenna Design for Wireless Communications using Self-adaptive Differential Evolution** | Tue-32 |

Goudos, Sotirios; Nanos, A.; Samaras, T.; Siakavara, K.; Sahalos, J.
Aristotle University of Thessaloniki, GREECE

Wideband E-shaped patch antenna design is presented. The design technique is based on a self-adaptive Differential Evolution (DE) algorithm. The results show that the self-adaptive DE algorithm outperforms other global optimizers like Particle swarm optimization (PSO) variants and the DE rand/1/bin strategy. Therefore, the results indicate the advantages of this approach and the applicability of this design method to other optimization problems in electromagnetic

| 14:30 | **Tefiku-Sierpinski Antenna Performance in Wireless Environments for WiMax and WLAN applications.** | Tue-34 |

Carro, Pedro Luis; de Mingo, J
University of Zaragoza, SPAIN

Antenna Diversity can overcome the multipath fading improving the overall performance of communication system. In order to study the impact of the wireless channel and perform antenna diversity, two parameters must be evaluated: the mean effective gain, and the correlation coefficient between the antennas. In this paper, a polarization diversity schema comprised of two dual-printed dipole antennas for WIMAX and WLAN applications are presented.

| 14:30 | **Electrically Small Band-Notch Reflected Inverse Parabolic Step Sequence Ultra Wideband Antenna** | Tue-36 |

Saleem, Rashid[1]; Brown, A. K.[2]
[1]University of Manchester, UNITED KINGDOM;
[2]The University of Manchester, UNITED KINGDOM

A novel electrically small Ultra Wideband (UWB) antenna with largest dimension 0.16 λ is presented in this paper. The antenna is impedance matched over 3-14 GHz band and has a quality band-notch functionality. The small variations in the antenna gain and the group delay in addition to a nearly constant path loss response make it a strong candidate for the UWB application.

| 14:30 | **UWB Antennas for Communications and Ground Penetrating Radar.** | Tue-38 |

Pennock, Stephen; Naji, A; Zhang, Q; Shepherd, P; Redfern, M
University of Bath, UNITED KINGDOM

The coaxial gap antenna is naturally thin and omnidirectional. Here the properties of the gap, log periodic arrays of gaps and short circuit loaded gaps are investigated. This shows much promise as an UWB antenna, particularly in application where antenna width is a restriction such as in some ground penetrating radar applications.

| 14:30 | **Research of Circular Polarisation Quality by Using Quad Ridged Horn Antenna** | Tue-40 |

Hradecky, Zdenek; Hamouz, Pavel
CTU Prague, CZECH REPUBLIC

This document presents the investigation of circular polarization quality by using a dual polarized broadband antenna and a hybrid coupler. The hybrid coupler shifts phase of signals between outgoing ports. By means of the phase shifted signals incoming into dual polarized antenna the circular polarization is achieved. The influence of polarization quality on the components parameters is discussed and the analysis and measurement are presented as well.

Time	Title	Abs No
16:40	**The Enhanced Leaky Lens Antenna: Prototype Demonstrators at MM-Wave Frequencies**	C09P2-1

Neto, A; Monni, S
TNO Defence Security and Safety, NETHERLANDS

This paper presents some of the results of the measurement campaign that was undertaken in order to validate some of the properties that had been previously anticipated for the enhanced leaky lens antenna. To our knowledge the link between two leaky lenses is demonstrated to be less dispersive than other radiation links previously reported

| 17:00 | **Beam Expansion in Multi-reflector Quasi-Optical Systems** | C09P2-2 |

Casaletti, M.[1]; Skokic, S.[2]; Maci, S.[1]; Sørensen, S.[3]

[1]University of Siena, ITALY;
[2]Faculty of Electrical Engineering and Computing, Zagreb, CROATIA;
[3]TICRA, Læderstræde 34, DK-1201 Copenhagen K, DENMARK

This paper presents an analytical field expansion in terms of a new type of conical beams in a segment of beam waveguide (BWG). The algorithm starts on a sampling of the equivalent currents on an auxiliary plane and relevant FFT calculation, from which the weights of the beams are determined by an automatic process. Numerical examples show an accuracy of the expansion within a dynamic of 5

| 17:20 | **Passive Microstrip Transmitarray Lens for Ku Band** | C09P2-3 |

Padilla, P.[1]; Muñoz-Acevedo, A.[2]; Sierra-Castañer, M.[2]
[1]University of Granada, SPAIN;
[2]Technical University of Madrid, SPAIN

The aim of this paper is to introduce a novel 12 GHz radiating design based on the idea of transmitarray lens device. In this document, an overview of the functioning of this kind of devices is given and the proposed transmitarray lens is studied, with architecture discussion and selection, as well as some ideas about the design, and manufacturing. Radiation pattern measurements in anechoic chamber, as well as gain and directivity values are offered.

| 17:40 | **Optimization of an X-Band Spline-Profile Horn for a Military SATCOM Terminal** | C09P2-4 |

Granet, C.; Davis, I.M.; Kot, J.S.; Pope, G.; Verran, K.
BAE Systems Australia Ltd, AUSTRALIA

As a risk mitigation exercise, a new X-band feed-pallet and feed horn for an existing military SATCOM terminal was designed. Through the use of an optimized horn design, and redesign of the feed network components, an improved design was obtained. The new feed system is more compact, has reduced weight, and is mechanically simpler than the existing feed pallet.

| 18:00 | **Omnidirectional Dual-Reflector Shaping by Concatenating Conic Sections** | C09P2-5 |

Moreira, F. J. S.[1]; Bergmann, J. R.[2]
[1]Universidade Federal de Minas Gerais, BRAZIL;
[2]Pontificia Universidade Catolica do Rio de Janeiro, BRAZIL

This work presents the shaping of axis-symmetric omnidirectional dual-reflector antennas. The shaping procedure is based on the consecutive concatenation of conic sections, in order to provide a uniform phase distribution together with a prescribed amplitude distribution over the antenna cylindrical aperture. To illustrate the shaping procedure, an axis-displaced Cassegrain is designed to provide a uniform aperture illumination. Results are validated using accurate method-of-moments analysis.

Time	Title	Abs No
16:40	**Calderon Preconditioned CFIE with MLFMM for Acceleration**	C24P2-1

Stephanson, M. B.[1]; Peng, Z.[1]; Wei, J.[1]; Lee, J.-F.[2]
[1]ECE Department, the Ohio State University, UNITED STATES;
[2]ElectroScience Lab., Electrical Engineering Dept., UNITED STATES

It is well known that the application of method of moments to solve electromagnetic wave scattering from large PEC targets usually results in very ill-conditioned matrix equations. We shall detail our progress in this paper, the success, the remaining difficulties, and finally our on-going efforts in making the proposed Calderon CFIE a fast and effective numerical method for solving electromagnetic wave scatterings from large closed PEC targets.

| 17:00 | **Low Frequency Analysis of Multi-scale Problems With a Multi-resolution Clipping Technique** | C24P2-2 |

Bercigli, M.[1]; Vipiana, F.[2]; Andriulli, F. P.[3]; Guidi, R.[1]; Vecchi, G.[3]; Bandinelli, M.[1]
[1]IDS Ingegneria Dei Sistemi S.p.A., ITALY;
[2]Antenna and EMC Lab (LACE), Istituto Superiore Mario Boella (ISMB), ITALY;
[3]LACE, Politecnico di Torino, ITALY

In this paper we present a Method of Moment matrix clipping technique based on the Multi-Resolution approach able to deal with low frequency problems without loss in accuracy. The MoM matrix sparsification reduces the memory occupation, making it possible to analyze very dense meshes on standard computational hardware. Comparisons in terms of accuracy with the standard MoM and in terms of memory requirements with Multi-Level Fast Multipole Algorithm confirm the validity of the approach.

| 17:40 | **Fast Macro Basis Function Approach to Irregular Array of Printed Dipole Antennas** | C24P2-4 |

Jha, S. N.; Gonzalez-Ovejero, D.; Hislop, G.; Craeye, C.
Universite catholique de Louvain, BELGIUM

A method is proposed for the fast Macro Basis Functions (MBFs) characterization of linear arrays of printed dipoles with irregular spacings. The presented technique is based on a model for the reaction terms between MBFs, which is obtained from pre-computed exact interactions at a limited set of relative positions.The developed model is flexible in terms of array complexity with regards to the number of elements in the array, the number of unknowns per antenna and the spacing irregularity between them.

| 18:00 | **Near Field Preconditioner for the Fast Multipole Method** | C24P2-5 |

Bertolo, J. M.[1]; Taboada, J. M.[2]; Landesa, L.[2]; Obelleiro, F.[1]; Rodriguez, J. L.[1]
[1]University of Vigo, SPAIN;
[2]University of Extremadura, SPAIN

Preconditioners involving the near-field information are available for the Fast Multipole Method (FMM), enabling fast convergence up to certain problems sizes. Nevertheless, for large electromagnetic problems, the near-field matrix containing the near-coupling blocks of the impedance matrix becomes insufficient to approximate the whole dense matrix. We present an extension of the near-filed matrix iterative preconditioner applied in the context of the Nested-FMM-FFT algorithm.

Time	Title	Abs No
16:40	**FIDA3: A Novel Active Array Design for the Mid-Frequency Range of the Square Kilometre Array**	A09-1

Garcia-Muñoz, L. E.[1]; Garcia-Perez, O.[2]; Gonzalez-Posadas, V.[3]; Vazquez-Roy, J. L.[1]; Segovia-Vargas, D.[1]; Serna-Puente, J. M.[2]; Finn, T.[2]; Lopez-Fernandez, J. A.[2]
[1]Universidad Carlos III de Madrid, SPAIN;
[2]Observatorio Astronomico Nacional, SPAIN;
[3]Universidad Politecnica de Madrid, SPAIN

The Square Kilometre Array (SKA) radio-telescope is projected to become a reality in 2020. Nowadays, many research groups are investigating the technologies that will be necessary to build this enormous instrument. The reference design of the SKA establishes that the mid-frequency range (from 300MHz to 1GHz) will be covered by planar aperture arrays. FIDA3 is an active array prototype formed by bunny-ear antennas, whose technology is a potential candidate for the mid-range of the SKA.

| 17:00 | **Reduction of Radiation from Central Exciting Region of Eleven Feed and Pattern Improvements for VLBI 2010 Applications.** | A09-2 |

Karandikar, Yogesh[1]; Yang, Jian[2]; Kildal, Per-Simon[2]
[1]Chalmers Univerisity of Technology, SWEDEN;
[2]Chalmers University of Technology, SWEDEN

Current version of Eleven feed uses four differential lines for excitation of log-periodic arrays above ground plane. These excitation lines packaged in small central region referred as centre puck shows radiation from lines above 10GHz causing distortion in feed pattern. This paper focuses on these radiations from exciting structures and proposes new methods to efficiently excite log-periodic arrays of Eleven feed while minimizing the radiation from central exciting region.

| 17:20 | **RF Performance of the GAVRT Wideband Radio Telescope** | A09-3 |

Imbriale, William[1]; Weinreb, S.[2]; Jones, G.[2]; Mani, H.[2]
[1]Jet Propulsion Laboratory, California Institute of Technology, UNITED STATES;
[2]California Institute of Technology, UNITED STATES

A wideband Radio Telescope was designed and built for use in the Goldstone Apple Valley Radio Telescope (GAVRT) program. It uses an existing 34-meter antenna retrofitted with a tertiary offset mirror placed at the apex of the main reflector. It can be rotated to use two feeds that cover the 0.5 to 14 GHz band. The feeds are commercially available open boundary quadridge horn from ETS-Lindgren. The measured performance is greater than 40% over much of the band.

| 17:40 | **The European ALMA Project: Design Manufacturing and Performances** | A09-4 |

MARCHIORI, GIANPIETRO; RAMPINI, FRANCESCO
EUROPEAN INDUSTRIAL ENGINEERING, ITALY

This document describes the European ALMA Project from its prototype to the production phase. The antenna is based on an innovative engineering and manufacturing design. Extreme performances have been achieved thanks to the choice of technologies such as the use of composite materials, the direct drive system, and most importantly the use of a metrology system capable to predict and control the non-repeatable errors induced by wind or by temperature variations.

| 18:00 | **X-Band Acquisition Aid Antenna for Ground Stations Application** | A09-5 |

Migl, Josef[1]; Hoetzel, Christian[1]; Hartwanger, Christian[1]; Hong, Un Pyo[1]; Concaro, Filippo[2]; Arza, Maite[2]; Besso, Piermario[2]; Heuer, Detlef[1]
[1]EADS Astrium, GERMANY;
[2]European Space Operation Center ESOC, GERMANY

This paper describes the design and operational validation of the X-band Acquisition Aid system (XAA) installed in the ESTRACK LEOP network. The purpose of this acquisition aid antenna is to provide a wider X-band beam than the 15m main antenna during the first critical acquisition phase after orbit injection. An XAA prototype was manufactured and installed within the ESA ground station . Operational validation of the system has been achieved in the frame of the Herschel-Plank LEOP mission.

Session:	**C18P2: Antennas for satellite applications - 2**
Type:	Convened Session
Date:	Tuesday, April 13, 2010
Time:	16:40 - 18:20
Room:	Room 124
Chair:	C. Mangenot

Time	Title	Abs No
16:40	**Sunflower Sparse Array for Space Applications: from Design to Manufacturing**	C18P2-1

Viganó, M.C.[1]; Caille, G.[2]; Mangenot, C.[3]; Lager, I.E.[1]; Toso, G.[3]
[1]TU Delft, NETHERLANDS;
[2]Thales Alenia Space Toulouse, FRANCE;
[3]ESA - ESTEC, NETHERLANDS

An innovative aperiodic planar array for satellite communications is proposed. The configuration presented guarantees an almost rotationally symmetric pencil beam pattern and a very low SLL. In order to improve the directivity, while keeping limited the number of controls, the available aperture is filled with different circularly-polarized sub-arrays. These sub-arrays, composed by several identical tiles, have been constructed, measured and used in the sunflower array configuration.

| 17:00 | **Density and Element-Size Tapering for the Design of Arrays with a Reduced Number of Control Points and High Efficiency** | C18P2-2 |

Bucci, Ovidio Mario[1]; Isernia, Tommaso[2]; Morabito, Andrea Francesco[3]; Perna, Stefano[4]; Pinchera, Daniele[5]
[1]Università Federico II di Napoli, ITALY;
[2]Università degli Studi Mediterranea di Reggio Calabria, ITALY;
[3]Università degli studi Mediterranea di Reggio Calabria, ITALY;
[4]Università Parthenope di Napoli, ITALY;
[5]Università degli Studi di Cassino, ITALY

Two innovative and computationally effective strategies for the synthesis of equi-amplitude planar sparse arrays are presented and assessed. The achieved architectures exploit both a density and an element-size tapering. Examples demonstrating the effectiveness of both the proposed solutions and of the relative design techniques are provided with reference to the problem of synthesizing Direct Radiating Arrays devoted to transmission from geostationary satellites.

| 17:20 | **Thales Alenia Space France Antennas: Recent Achievements for Telecommunications** | C18P2-3 |

Lepeltier, Philippe; Maurel, J; Navarre, G
Thales Alenia Space, FRANCE

Thales Alenia Space France presents a description and the main performances of recently developed antenna products in the frame of GEO telecommunication programs. The main topics of interest are: - Ku/Ka-band multi-frequency feeds (full bandwidth BSS+FSS or Ku+Ka) - Very high power application transmit/receive in Ku-Band and associated thermal control - Shared reflector aperture to realize several coverages - Compact Ka-band transmit/receive feeds for broadband applications.

| 17:40 | **Distributed Multi-Function Antenna System for Micro-and Nano-Satellites** | C18P2-4 |

Marrocco, G.1; Mattioni, L.2; Potenza, A1; Milani, F3; Giacomini, A.4; Sabbadini, M.5
1University of Roma Tor Vergata, ITALY;
2IDS, ITALY;
3Ids, ITALY;
4SATIMO, ITALY;
5ESA-ESTEC, NETHERLANDS

Nano and pico satellites have recently come out, focusing on the realization of spacecraft with small mass, small size, low cost and rapid timescales but with reduced RF capability. It is here shown how this last limitation may be overcome by exploiting a new antenna concept based on the idea of "distributed structural radiators" borrowed from Avionic and Naval applications as well as from hand-held communication

| 18:00 | **A New Concept for High Performance Ka-band Reflectors** | C18P2-5 |

Petersson, M; Baunge, M; Ekstrom, H; Sohtell, V
RUAG Space AB, SWEDEN

The document presents a new concept for Ka-band high performance reflectors that gives excellent manufacturing surface accuracy as well as thermo-elastic stability. The simplicity of the mechanical design, manufacturing processes and methods also gives advantages leading to short lead-times and cost effective production. The concept can of course also be used for lower frequency bands.

Session:	**Tue-Poster Session P2: Propagation & Modeling**
Type:	Poster
Date:	Tuesday, April 13, 2010
Time:	16:40 - 18:20
Room:	Foyer 2
Chairs:	P. Pechac
	J.M. Riera

Time	Title	Abs No
16:40	**THz Propagation Research within the TERASENSE Project: Atmospheric Gases Attenuation**	Tue-57

Riera, Jose Manuel; Siles, G.; Garcia , P.
Universidad Politecnica de Madrid, SPAIN

The fundamentals of the estimation of gaseous absorption between 0.1 and 1 THz are discussed, according to the commonly used ITU-R Rec. P.676-8 model, based on the MPM model. Preliminary results of calculations of THz atmospheric gaseous absorption, using radiosounding data, are exposed, as well as its variation with both height and water vapor content. With the aim of deploying instruments at 100 GHz and 300 GHz , preliminary calculations of the expected values of antenna noise are discussed.

16:40	**Contrast Agent Based Tumour Detection by Ultra-Wideband Radar:a Modell Approach**	Tue-59

Thiel, Florian; Kosch, O; Seifert, F.
PTB Berlin, GERMANY

Ultra-wideband electromagnetic pulses generated by a UWB radar are able to probe the human body in a non-contact way, because electromagnetic waves can propagate through the body and are reflected at interfaces between materials with different dielectric properties.

16:40	**Statistics of Multipath Component Clustering in an Office Environment.**	Tue-61

Tanghe, E.[1]; Joseph, W.[1]; Lienard, M.[2]; Nasr, A.[2]; Stefanut, P.[2]; Martens, L.[1]; Degauque, P.[2]
[1]Ghent University / IBBT, Dept. of Information Technology, Gaston Crommenlaan 8 box 201, B-9050 Ghent, BELGIUM;
[2]University of Lille, IEMN, Group TELICE, Bldg. P3, F 59655 Villeneuve d'Ascq, FRANCE

Directional MIMO measurements in an indoor office environment are presented. A 5-D ESPRIT estimation algorithm is used to extract parameters associated with discrete propagation paths, such as their azimuth of arrival, azimuth of departure, delay, and power. The estimated path parameters are grouped into clusters using the statistical K-power-means algorithm. Statistical distributions are determined for the path parameters within individual clusters and for their change between clusters.

16:40	**Combination of Geometric and Finite Difference Models for Radio Wave Propagation in Outdoor to Indoor Scenarios**	Tue-63

de la Roche, Guillaume[1]; Flipo, Paul[2]; Lai, Zhihua[1]; Villemaud, Guillaume[2]; Zhang, Jie[1]; Gorce, Jean-Marie[2]
[1]University of Bedfordshire, UNITED KINGDOM;
[2]CITI/INSA Lyon, FRANCE

A new model used to compute the outdoor to indoor signal strength emitted by a base station is presented. This model is based on the combination of 2 existing models: a 3D geometric-like model especially optimized for outdoor predictions and a 2D FDTD-like model initially implemented for indoor propagation. The performance of the new combined model is evaluated via measurements, and it appears to be an efficient solution for radio network planning both in term of accuracy and computational cost

16:40	**Channel Model for Tyre Pressure Monitoring Systems (TPMS)**	Tue-65

Lasser, Gregor; Mecklenbräuker, Christoph F.
Vienna University of Technology, AUSTRIA

Tyre pressure monitoring systems operate on a propagation channel which is time variant and introduces Doppler shifts due to vehicle movements. In the following paper we propose and discuss a channel model for TPMS, which is comprised of a deterministic and a stochastic component. In a second part channel simulations with an arbitrary vehicle model are presented to gain insight to the behaviour of TPMS channels. Finally an example out of a series of static channel measurements is shown.

16:40	**Experimentally Assessed Underground Mines Propagation Model at High UHF Frequencies**	Tue-67

M. M. Moutairou, Dr[1]; G. Y. Delisle, Dr[2]; D. Genier, Dr[3]
[1]LRTCS (1Underground Communications Research Laboratory), CANADA;
[2]Technopole Defense and Security, CANADA;
[3]Laval University, CANADA

This paper shows that a ray-tracing model focused on reflected rays can be used for power prediction in an underground area. The model is calibrated and then validated in scenarios where the received power prediction efficiency is confirmed by experimental measurements recorded . Different positions of the transmitting antenna and their effects on the model are analysed . Some electromagnetic parameters of the model are definitively proposed to characterize propagation at 2.4GHz

16:40   **An Efficient Propagation Model for Automatic Planning of Indoor Wireless Networks**   Tue-69

Dimitriou, Antonis[1]; Siachalou, S.[1]; Bletsas, A.[2]; Sahalos, J. N.[1]
[1]Aristotle University of Thessaloniki, GREECE;
[2]Technical University of Crete, GREECE

Planning and optimization of indoor wireless networks require propagation predictions for several antenna-configurations in reasonable running time. In this paper, we propose treating each room as a single entity, where estimations of the mean received power, as well as the minimum and maximum values of the mean are sought. It is shown and verified that these metrics can be estimated by calculating the transmitted field at the corners of each room, accounting only for wall penetration losses.

16:40   **A Rigorous Simulator of ILS Perturbations**   Tue-71

Thain, A[1]; Estienne, J-P[1]; Peres, G[1]; Spitz, B[2]; Evain, L[3]
[1]EADS Innovation Works, FRANCE;
[2]ENAC, FRANCE;
[3]Airbus SAS, FRANCE

We present a new, easy to use, simulator of the Instrument Landing System. The Method of Moments (MoM) and the MultiLevel Fast Multipole Method (MLFMM) allow precise predictions of perturbations due to buildings, taxiing aircraft and other scatterers encountered in an airport environment.

16:40   **RFID-Netwok Planning by Particle Swarm Optimization**   Tue-73

Di Giampaolo, E.[1]; Marrocco, G.[1]; Forni, F.[2]
[1]University of Rome, ITALY;
[2]University of Rome "Tor Vergata", ITALY

When a number of readers are planned in a network, mutual coverage of read-zones and mutual interference among readers are undesired while safety regulation constraints have to be fulfilled in the whole area. Simple and effective models of electromagnetic elements involved in the planning are developed and included in the frame of a Particle Swarm Optimization algorithm. Numerical results show the effectiveness of the method.

16:40   **A Novel Three-Dimensional Hybrid Spatial Model for Wideband MIMO Channel in Indoor Environments**   Tue-75

Tarng, Jenn-Hwan[1]; Chang, Wei-Ju[2]; Wu, Sung-Jung[1]
[1]National Chiao-Tung University, HsinChu, TAIWAN;
[2]Telecommunication Laboratories, Chunghwa Telecom Co., Ltd., TAIWAN

In this paper, a hybrid wideband spatial channel model, which combines a 3D deterministic ray-tracing based model with a new 3D model for single-bounce randomly scattering rays, is proposed. In this model, effects of both the azimuth and elevation spectrum on sub-channel correlation of spatial/polarized arrays are taken into account. From the comparisons between measured and simulated space correlation, it is found that the 3D model gives more reasonable results compared to the 2D model.

16:40   **The Influence of Dynamic Changes of Indoor Scenarios on Electromagnetic Wave Propagation**   Tue-77

Subrt, Ludek; Pechac, Pavel
Czech technical university in Prague, CZECH REPUBLIC

The effect of common dynamic changes such as opening and closing doors or windows, as well as minor floor alternations in buildings on an electromagnetic wave propagation environment is studied in this paper. A sample scenario is used in order to show how these situations over the course of an ordinary work day influence wave propagation. Both signal coverage and impulse response are predicted in order to obtain more complete information about the environment.

16:40   **Multi-wavelength Radar Performance Modeling During An Extreme Clear Air Propagation Event Over The Persian Gulf**   Tue-79

Marshall, Robert; Wiss, V; Thornton, W; Horgan, K
Naval Surface Warfare Center Dahlgren Division, UNITED STATES

Dry and warm air flowing offshore over a cold ocean creates thermodynamic stable internal boundary layers that are breeding grounds for strong surface radio frequency ducts. These ducts can exist for hundreds of kilometers in the downwind flow and trap energy in shallow layers. This paper will examine the non-standard performance of notional S, C, and X band radars in an extreme surface duct event on the Persian Gulf in May, 2009 resolved by a mesoscale numerical weather prediction model.

16:40   **Outdoor-to-Aircraft Cabin Measurements and Study of Interference Scenarios**   Tue-81

Moraitis, Nektarios; Panagopoulos, Athanasios
Institute of Communications and Computer Systems - National Technical University of Athens, GREECE

This paper presents an outdoor-to-aircraft measurement campaign conducted inside a long range Airbus A340-300 aircraft in order to evaluate the attenuation induced by the haul of the aircraft. The obtained results can be used to perform an interference study and assess whether the aircraft mobile terminal interferes to the ground base station and the opposite.

| 16:40 | **Automatic Channel and Aps Allocation in WiFi Networks Using Ray Tracing Techniques and Particle Swarm Optimization** | Tue-83 |

Moreno Delgado, Jose; Domingo Gracia, M.; Basterrechea Verdeja, J.; Pérez López, J. R.; Valle López, L.
Universidad de Cantabria, SPAIN

A planning tool that combines the strengths of a propagation prediction tool, CINDOOR, and a particle swarm optimization algorithm (PSO) is presented in this work when applied to optimize wireless networks resources prior to their deployment. For an arbitrary scenario, the approach proposed performs channel allocation, choosing the best set of access points (APs) to be used, including their activation or deactivation to meet a required quality of service (QoS).

| 16:40 | **Characterization of Second Order Moments of a Multi-Cluster Gaussian Scatterer Distribution Channel Model** | Tue-85 |

Galaviz, G.; Covarrubias, D.H.
CICESE, MEXICO

The analysis of the angle spread as a second order moment of the statistic behavior of a multi-cluster Gaussian scatterer distribution channel model is presented. The analysis is based on computer simulation and evaluation of mathematical expressions found in open literature as well as new derived expressions. Results are useful for understanding the behavior of a multi-cluster channel and serve well as a reference for assessing the possible gain of using multiple antenna technologies.

| 16:40 | **Human-Body Shadowing Effects on Indoor MIMO-OFDM Channels at 5.2 GHz** | Tue-87 |

Ziri-Castro, Karla; Tan, H.; DasGupta, J.
Queensland University of Technology, AUSTRALIA

A statistical characterization of indoor MIMO-OFDM channels at 5.2 GHz considering pedestrian movement is reported. Empirical CDFs of fading envelope fit the Ricean distribution with K-factors from 7 to 15 dB, for a 10 pedestrian and vacant scenario respectively. As the number of pedestrians increase, intensifying multipath effects, the average channel capacity increases proportionally. Results provide an insight into the prediction of human-body shadowing effects for indoor MIMO-OFDM channels.

| 16:40 | **Computation of False Echo Zones and Shadowing for Aeronautical and Weather Radars** | Tue-89 |

Van Lil, Emmanuel[1]; De Bleser, J-W[1]; Trappeniers, D.[2]; Van de Capelle, A.[1]
[1]K.U.Leuven, BELGIUM;
[2]Altran, BELGIUM

This paper presents approximate analytical formulas for the computation of two important effects of large objects like wind turbines, buildings, high voltage lines, transmitters and cranes on radar systems. It is of course too tedious to require full computations of every turbine park or every object that is planned in the neighbourhood of radar systems. The purpose is to allow authorities to determine fast when to require further studies, or when to refuse it immediately.

| 16:40 | **Synthesis on Transmission Coefficients for Deterministic Through-the-Wall Propagation Modelling** | Tue-91 |

Plouhinec, E.[1]; Uguen, B.[2]
[1]Centre de Recherche des Ecoles de Coetquidan (CREC), FRANCE;
[2]IETR/Universite de Rennes, FRANCE

The paper presents a synthesis on the phenomenon of transmission for indoor deterministic propagation modelling based on ray-tracing and Geometrical Optics. After the description of the commonly used litterature transmission coefficients, the authors present their own reference coefficient. They show that only one litterature coefficient is valid (compared with their reference coefficient) and look for its validity domains with simulations depending on transmission scenario parameters.

| 16:40 | **COST231-HATA and SUI Models Performance Using a LMS Tuning Algorithm on 5.8 GHZ in Amazon Region Cities** | Tue-93 |

Souza Lyra Castro, Bruno; Ruiz Gomes, Igor; Carlos Ribeiro Jr, Francisco; Protazio do Santos Cavalcante, Gervasio
Federal University of Para, BRAZIL

This paper presents a performance comparison between COST231-Hata and SUI Models through LMS tuning Algorithm for 5.8 GHz frequency band. The studied environment is based on the cities located in Amazon Region. After the adjustments and simulations, SUI Model has shown a smaller RMS error when compared with COST231-Hata Model.

| 16:40 | **Radar Propagation Modeling in Complex Environments for Marine Navigational Radar Using Measured Pulse Shapes** | Tue-95 |

Rashid, L; Williams, K; Brown, A K
University of Manchester, UNITED KINGDOM

Radar pulses from magnetron radar are far from perfect rectangular shape. This paper investigates the effect of integrating a measured pulse shape of marine navigational radar into a radar propagation model used to assess the effect of a complex environment, in this case a wind farm. A comparison between the results from the model and measured data taken near the North Hoyle wind farm in North Wales, UK is provided.

16:40   **Bi-Dimensional Characterization of a WIMAX Radio Channel at 3.5GHz.**   Tue-97

Pinho, Pedro[1]; Roldão, João[1]; Pinho, Pedro[2]
[1]ISEL, PORTUGAL;
[2]ISEL/IT, PORTUGAL

This paper presents the characterization of an indoor Wimax radio channel using the Finite-Difference Time-Domain (FDTD) [1] method complemented with the Convolutional Perfect Matched Layer (CPML) technique [2]. An indoor 2D scenario is simulated in the 3.5GHz band (IEEE 802.16d-2004 and IEEE 802.16e-2005 [3]). Simulated results define the channel as flat, slow and without inter-symbolic interference (ISI), making the application of the spatial diversity the most appropriate scheme

16:40   **Long Term Path Attenuation Measurement of the 71-76 GHz Band in a 70/80 GHz Microwave Link**   Tue-99

Hansryd, J.; Chen, J.; Li, Y; Ligander, P
Ericsson AB, SWEDEN

The work presents ten months path attenuation measurements versus hydrometeor events for the 71-76 GHz band of an installed 1 km GbE 70/80 GHz microwave link in Mölndal, Sweden. Precipitation and path attenuation agree well with predictions from the ITU-R models. The impact of a finite rain cell across the link is observed.

16:40   **Improved estimation of the K-factor for Rician channels emulation in a reverberation chamber**   Tue-100

LEMOINE, Christophe; AMADOR, Emmanuel; BESNIER, Philippe
IETR - INSA de Rennes, FRANCE

In many radio propagation environments, the timevarying envelope of the received signal can be statistically described by a Rician distribution. Recently, reverberation chambers have been proposed to simulate Rician radio environments with controllable K-factor. However, evaluation of Rician K-factor out of RC measurements must be analyzed very carefully. The paper provides an analytical formulation of both the estimation of K and the confidence interval associated with its estimation.

Session:	**Tue-Poster Session ST1: Materials & Metamaterials**
Type:	Poster
Date:	Tuesday, April 13, 2010
Time:	16:40 - 18:20
Room:	Foyer 2
Chairs:	W. Whittow
	P.J. Ferrer

Time	Title	Abs No

16:40 **Design and characterization of a Planar Artificial Magnetic Conductor in the RFID SHF Band** — Tue-44

de Cos Gómez, Mª Elena[1]; Alvarez Lopez, Yuri[2]; Las-Heras Andres, Fernando[2]
[1]TSC. Universidad de Oviedo, SPAIN;
[2]Universidad de Oviedo, SPAIN

A novel design of planar Artificial Magnetic Conductor (AMC) for frequencies in the SHF RFID band is presented. The designed AMC is based on a Frequency Selective Surface (FSS) and shows polarization angle independency. Its angular margin when operating under oblique incidence is also tested. Design parameters are discussed with the support of FEM simulations and measurements in anechoic chamber of the manufactured prototype, with a good agreement between simulations and measurements.

16:40 **Investigations and Design of Small-Size Printed Antennas on a Reactive Impedance Substrate** — Tue-46

REN, C[1]; BERNARD, L[2]; SAULEAU, R[3]
[1]Polytech' Marseille, FRANCE;
[2]ISL, FRANCE;
[3]IETR, FRANCE

In this paper we compare the performances of microstrip antennas printed on conventional substrate and on a Reactive Impedance Substrate, both of them being constituted with the same substrate layers. In particular we investigate the effects of the lateral size and number of reactive elements upon the antenna bandwidth and size of the radiating element. The impedance and radiation characteristics of two patch antennas with and without a RIS arrangement are also compared experimentally.

16:40 **Study of the Behaviour of a Two Layered High Impedance Surface with Electromagnetic Band Gap** — Tue-48

CAPET, Nicolas[1]; MARTEL, Cedric[1]; SOKOLOFF, Jerome[2]; PASCAL, Olivier[2]
[1]ONERA, FRANCE;   [2]UPS LAPLACE, FRANCE

In this paper, we investigate the behaviour of a HIS composed of several EBG cells for mutual coupling reduction between L band patch antennas. An innovative characterisation method, based on waveguide transmission measurements, has been used. Two configurations have been studied – embedded or not. It is shown that two additional frequencies are present for the embedded one. The enhanced decoupling properties of the embedded HIS configuration could be used to design multiband antenna systems.

16:40 **Low Profile Dipole Antenna Backed by Isotropic Artificial Magnetic Conductor Reflector** — Tue-50

Al-Nuaimi , M. K. T[1]; Whittow, W. G[2]
[1]University of Technology, Baghdad, IRAQ;
[2]Loughborough University, UNITED KINGDOM

The design of high gain low profile antenna backed by isotropic Artificial Magnetic Conductor (AMC) with an overall height of 0.045ë is introduced. The AMC structure consisting of the Jerusalem Cross Frequency Selective Surface (JC–FSS) on a grounded dielectric slab, is investigated. It is shown that the JC–FSS offers stable resonance frequency with respect to the plane wave angle of incidence as an isotropic AMC medium, very compact size and an acceptable bandwidth (∼13%).

16:40 **Compact Microstrip Band Stop Filter Using SRR and CSSR:Design,Simulation and Results** — Tue-52

Al-Nuaimi , M. K. T[1]; Whittow, W. G[2]
[1]University of Technology, Baghdad, IRAQ;
[2]Loughborough University, UNITED KINGDOM

This paper demonstrates the potential of the sub-wavelength (i.e. electrically very small) split ring resonators and complementary split ring resonators (CSRRs) inclusions to build compact microstrip band stop filters to reject the unwanted spurious bands in microwave regime. Moreover, the magnetic coupling between the SRRs and the microstrip line is also investigated via numerical calculations.

16:40 **Ultra-Narrow Bandwidth Filters Based on Highly Dispersive Metamaterial Basic Cells** — Tue-54

Lucas Borja, Alejandro[1]; Carbonell, Jorge[2]; Cascon, Joaquin[1]; Boria, Vicente E.[2]; Lippens, Didier[3]
[1]Universidad de Castilla-La Mancha, SPAIN;
[2]Universidad Politecnica de Valencia, SPAIN;
[3]Institut d'Electronique de Microélectronique et de Nanotechnologie, FRANCE

Two narrow pass-band filters with an out-of-band rejection in excess of 30 dB was designed for an operation in the C-band (frequency @ 4.5 GHz). These potential performances were achieved by cascading three double-split ring resonator cells magnetically coupled to a coplanar waveguide line and six shunt wires placed between the central strip and the ground metal layers. The design of the basic cell was achieved by a proper engineering of the plasma frequencies of the electrical and magnetic systems.

16:40   **Beam-Steering MEMS-Loaded Antenna Based on Planar Transmission Lines.**   Tue-56

Tomas, Zvolensky; Chicherin, D; Raisanen, A; Simovski, C
Helsinki University of Technology, FINLAND

Design, analytical analysis and numerical analysis of beam-steering possibilities of the planar transmission line loaded with microelectromechanical systems (MEMS) capacitors and stub inductors is presented. First, the design and analysis of a single unit cell comprising antenna structure is carried out. By stacking certain number of these unit cells leaky-wave structure is obtained, which is then analyzed. Effective beam-steering structure (controlled by MEMS capacitance) is obtained.

16:40   **Surface Wave Losses in Printed Antennas over Magneto-Dielectric Materials**   Tue-58

NIAMIEN, Constant; COLLARDEY, Sylvain; MAHDJOUBI, Kouroch; SHARAIHA, Ala
Institue of Electronic and Telecommunication of Rennes, FRANCE

Printed antennas over lossless infinite magneto-dielectric materials are investigated in terms of surface wave losses using the spectral domain approach . It has been shown that surface wave losses increase faster with the substrate permeability than with the substrate permittivity and this fact contributes to decrease faster the radiation efficiency of the antenna.

16:40   **Influence of Finite High-Impedance Surface Dimensions on the Characteristics of a Planar Printed Dipole**   Tue-60

Hampel, Sven Karsten; Kiral, I.; Schmitz, O.; Rolfes, I.
Leibniz Universitaet Hannover, GERMANY

This article highlights the effects of a finite basic High-Impedance Surface (HIS) structure on the impedance, the directivity and the radiation pattern of a printed linear dipole antenna. Furthermore the tradeoff between the minimum and maximum needed physical size of the reflecting surface will be addressed. The achieved results offer a systematic design approach and lead to an optimized planar dipole antenna, while keeping the physical dimensions as small as possible.

16:40   **Compact High Impedance Surface Based on Interdigital Capacitors**   Tue-62

Arriola, A.[1]; Sasiain, G.[1]; Sancho, J.I.[2]; Parron, J.[3]; Gemio, J.[3]; Villarino, R.[3]
[1]Ikerlan-IK4, SPAIN;
[2]CEIT, SPAIN;
[3]Universitat Autonoma de Barcelona, SPAIN

This paper proposes a compact high impedance surface based on interdigital capacitors. Compared with another surface which follows a similar compacting principle, the new structure increases the interdigital capacitance and obtains a lower resonance frequency. This performance is confirmed by several measurement methods, and an equivalent is presented which models the frequency behaviour of the proposed structure for design purposes.

16:40   **Multifrequency Single Patch Antennas Loaded with Split Ring Resonators**   Tue-64

Montero-de-Paz, J.; Ugarte-Muñoz, E.; Herraiz-Martinez, F. J.; Segovia-Vargas, D.
Universidad Carlos III de Madrid, SPAIN

Multifrequency antennas with low frequency ratio between frequencies would be desirable for systems that work on different frequency bands which are very close. In this paper multifrequency single patch antennas loaded with Split Ring Resonators (SRRs) are presented. Two or more working frequencies with ratios lower than 1.05 are achieved and two manufactured prototypes working on the X-Band are presented.

16:40   **Spatial Filters Based on EBG Structures with Anisotropic-Like Dispersion**   Tue-66

Serebryannikov, Andriy[1]; Cakmak, A. O.[2]; Colak, E.[2]; Ozbay, E.[2]
[1]TUHH, GERMANY;
[2]NANOTAM, Bilkent University, TURKEY

Bandpass and bandstop spatial filters based on the dielectric-rod EBG structures are proposed and validated for the frequency range from 18 to 25 GHz. The obtained experimental results are well consistent with the theoretical predictions. The exploited mechanism utilizes, in particular, anisotropic-like dispersion, which can occur in the conventional EBG structures made of isotropic materials.

16:40   **Analysis of spiral-slot-loaded, width-modulated, periodic microstrip lines**   Tue-68

Matekovits, L.[1]; Orefice, M.[1]; Esselle, K.[2]
[1]Politecnico di Torino, ITALY;
[2]Macquarie University, AUSTRALIA

The effect of a periodic reactive load on the phase velocity of a constant-width microstrip transmission line is investigated. The presence of resonant spiral slots etched in the ground plane modifies the electromagnetic response of the structure. It can be quantified by the phase velocity extracted from the dispersion diagram. Because of the presence of the periodic load, the correct characterisation requires the consideration of higher order modes, or analysis in the second Brillouin zone

16:40 **State of the Art Methods for Low SAR Antenna Implementation**   Tue-70

Gomez-Villanueva, R.[1]; Jardon-Aguilar, H.[1]; Linares y Miranda, R.[2]
[1]Centro de Investigacion y de Estudios Avanzados, MEXICO;
[2]Escuela Superior de Ingenieria Mecanica y Electrica, MEXICO

This paper is a state of the art review of the low SAR antenna techniques proposed in the last years for mobile phone terminals. From the review is apparent that more research is needed in this field to design a practical solution that meet the low cost, wideband and high efficiency requirements of the new models of handsets available in the market. The use of metamaterials is suggested as a cost effective solution to obtain low SAR but more research effort is required to increase bandwidth.

16:40 **Microstrip Patch Antenna Design Using Artificial Material Loadings**   Tue-72

Calafell, Irena; Ferrer, Pere J.; Gonzalez-Arbesu, Jose M.; Romeu, Jordi
Universitat Politècnica de Catalunya, SPAIN

Patch antennas filled using different material loadings, both homogeneous and dispersive, are reviewed in order to assess its FBW value. A compact formulation proposed by Yaghjian and Best to compute the FBW of antennas is successfully applied.

16:40 **Design of a Bidirectional Metamaterial Spacer at 2.45 GHz**   Tue-74

Imbert, Marc; Ferrer, Pere J.; Gonzalez-Arbesu, Jose M.; Romeu, Jordi
Universitat Politecnica de Catalunya, SPAIN

A bidirectional metamaterial spacer composed by Spiral Resonators (SRs) and metal strips has been designed, simulated, fabricated, and tested to operate like an artificial magnetic conductor (AMC) reflector at 2.45 GHz. A prototype of the new metamaterial spacer has been used to decorrelate two closely spaced monopole antennas achieving a good isolation and matching over a wide frequency range. This design could be used to develop a more compact multi-antenna Wi-Fi (IEEE 802.11b/g) router.

16:40 **Planar Bianisotropic Waveguides for Application in Microwave Devices**   Tue-76

Osaretin, I.; Rojas, R.
The Ohio State University, UNITED STATES

Planar waveguide structures (microstrip and slotlines) using thin film substrates having bianisotropic constitutive relationships are presented. Propagation characteristics of the waveguide structure when biased with a DC magnetic field show field and power displacement towards one edge of the planar waveguide. This nonreciprocal nature of bianisotropic materials shows a potential for applications in microwave devices.

16:40 **Dual Band Electromagnetic Band Gap Structure Incorporated with Ultra-Wideband Antenna**   Tue-78

Ayop, Osman[1]; A. Rahim, Mohamad Kamal[1]; Kamarudin, Muhammad Ramlee[1]; Abdul Aziz, Mohamad Zoinol Abidi[2]; Abu, Maisarah[2]
[1]Universiti Teknologi Malaysia, MALAYSIA;
[2]Universiti Teknikal Malaysia Melaka, MALAYSIA

This paper presents a new structure of electromagnetic band gap (EBG) which is slotted patch EBG (spEBG). This structure is incorporated with an ultra-wideband (UWB) antenna to produce a dual band rejection. The result is presented in term of S21 for spEBG structure and S11 for UWB antenna. From the result, this new shape of EBG can reject two frequency bands compared to the conventional EBG structure. By varying the parameter of spEBG, it can reject at different operating band frequencies.

16:40 **Estimation of the Effective Permeability of Stacking Dispersive Conductor Magnetic Layers**   Tue-80

RIALET, Damien[1]; SHARAIHA, A[1]; TAROT, A-C[1]; DELAVEAUD, C[2]; VIALA, B[1]
[1]IETR, FRANCE;
[2]CEA, FRANCE

Based on the works of Sarabandi and Mosallaei related to the model of "eddy currents", we are introducing the concept of resistive permeability μ_r in order to determine the effective permeability of multi-layer stacking for dispersive conductor magnetic layers of LLG type. The results show that the numerical results agree well with the analytic solution with an error less than for the extrinsic permeability $|\mu_{ext}| < 5\%$.

16:40 **Design and Measurement of High Impedance Surface**   Tue-82

Linot, Fabrice[1]; Cousin, R.[2]; Begaud, X.[1]; Soiron, M.[3]
[1]Telecom ParisTech, FRANCE;
[2]CST AG, FRANCE;
[3]Thales Airborne Systems, FRANCE

The design process of High Impedance Surface (HIS) is a challenge in realizing low-profile antenna. To carry out properly this process, a 3D-electromagnetic simulator is required. This paper shows an overview of the different numerical techniques which can be applied to simulate the behaviour of an HIS using CST Microwave Studio (CST MWS). To demonstrate the validity of the different solver used, some measurements of an HIS have been done in a waveguide simulator.

| 16:40 | **CANCELLED** | Tue-84 |

| 16:40 | **Comparison of Small 3D Multi-Loop and Micro-Coplanar ZOR Antennas** | Tue-86 |

Polivka,
CTU in Prague, CZECH REPUBLIC

In this paper, we present performance comparison of 3D four-loop antenna (3D-LA) and ZOR (zeroth-order resonator) antenna realized on micro-coplanar waveguide [1]. The purpose of this study is to further develop 3D multi-loop antenna of similar properties as ZOR antenna. Space arrangement of the 3D-LA enables antenna module realization which can be integrated in PCB.

| 16:40 | **Optimization of Wire-Medium-Based Shortened Horn Antenna** | Tue-88 |

Hrabar, S; Muha, D; Sipus, Z
University of Zagreb, CROATIA

This paper reports preliminary results of numerical optimization of shortened wire-medium-based horn antennas. The simpler shortened horn with single-wire slab had a length of 52% of the length of the optimal horn and gain equal the gain of the full length optimal horn within a bandwidth of 12%, A more complicated shortened horn with double-wire-based slab had a length of 33% of the length of the optimal horn and the gain equal to the gain of the optimal horn within a 6% bandwidth.

| 16:40 | **Low Profile, Directive and Very Wideband Antenna on a High Impedance Surface** | Tue-90 |

Damaj, L.; Lepage, AC.; Begaud, X.
Telecom ParisTech, FRANCE

In this article, a low profile directive and very wideband antenna is presented. A bow-tie is mounted above a high impedance surface. This structure exhibits an impedance bandwidth from 5.8 to 9 GHz and a broadside gain varying from 3.9 dB to 8.3 dB over this band. Its thickness is $\lambda/11$ at 5.8 GHz. Moreover, the structure is low cost and easy to fabricate due to the absence of vias.
The design methodology of this antenna is also presented.

| 16:40 | **New Topologies for Miniaturized Horizontal Corrugations** | Tue-92 |

Inclán Sánchez, Luis[1]; Vazquez-Roy, J.L.[2]; Quevedo-Teruel, O.[2]; Rajo-Iglesias, E.[2]
[1]Universidad Autónoma de Madrid, SPAIN;
[2]Universidad Carlos III de Madrid, SPAIN

In this paper, novel soft/hard surfaces based in new geometries are presented. We analyze the properties of surface wave propagation through these structures made of printed modified strips. The new shapes for the strips are the coupled lines topology and the spiral one, both are provided with metalised via holes in a lateral position. The size reductions for new shapes when compared with strip-loaded surface are 14% and 23% respectively.

| 16:40 | **Spiral Resonater MU-Near-Zero Substrates for Grounded Slot** | Tue-94 |

Ferrer, Pere J.; Gonzalez-Arbesu, Jose M.; Romeu, Jordi
Universitat Politecnica de Catalunya, SPAIN

Artificial magnetic material (AMM) slabs composed of spiral resonators (SRs), operating in the mu-near-zero (MNZ) band, $0 < \mu r < 1$, are investigated as slot antennas substrates for broadside radiation and directivity enhancement. Results for the slot antenna in free-space are compared with the slot antenna in presence of a single-layer and a four-layer SR AMM slabs

| 16:40 | **Microwave Aperture Antennas Using Nanomaterials** | Tue-96 |

Whittow, W.G; Vardaxoglou, J. C
Loughborough University, UNITED KINGDOM

Simulations are used to investigate the concept of designing microwave aperture antennas, potentially fabricated using metallic nanomaterials. Nanomaterials may facilitate fabrication and electromagnetic advantages. Aperture radiating structures have been excited by a plane wave in a microstrip line. The aperture was modified with the addition of fine vertical strips shorter than the height of the aperture which decreased the resonance frequency at the expense of the bandwidth.

| 16:40 | **Optical Antennas as Nano-Probes in Photonic Crystals and Dielectric Waveguide Structures** | Tue-98 |

Gonzalez, Francisco J.[1]; Alda, Javier[2]
[1]Universidad Autónoma San Luis Potosí, MEXICO; [2]University Complutense of Madrid, SPAIN

The performance of dipole and bowtie nanoantennas coupled to a photonic crystal waveguide is analyzed by numerical simulations as a function of the antenna length. The antennas showed two resonances spectrally far apart from each other: one of them corresponds to the main antenna resonance and the other one to the allowed modes in the bandgap of the photonic crystal substrate. The results also show a nonlinear scaling between the resonant wavelength and the length of the antennas.

Session:	**P04P1: Mobile Channel Modeling 1**
Type:	Propagation Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 113
Chairs:	P. Pechac
	R. D'Errico

Time	Title	Abs No

08:30 **Analytical Propagation Model of Body Area Network Channels Based on the Creeping Wave Theory** P04P1-1

Alves, Thierry[1]; Poussot, Benoit[1]; Laheurte, Jean-Marc[1]; Terchoune, Hanae[2]; Wong, Man-Faï[2]; Fouad Hanna, Victor[3]
[1]ESYCOM University Paris-Est Marne-la-Vallée, FRANCE;
[2]Orange-FT Research Lab, Paris, FRANCE;
[3]University of Paris 6, FRANCE

This paper presents the first attempt to provide analytical models of BAN channels including the body morphology. Studied transmissions are along curved parts like waist or head. An accurate model is derived from diffraction theory used in the prediction of the surface wave attenuation on curved surfaces. The validity of the model is first confirmed with simulations and a set of measurements is then presented.

08:50 **Empirical Time-Spatial Propagation Formula for Outdoor LOS Environments** P04P1-2

Fujii, Teruya[1]; Ohta, Yoshichika[1]; Omote, Hideki[2]; Sugita, Y[3]
[1]Soft Bank Mobile Corp., JAPAN;   [2]Soft Bank Mobile Corp, JAPAN;   [3]Softbank Telecom Corp. / Japan, JAPAN

In order to accurately evaluate spatial processing techniques, a Time-Spatial Propagation (TSP) model that can simulate the characteristics of both delay profile and spatial arrival angular profile for travelling waves at the same time is required. We proposed the TSP model for wideband mobile communication systems using UHF and SHF bands in NLOS environments. Based on measurement data, this paper extends the TSP model for NLOS environments to create an empirical TSP model for LOS environments.

09:10 **Physical Channel Modeling for Static Mobile Terminals in Indoor Environments** P04P1-3

Fujii, Teruya; Ohta, Yoshichika
Soft Bank Mobile Corp., JAPAN

In static usage, the mobile terminal itself doesn't move, but the environment around it changes due to moving obstacles such as people. In order to evaluate the QoS of such terminals, a channel model that takes account of stationary usage is required. We proposed a dynamic channel model for static terminals used in indoor. This paper analyzes the power spectrum of proposed model in order to easily generate the channel variation and to propose a simple formula for the power spectrum.

09:30 **Urban Measurements and Propagation Models Comparison of a 3.5 GHz Signal for Broadband Wireless Systems** P04P1-4

Ramos, Glaucio[1]; Vieira, Robson[2]; Rego, Cassio[3]; Pereira, Paulo[4]; Siqueira, Glaucio[5]
[1]Federal University of Espirito Santo, BRAZIL;
[2]INdT, BRAZIL;
[3]Federal University of Minas Gerais, BRAZIL;
[4]University Center of Belo Horizonte, BRAZIL;
[5]Pontifical Catholic University of Rio de Janeiro, BRAZIL

This paper presents the results of propagation measurements taken at 3.5 GHz in Rio de Janeiro city. An urban environment was chosen to collect data. The results presented in this paper deal with path loss measurement for coverage prediction and the study of received signal variability essential for determining system parameters. The results are compared with the most popular empirical and statistical models in the literature.

09:50 **Vegetation Attenuation Measurements at 2 GHz Using a Remote-Controlle Airship a€" Initial Results** P04P1-5

Horak, P; Kvicera, M; Simunek, M; Pechac, P
CVUT FEE, CZECH REPUBLIC

The aim of this paper is to describe tree attenuation measurements at 2 GHz in four different locations inside vegetation, and at three different positions for a single tree shadowing. The purpose of this measurement campaign was to use a 9–meter long remote-controlled airship as a pseudo-satellite. The data were obtained at each position as a function of elevation angles ranging from 25 to 90 degrees. The final results are presented.

Session:	**C29P1: Recent development of antennas and propagation for body-centric wireless communications - 1**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 119
Chairs:	Y. Hao
	P. Hall

Time	Title	Abs No
08:30	**Delay Dispersion of the On-Body Dynamic Channel**	C29P1-1

D'Errico, R.; Ouvry, L.
CEA, LETI, MINATEC, FRANCE

This paper addresses the characterization and modeling of power delay profile characteristics in time-variant on-body channels, by considering different human mobility conditions and antenna positions. The model takes into account the space-time correlated shadowing effect on the delay dispersion of the channel impulse response.

| 08:50 | **Characterization of 3D-Stacked Nodes for Body Area Networks at 2.45 GHz** | C29P1-2 |

Arriola, A.[1]; Irastorza, S.[1]; Torfs, T.[2]; Brebels, S.[2]; De Raedt, W.[2]
[1]Ikerlan-IK4, SPAIN;
[2]IMEC vzw, BELGIUM

This paper presents the characterization of two 3D-stacked BAN nodes, both for free-space and on-body operation. Input impedance, radiation pattern and efficiency measurements have been carried out, showing the effect of the shielding layers below the antenna and the metallic parts around it. It has been demonstrated that for antennas embedded in small nodes and surrounded by metal traces and vias, simplified simulation models provide qualitative information but not realistic results.

| 09:10 | **Dual-Band Implantable Antenna Based on Short-Circuited SRR** | C29P1-3 |

Sanchez-Fernandez, Carlos J.[1]; Quevedo-Teruel, Oscar[1]; Requena-Carrion, Jesus[2]; Inclan-Sanchez, Luis[3]; Rajo-Iglesias, Eva[1]; Ng Mou Kehn, Malcolm[4]
[1]University Carlos III of Madrid, SPAIN;
[2]Universidad Rey Juan Carlos, SPAIN;
[3]Universidad Autónoma de Madrid, SPAIN;
[4]National Chiao Tung University, TAIWAN

In this communication, an innovative dual band microstrip patch antenna is proposed for Implantable Medical Devices (IMD). Particularly, the covered bands are MICS (402- 405MHz) and ISM (2.4-2.48GHz). The antenna has a multilayer configuration where the feeding line and radiating layer are located at different levels. The radiating element of the antenna is a Split Ring Resonator (SRR) coupled to a Spiral.

| 09:30 | **Military UHF Body-Worn Antennas for Armored Vests** | C29P1-4 |

Psychoudakis, D.; Lee, G. Y.; Chen, C-C.; Volakis, J. L.
The Ohio State University, UNITED STATES

In this paper, we present new body-worn antennas specifically designed for armored vests used by the military and law enforcement agencies. Typically, these vests have hard ceramic reinforced plates protecting the abdomen. The proposed antennas are mounted on these plates. New designs are shown for front, back and side armor plates and the simulations are validated using measurements. A diversity study is also performed to assess practical performance.

| 09:50 | **A Study of Perturbations in Linear and Circular Polarized Antennas in close proximity to the Human Body and a Dielectric Liquid Filled Phantom at 1.8 GHz** | C29P1-5 |

Khattak, M.I.[1]; Edwards, R[1]; Ma, J[1]; Ullah, A[2]; Panagamuwa, C[1]
[1]Loughborough University, UNITED KINGDOM;
[2]University of Engineering and Technology Peshawar, PAKISTAN

This paper deals with the comparison of perturbations caused to the matching of simple linear and circular polarized patch antennas due to the close proximity of a human torso and rectangular box phantom filled with muscle simulating liquid at 1.8GHz. The isolated variable is return loss (S11). Results show that both linear and circularly polarized antennas produce an optimal return loss closer to the surface of a typical phantom than the back of a human volunteer.

Session:	**C26P1: Integral equation techniques for large and multiscale challenging problems - 1**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 120
Chairs:	G. Vecchi
	A. Freni

Time	Title	Abs No
08:30	**Analysis of Antennas in the Presence of Large Composite 3-D Structures with Linear Embedding via Green's Operators (LEGO) and a Modified EFIE**	C26P1-1

Lancellotti, V.; de Hon, B. P.; Tijhuis, A. G.
EINDHOVEN UNIVERSITY OF TECHNOLOGY, NETHERLANDS

We combine the LEGO method with an EFIE to solve the problem of an antenna system which radiates nearby a large 3-D structure. Upon rearranging the relevant equations we include the contribution of the large structure into the EFIE posed over the antenna surface - which results in a "modified" EFIE. The latter can be solved by MoM and direct methods, if the antenna system is not too large. We provide validation of the proposed strategy and an example of application to a real-life antenna.

08:50	**Scattering from Rough Surfaces at Low Grazing Incidence**	C26P1-2

Saillard, Marc[1]; Soriano, Gabriel[2]
[1]Universite du Sud Toulon-Var, FRANCE;
[2]Aix-Marseille Universite, FRANCE

The problem of scattering of electromagnetic waves from randomly rough surfaces illuminated at grazing incidence is addressed. A boundary integral equation is proposed, which, combined with the method of moments, allows an accurate estimation of the very low scattering cross-sections encountered in such conditions. This model is used as a tool to check the validity of approximate theories to predict the radar cross-section from sea surface in the microwave range.

09:10	**Combined Lego-Eigencurrent Approach for Enhanced Solution of Electrically Large 2-D EBG Structures**	C26P1-3

Duque, D.[1]; Lancellotti, V.[2]; de Hon, B.P.[1]
[1]Eindhoven University of Technology, NETHERLANDS;
[2]Eindhoven University of technology, NETHERLANDS

We combine the linear embedding via Green's operators (LEGO) and the eigencurrent expansion method (EEM) to efficiently deal with 2-D electrically large electromagnetic band-gap (EBG) structures. In LEGO, the composite structure is broken up into elements called "bricks" that are characterized through scattering operators by invoking Love's equivalence principle. The problem is then formulated through an integral equation involving the total inverse scattering operator of the structure.

09:30	**Hierarchical Fast MoM Analysis of Large Multiscale Wire-Surface Structures**	C26P1-4

Vipiana, F.[1]; Francavilla, M. A.[2]; Vecchi, G.[2]; Wilton, D. R.[3]
[1]Istituto Superiore Mario Boella (ISMB), ITALY;
[2]Politecnico di Torino, ITALY;
[3]University of Houston, UNITED STATES

The paper presents a fast EFIE MoM analysis of structures with fine details, non-uniform meshes, formed by surfaces and wires. The developed hierarchical preconditioner is efficiently integrated with a MoM iterative fast solver to analyze electrically large objects. The numerical results show a strong reduction of the number of iterations with a very low memory overhead.

09:50	**Global Generalized Shannon Functions for the Scattering of 3-D Polyhedral Surfaces**	C26P1-5

Casaletti, M.[1]; Petruzziello, M.G.[1]; Maci, S.[1]; Vecchi, G.[2]
[1]University of Siena, ITALY;
[2]Politecnico di Torino, ITALY

This paper introduces a new type of entire-domain basis functions for the analysis of the scattering from 3D polyhedral bodies. A non-redundant set of basis functions is determined a priori by explicit approximate formulas either for currents or radiated field representation. Numerical results are presented to shown the accuracy of the method.

10:10	**Combination of MLFMA and an Iterative Method to Compute Large Scattering or Radiation** Problems	C26P1-6

Delgado, C[1]; García, E[1]; González, I[2]; Catedra, F[1]
[1]University of Alcalá, SPAIN;
[2]University of Alcala, SPAIN

An efficient approach for the computation of large scattering or radiation problems is presented in this work. The underlying technique analyzes different parts of the geometry separately, and then it computes different effects or interactions between these parts. We show in the results section good agreement with conventional rigorous methods for a number of test cases.

Session: **C35P1: Nano-photonic antennas- 1**
Type: Convened Session
Date: Wednesday, April 14, 2010
Time: 08:30 - 10:30
Room: Room 121
Chairs: N. van Hulst
P. Burke

Time	Title	Abs No

08:30   **Fresnel Spiral Antenna for Detection at Visible and Far-Infrared Bands**   C35P1-1

González, F.J.[1]; Alda, J.[2]
[1]Universidad Autónoma San Luis Potosí, MEXICO;
[2]University Complutense of Madrid, SPAIN

A dual-band device has been designed and simulated to simultaneously detect optical radiation in the far infrared and the visible band. The infrared detector consists of a spiral antenna adapted from a Fresnel zone plate. Symmetric and asymmetric designs have been proposed and simulated. The response in the infrared is obtained from a computational electromagnetic calculation. The diffraction pattern at the focal point of the element has been calculated to check the feasibility of the model.

08:50   **Graphene-Based Nano-Antennas for Electromagnetic Nanocommunications in the Terahertz Band**   C35P1-2

Jornet, J. M.; Akyildiz, I. F.
Georgia Institute of Technology, UNITED STATES

Nanotechnology is enabling the development of devices in a scale ranging from one to a few hundred nanometers. Coordination among these nano-devices will lead towards the development of future nanonetworks. For the time being, however, it is not clear how these machines will communicate. In this paper, we analyze the use of carbon nanotubes as nano-dipole antennas and using a new quantum mechanical framework we illustrate that a nano-dipole antenna can radiate EM waves in the terahertz band.

09:10   **A Nano-Optical Yagi-Uda Antenna Driven by Single Emitters**   C35P1-3

Curto, A. G.; Taminiau, T. H.; Volpe, G.; Kreuzer, M.; Quidant, R.; van Hulst, N. F.
ICFO - The Institute of Photonic Sciences, SPAIN

Optical antennas are the counterparts of conventional radio frequency and microwave antennas for frequencies in the visible regime ($\sim$500 THz). They localize optical fields to sub-diffraction-limited volumes, enhance and redirect the excitation and emission of quantum emitters as well as modify their spectra. They open up exciting opportunities in a wide range of fields including nonlinear light-matter interaction and superresolution microscopy.

09:30   **Nano-optical trapping by resonant optical antennas of Rayleigh particles and E-coli bacteria**   C35P1-4

Righini, M[1]; Ghenuche, P[1]; Cherukulappurath, S[1]; Myroshnychenko, V[2]; García de Abajo, F.J.[2]; Quidant, R[1]
[1]ICFO, SPAIN;
[2]Instituto de Optica, SPAIN

We demonstrate a novel optical trapping scheme that allows us to hold living E-coli bacteria for times of several hours using moderate light intensities. We pattern metallic nanoantennas on a glass substrate to produce strong light intensity gradients responsible for the trapping mechanism. Several individual bacteria are trapped simultaneously, with their orientation fixed by the asymmetry of the antennas.

09:50   **Shaping the Optical Response of Nanoantennas**   C35P1-5

Volpe, G; Cherukulappurath, S; Juanola Parramon, R; Molina-Terriza, G; Quidant, R
ICFO, SPAIN

In this paper, we investigate the effect of the sub-wavelength spatial phase modulation at the focus of high order paraxial beams on the near-field distribution of plasmonic nanoantennas. We show, in particular, how high-order beams can be used to control the light localization in the gaps of dipolar nanoantennas and in chains of antennas.

Time	Title	Abs No

08:30   Tunable Antenna for DVB-H and GSM 900 Standard   A10P1-1

CANNEVA, Florian; Ribero, J-M; Staraj, R
Laboratoire d'électronique antenne et télécommunication, FRANCE

In this paper we present an active antenna for DVB-H standard. The active components used in this antenna are PIN diodes to switch the antenna in the desired frequency band, and a Varactor diode to adjust accurately the working frequency. By combining selected switched PIN diodes and controlled values of the varactor diode capacitance, this miniature antenna t reaches to cover a large part of the desired reception channels and anather standard like GSM's one.

08:50   MEMS-Reconfigurable Antenna Based on a Multi-Size Pixelled Geometry   A10P1-2

Rodrigo, D.[1]; Damgaci, Y.[2]; Biyikli, N.[2]; Cetiner, B. A.[2]; Romeu, J.[1]; Jofre, L.[1]
[1]Universitat Politècnica de Catalunya, SPAIN;
[2]Utah State University, UNITED STATES

A MEMS multi-parameter reconfigurable antenna with beam steering capability and resonance frequency reconfigurability is presented. The design is based on an interconnected patch grid structure with an efficient biclustered distribution using different sized patches. A small antenna of $\lambda/2$ by $\lambda/2$ using only 12 RF-MEMS switches is optimized using genetic algorithms, demonstrating beam tilting over a range of 120° and resonant frequency reconfigurability over 4, 5 and 6GHz.

09:10   Pattern and Polarization Reconfigurable CRLH Leaky Wave Antenna   A10P1-3

Piazza, D; D'Amico, M
Politecnico di Milano, ITALY

A novel reconfigurable leaky wave antenna (LWA) that takes advantage of the CRLH properties to achieve dynamic pattern and polarization reconfigurability is proposed. The radiation beam can be steered from endfire to backfire while tuning the polarization of the radiated field from circular to linear. The antenna has frequency dependent beam scanning capabilities, however by properly loading the LWA with variable capacitors a frequency independent beam scanning behavior is achieved.

09:30   Reconfigurable Orthogonal Antenna Array (ROAA) Based on Separated Feeding Network   A10P1-4

Ali, Mohd Tarmizi[1]; Abd Rahman, Tharek[1]; Kamarudin, Muhammad Ramlee[1]; Md Tan, Mohd Nor[1]; Sauleau, Ronan[2]; Jamlos, Muhammad Faizal[3]
[1]Universiti Teknologi Malaysia, MALAYSIA;
[2]Institut d'Electronique et de Telecommunications de Rennes, FRANCE;
[3]Universiti teknologi Malaysia, MALAYSIA

A novel structure of Reconfigurable Orthogonal Antenna Array (ROAA) constructed with separated feeding network by an air gap technique is introduced in this paper. In contrast to the conventional antennas that produce fixed directional radiation patterns, the ROAA is able to scan the beam over 360Â° in the horizontal plane by utilising the PIN diodes switches. The structures are consists of four reconfigurable Planar Antenna Arrays (RPAA) operating at 5.8GHz.

09:50   Tunable Multiband Antenna Using ENG ZORs   A10P1-5

Kim, Jeongpyo[1]; Lee, Y[2]; Choi, J[2]
[1]E.M.W. Co., Ltd., KOREA, REPUBLIC OF;
[2]Hanyang University, KOREA, REPUBLIC OF

We propose a tunable multiband antenna using four ENG ZORs. Each ENG ZOR unit cell consists of two shunt inductors, a transmission line, and a variable capacitor. ENG ZORs #1 and #2 are placed on the same ground plane and operated at Tx band (f1) and Rx band (f2) of lower band, respectively. In contrast, ENG ZORs #3 and #4 are constructed perpendicular to the ground plane and have the resonance frequencies at Tx band (f3) and Rx band (f4) of higher band, respectively.

10:10   Tunable Pass-Band FSS for Beam Steering Applications   A10P1-6

Russo, I.; Boccia, L.; Amendola, G.; Di Massa, G.
University of Calabria, Microwavelab, ITALY

This work aims at demonstrating the beam-steering capabilities of active FSSs working in transmission mode. A pass-band varactor-loaded FSS-based has been designed to obtain large phase agility. The multi-layer arrangement introduced in this work allows steering angles of ±90° for the transmitted beam thanks to an overall phase agility of about 360° for the unit cell. The proposed technique allows a simultaneous control of phase and amplitude, keeping attenuation level below a 3dB limit.

Time	Title	Abs No
08:30	**Retrodirective Array Based RADAR**	C08P1-1

Fusco, V.; Buchanan, N
Queens University Belfast, UNITED KINGDOM

This paper will demonstrate recent work at Queens University of Belfast as well as review the small body of literature on the new topic of Retrodirective Radar. Details are presented on the core capabilities of Retrodirective antenna arrays for near field target acquisition and pulsed far field tracking in Radar applications.

08:50	**SE-IT Joint M-AESA Program: Overview and Status**	C08P1-2

Ouacha, A.[1]; Fredlund, A.[2]; Andersson, J.[2]; Hindsefelt, H.[2]; Rinaldi, V.[3]; Scattoni, C.[3]
[1]Swedish Defence Research Agency, SWEDEN;
[2]Swedish Defence Materiel Administration, SWEDEN;
[3]Ministry of Defence, SGD, DIFESA, ITALY

M-AESA program is a joint SE-IT initiative for the development of a capability driven multifunction phased array system concept. In this paper an overview and status of this unique R&D partnership are discussed with a mission of evaluating new technology and system architecture for developing the next generation phased array antenna system capable of exploiting the most relevant operational functions (Radar, EW and Comm) according to the operational scenarios.

09:10	**Application of the Shared Aperture Antenna Concept to Radar Front-Ends: Advantages and Limitations**	C08P1-3

Lager, Ioan[1]; Trampuz, C.[2]; Simeoni, M.[2]; Coman, C.I.[3]; Ligthart, L.P.[2]
[1]TU Delft, NETHERLANDS;
[2]IRCTR, Delft University of Technology, NETHERLANDS;
[3]NATO Consultation, Command and Control Agency (NC3A), NETHERLANDS

The shared aperture antenna, an effective and versatile radar front-end design strategy based on deploying interleaved sub-arrays on a common aperture, is discussed. A number of instantiations of this concept, demonstrating multi-functionality and polarisation agility capabilities, is described in detail. Some limitations of this concept are singled out, and measures to counteract them are put forward.

09:30	**Antenna Front-End Concepts of a Low-Cost Coherent Radar Demonstrator for S-Band Application**	C08P1-4

Loecker, C.[1]; Pamies, M.[1]; Bertuch, T.[1]; Knott, P.[1]; Erkens, H.[2]; Wunderlich, R.[2]; Heinen, S.[2]
[1]Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, GERMANY;
[2]RWTH Aachen University, Chair of Integrated Analog Circuits and RF Systems, GERMANY

Concepts of a new approach for a radar system based on an active electronically scanned array antenna for maritime applications will be presented with respect to cost reduction in fabrication and maintenance. In the proposed system the usually mechanically rotated antenna will be replaced by a phased array with custom-developed ICs as core components of its T/R modules.

09:50	**Antenna Frontends for Radar Applications**	C08P1-5

Litschke, Oliver; Bettray, Andreas; Holzwarth, Sybille; Lauer, Andreas; Martinez-Vazquez, Marta; Otto, Simon; Sanadgol, Bahram
IMST GmbH, GERMANY

This paper gives an overview on different antenna frontends for radar applications. Some properties of the showed systems are explained in more detail to present different ways to fulfill special system requirements.

Session:	**C20P1: Antennas and propagation aspects for multi-gigabit communication in the mm- and submm-waverange - 1**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 125
Chairs:	P. Smulders
	P. Herrero

Time	Title	Abs No
08:30	**Impact of Regulations on Feasible Distance between 60GHz Devicex**	C20P1-1

Smulders, Peter
Eindhoven University of Technology, NETHERLANDS

This paper addresses the impact of the current world-wide safety and interference regulations with respect to the 60 GHz band on the feasible distance between a transmitting and a receiving device assuming a beam-forming array antenna at both ends of the link. From these considerations it occurs that these regulations impose severe constraints in terms of allowable antenna gain at the transmitter as well as allowable levels of transmit power in case of non-line-of-sight operation.

| 08:50 | **60 GHz Time-Variant Shadowing Characterization within an Airbus 340** | C20P1-2 |

Garcia, A. Paolo[1]; Kotterman, W.[1]; Trautwein, U.[2]; Brückner, D.[2]; Kunisch, J.[3]; Thomä, R. S.[1]
[1]Ilmenau University of Technology, GERMANY;
[2]MEDAV GmbH, GERMANY;
[3]IMST GmbH, GERMANY

The time-variant-shadowing by human-bodies (TVSHB) is one of the most harmful propagation effects at 60 GHz. In this paper is presented an experimental characterization of the TVSHB at 60 GHz based on real-time wideband measurement campaigns performed within an Airbus-340 aircraft cabin, using redundant cell configurations and different antennas. The fading-rate, fading-depth, depth-duration, and correlation when passengers were walking, blocking and standing up were considered for the analysis.

| 09:10 | **Planar Antennas and Beamforming Devices for a Multi Gigabit 60 GHz Demonstrator with Quality of Service** | C20P1-3 |

Herrero, Pablo; Schoebel, Joerg
Terahertz Communications Lab, GERMANY

Two antennas are developed in this paper which could be included in a multi gigabit demonstrator with Quality of Service (QoS) capabilities. The antennas are suitable for two applications operating in the 60GHz band: Kiosk downloading and Wireless High-Definition Multimedia Interface (wHDMI).

| 09:30 | **Low Complexity MIMO Beamforming Scheme for Millimeter-Wave Wireless Personal Area Network** | C20P1-4 |

Lee, Hyun-Ho[1]; Jeon, Taehyun[2]; Ko, Young-Chai[1]
[1]Korea University, KOREA, REPUBLIC OF;
[2]Seoul National University of Technology, KOREA, REPUBLIC OF

In this paper, we propose a beamforming scheme with low complexity in terms of the number of training sequences to be used for the estimation of weight vectors in millimeterwave wireless personal area network. Our proposed scheme is based on the multiple-level procedure to reduce the number of training sequences. From the numerical results, we confirm that the proposed scheme can achieve considerable average output SNR with fewer training sequences for the case of the large number of antennas.

| 09:50 | **Characteristics of Indoor Millimeter-Wave Channel at 60 GHz in Application to Perspective WLAN Systems** | C20P1-5 |

Maltsev, A.[1]; Maslennikov, R.[2]; Sevastyanov, A.[1]; Lomayev, A.[1]; Khoryaev, A.[1]; Davydov, A.[1]; Ssorin, V.[2]
[1]Intel Corporation, RUSSIAN FEDERATION;
[2]N.I. Lobachevsky State University of Nizhny Novgorod, RUSSIAN FEDERATION

This work presents results of the investigation of indoor millimeter-wave channel at 60 GHz in application to perspective WLAN systems. The results are based on the work of the authors on the IEEE 802.15.3c (60 GHz WPAN) and IEEE 802.11ad (60 GHz WLAN) channel models development. The most important aspects of the 60 GHz indoor radio channel are considered including the quasi-optical propagation nature, inter and intra cluster parameters, and the polarization characteristics impact.

Time	Title	Abs No

08:30   **60 GHz Substrate Integrated Waveguide Fed Steerable LTCC Antenna Array**   A11P1-1

Sanadgol, B.[1]; Holzwarth, S.[1]; Milano, A.[2]; Popovich, R.[2]
[1]IMST GmbH, GERMANY;
[2]Beam Networks, ISRAEL

This paper presents the design and fabrication of a 60 GHz substrate integrated waveguide fed steerable LTCC (Low Temperature Cofired Ceramics) antenna array. This antenna is suited for transmit and receive in the 60 GHz WPAN frequency band. This wireless system can be used for several applications such as HDTV, high data-rate networking (up to 4.5 GB/s), security & surveillance and other similar applications.

08:50   **Behavioral Model of Solid State Power Amplifiers (SSPAs) for Agile Antennas Application**   A11P1-2

ZAKKA EL NASHEF, G.; TORRES, F.; REVEYRAND, T.; MONS, S.; N'GOYA, E.; MONEDIERE, T.; QUERE, R.
XLIM, FRANCE

This paper focuses on behavioral modeling approach for a power amplifiers used in agile antennas application. This approach of active antennas can take into account the interactions between the nonlinear circuits and antennas: the matching impedances for each antenna of a specified array are calculated from rigorous EM analysis, then those calculated matching impedances are used instead of the real antennas to define the load impedances of the active circuit to optimize the global performances.

09:10   **First Prototyping of a Compact Mobile Ku-Band Satellite Terminal**   A11P1-3

Baggen, Rens[1]; Vaccaro, Stefano[2]; Llorens del Río, Daniel[2]; Torres Sánchez, Roberto[3]
[1]IMST, GERMANY;
[2]JAST, SWITZERLAND;
[3]EPFL, SWITZERLAND

This article focuses on the buildup of the first prototype of a phased array realised within the ESA-project NATALIA. This array is designed for mobile satellite services and dedicated to automotive applications. Key components of the complete buildup will be introduced such as a highly optimised antenna aperture, a first version of a multilayer Printed Circuit Board (PCB) including various circuits like RF-feeding network and digital logic, and a dedicated MMIC.

09:30   **Highly Integrated 8x8 Antenna Array Demonstrator on LTCC with Integrated RF Circuitry and Liquid Cooling**   A11P1-4

Holzwarth, Sybille; Litschke, Oliver; Simon, Winfried; Kassner, Jürgen; Fischer, Horst; Serwa, Alexandra
IMST GmbH, GERMANY

This paper presents the design, manufacturing and measurement of an highly integrated 8x8 DBF antenna array on LTCC with integrated RF circuitries and liquid cooling.

09:50   **T/R Module Design for GEODA Antenna**   A11P1-5

Arias Campo, M.[1]; Montesinos Ortego, I.[2]; Fernández Jambrina, J.L.[2]; Sierra Perez, M.[2]
[1]IMST, GERMANY;
[2]Universidad Politécnica de Madrid, SPAIN

GEODA is a smart, conformal multiarray antenna system designed for satellite communications, operating at 1.7 GHz. Its structure is based on a triangular array configuration, divided into subarrays (cells) of three circular radiant elements. The reception module of the GEODA, that manages the beam steering control, has been designed, realised and successfully measured. In this article, the design process to add transmission capacity is described, which will represent the GRUA project.

Session:	**A12: Millimeter wave antennas**
Type:	Antennas Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 128
Chairs:	J. Teniente
	E. Lheurette

Time	Title	Abs No
08:30	**Bandwidth Improvement of 60GHz Micromachining Patch Antenna Using Gap Coupled U-Microstrip Feeder**	A12-1

ADANE, A.; GALLEE, F.; PERSON, C.
Lab-STICC - Telecom-bretagne, FRANCE

A 60 GHz patch antenna is built-up on Si/BCB membrane and excited with T or U-microstrip feeders via a dielectric gap. This excitation is used to improve the bandwidth of a simple patch and cover the 60 GHz-band (11%) for WLAN applications without increasing the realisation complexity. The respective bandwidths of final T and U-shape antennas occupy 13.3% and 12.3% for antenna efficiency > 90%. The U- configuration is found to be more compact and suitable for designing beamforming array.

| 08:50 | **Design of 60-GHz CPW-Fed CMOS On-Chip Integrated Antenna-Filter** | A12-2 |

Tsai, Kai-Hsiang; Yeh, Lung-Kai; Kuo, Pei-Chun; Chuang, Huey-Ru
National Cheng Kung University, TAIWAN

This paper presents a 60-GHz millimeter- wave on-chip integrated Yagi-antenna-filter fabricated with a 0.18-$f\acute{Y}$m CMOS process. An FEM-based 3-D full-wave EM solver, HFSS, is used for design simulation. The measured input VSWR of the fabricated on-chip Yagi-antenna-filter is less than 2 from 55 to 65 GHz. The measured maximum power gain is about -14 dBi. The front-to-back ratio of the radiation pattern is about 14 dB.

| 09:10 | **Design of a Balanced-Fed Patch-Excited Horn Antenna at Millimeter-Wave Frequencies** | A12-3 |

Methfessel, Sebastian; Schmidt, Lorenz-Peter
University of Erlangen-Nuremberg, GERMANY

A millimeter wave patch-excited horn antenna is introduced. Its plane of polarization can be rotated by 45° relative to the balanced feed, useful for multi-element array radar applications and easy planar integration with transceiver chips. Radiation characteristics are enhanced with a substrate integrated cavity and a stacked horn, yielding more than 8 dBi gain. A relative bandwidth of 18% is achieved by using an aperture coupled patch element. Simulation and measurement are in good agreement.

| 09:30 | **Half Truncated Icosahedral Passive Electromagnetic Deflector for the 60 GHz Band** | A12-4 |

Kazim, M. I.; Herben, M. H. A. J.; Huang, M. D.
Technical Universiteit Eindhoven (TU/e), NETHERLANDS

A possible low-cost alternative to a multifaceted active antenna array configuration for wide angular coverage is proposed. It consists of a single planar antenna array and a passive electromagnetic half truncated icosahedral deflector for 60 GHz band. A generalized formulation for the simple set-up of the proposed configuration is simulated in MATLAB and a comparison is made with CST MWS simulation. The measurement shows an acceptable performance of the deflector's transmission coefficient.

| 09:50 | **Millimeter Wave Isolator Based on Thin Film Magnetized Semiconductors in Fully-Planar Waveguide** | A12-5 |

Alshannaq, S.; Rojas, R.
The Ohio State University, UNITED STATES

This paper demonstrates the possibility of designing a fully planar slotline isolator based on magnetized semiconductor substrates at room temperature. Semiconductors magnetized with dc magnetic bias can be used to overcome some of the limitations of ferrites. The design is based on the non-reciprocal field displacement effect, and is intended for the V and W frequency bands. Two configurations will be proposed and then accessed using 2D (eigenvalue) and 3D finite element based simulations

| 10:10 | **High Gain Conical Horn Antenna Integrated With a Planar Substrate for 60 GHz WPAN Applications** | A12-6 |

Caillet, N.; Person, C.; Favennec, J-F.; Quendo, C.; Pinel, S.; Rius, E.; Laskar, J.
Lab-STICC, FRANCE

A integration technique of horn antennas on conventional substrates is proposed for improving interconnections and therefore losses with planar devices. Considering Ag/Cu metallised foams, a 3D micro-machining process is employed for developing a circular horn antenna, with implicit integrated excitation structure and back side cavity. This antenna can be mounted on a conventional substrate, providing high gain value non achievable with planar antennas. Measurements are compared to simulations.

Time	Title	Abs No
08:30	**Metamaterial-Enabled Transformation Optics Lenses for Antenna Applications**	C06P1-1

Turpin, J. P.[1]; Jiang, Z. H.[1]; Kwon, D.-H.[2]; Werner, P. L.[1]; Werner, D. H.[1]
[1]Pennsylvania State University, UNITED STATES;
[2]University of Massachusetts, Amherst, UNITED STATES

Metamaterial lenses derived through transformation optics offer control over wave behavior and potential for new antenna structures. A collimating lens is presented with an embedded source that produces up to four orthogonal beams based on the position of the source. An example metamaterial design for the lens is also presented. Another far-field collimating flat lens allows for fine beam scanning and potential for multiple beamforming based on the position of the sources behind the lens.

| 08:50 | **Antenna Directivity Enhancement Using a Metamaterial Parabolic Lens** | C06P1-2 |

Navarro-Cia, M.[1]; Beruete, M.[1]; Falcone, F.[1]; Sorolla, M.[1]; Campillo, I.[2]
[1]Universidad Publica de Navarra, SPAIN;
[2]CIC nanoGUNE Consolider, SPAIN

This work presents advances in the application of stacked subwavelength hole arrays for beamforming at millimetre-waves. In particular, it is shown that a metamaterial parabolic stepped lens made by stacking perforated plates with an open-ended waveguide as source gives has a directivity of 29 dB. The results shown here as susceptible of being extended to any frequency range such as THz or even visible since Extraordinary Transmission has been reported along the whole spectrum.

| 09:10 | **Metamaterials in Antenna Design and Technology** | C06P1-3 |

Bilotti, Filiberto; Vegni, Lucio
University ROMA TRE, ITALY

In this contribution, we present some designs showing the possible benefits of the employment of metamaterials in antennas. We show how cloaking devices, commonly used to reduce object observability, may be used to limit the negative effects due to the presence of obstacles in the near-field of an antenna. When going at optical frequencies, we show that metamaterials may be used to design proper screens to enhance the otherwise poor directivity of nano-antennas.

| 09:30 | **Lens Effect in Parallel Plate Waveguide Realized by Using a Metamaterial Surface** | C06P1-4 |

Casaletti, M.; Caminita, F.; Maci, S.
Universita di Siena, ITALY

This paper presents an idea for designing a planar Luneburg lens inside a parallel plate waveguide by using an artificial metamaterial surface. In the present article, the surface is realized by a bed of nails. By modulating the heights of the nails, a variable impedance is obtained on one boundary of the parallel plate thus obtaining an equivalent desired refraction index for the guided wave. The method can be used for designing other kinds of planar lenses.

Session:	**M03: Antenna Design and Measurements**
Type:	Measurement Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 131
Chairs:	S. Burgos
	P-S. Kildal

Time	Title	Abs No
08:30	**Antenna Pattern Correction Using Cauchy-Gauss Modelling**	M03-1

Gonzalez-Ayestaran, Rafael; Leon, German; Loredo, Susana; Las-Heras, Fernando
Universidad de Oviedo, SPAIN

Antenna measurement in a semi-anechoic chamber is always affected by multipath effects. In this paper, Cauchy and Gauss models of the measurement in the time domain and the noise, and the Bayesian estimation theory are applied to identify clearly the direct and reflected waves. Then, it is possible to recover the distortionless radiation pattern removing the reflected waves. Satisfactory results have been found in the comparison between retrieved radiation patterns and the reference ones.

08:50	**Application of Genetic Algorithms to the Manufacturing of Large Planar Array Antennas on Radar Applications**	M03-2

Rengifo, L.[1]; Martin, F.[1]; Torres, J.[1]; Burgos, S.[2]; Sierra, M.[2]; Vera, M.[3]
[1]Indra, SPAIN;
[2]Universidad Politecnica de Madrid, SPAIN;
[3]Universidade de Vigo, SPAIN

A genetic algorithm (GA) is presented to obtain the best arrangement for the linear arrays (previously measured) used for the construction of a large planar array for radar applications. The designed algorithm allows the selection of the frequency and the pointing, furthermore the given weight of the different parameters of the radiation pattern (SLL, directivity**...**). Finally, some results are showed.

09:10	**A Comparison of Fractal Koch Antenna for UHF Band Applications**	M03-3

A Karim, Mohd Nazri[1]; A Rahim, Kamal[1]; Kamarudin, Muhammad Ramlee[2]; Abd Aziz, Muhammad Zoinol[3]
[1]Universiti Teknologi Malaysia, MALAYSIA;
[2]Faculty of Electrical Engineering, Universiti Teknologi Malaysia., MALAYSIA;
[3]Universiti Teknikal Malaysia Melaka, MALAYSIA

The LPFKA with three differences iteration such as 0th, 1st and series have been designed, simulated and fabricated. The size of the antennas have been reduced up to 7% for 1st iteration and reduced up to 26 % for series iteration antenna compared to the 0th iteration. The result such as return loss, radiation patterns of all fabricated antennas are comparable to the simulated patterns. It shows, by applying Koch geometry and different number of iteration to the antenna, the size can be reduced

09:30	**Comparisons of Different Descrambler/ Power Combining Boards Layout for Multi-Port, Decade Bandwidth Eleven Feed.**	M03-4

Yogesh, Karandikar; Kildal, Per-Simon
Chalmers University of Technology, SWEDEN

Eleven feed based on parallel folded dipole log-periodic arrays has four differential ports above ground plane. This paper presents different possibilities of combining these ports below ground plane so as to have two unbalanced ports for orthogonal linear polarizations. Also the various ways of combining balanced and unbalanced LNAs in these boards is discussed.

09:50	**Inset a Novel Cutting Pattern to Reduce the Actuation Voltage of the RF-MEMS Switches**	M03-5

Lotfi Neyestanak, Abbas Ali; Jahanbakht, Mohammad
IRIEE, IRAN, ISLAMIC REPUBLIC OF

In this paper a novel and simple cutting pattern is introduced over the membrane of an RF-MEMS switch which will be shown to considerably decrease the actuation voltage required to bend the membrane by electrostatic force.

10:10	**Verification of a Large Broadband Electronically Scanned Array Aperture**	M03-6

Svensson, B; Jensen, Y
Saab AB, Saab Microwave Systems, SWEDEN

Two large, broadband antenna apertures have been designed, manufactured and tested. The first is a single polarized antenna with tapered notch elements. The second antenna is dual polarized . Both antennas have been designed for 2-18 GHz operation. Measurements of both S-parameters and embedded element patterns have been performed and superposed to active reflection coefficient and full array radiation pattern. Results for the single polarized antenna are presented.

Session:	**A13: Multiband and Wideband Antennas**
Type:	Antennas Session
Date:	Wednesday, April 14, 2010
Time:	08:30 - 10:30
Room:	Room 132
Chairs:	J. Parrón
	B. Monsalve

Time	Title	Abs No
08:30	**Broadband Hexagonal Slotted Microstrip Antenna for Wireless Applications.**	A13-1

Kesavath, Vasudevan; V.P, Sarin; M.S, Nisha mol; d, Tony; C.K, Aanandan; P, Mohanan
Cochin University of Science and Technology, INDIA

A hexagonal slot loaded broadband printed microstrip antenna suitable for wireless communication systems is presented. The broadband operation is achieved by merging the resonances of the slotted antenna using a rectangular metal strip. The proposed antenna has a 2:1 VSWR bandwidth of 45.8% from 4.2 GHz to 6.7 GHz with good radiation characteristics and gain in the entire operating frequency band.

| 08:50 | **Broadband Log-periodical Antenna with Omni-Directional Radiation Pattern in the Horizontal Plane** | A13-2 |

M.P. Aghdam, Karim[1]; Farsi, Saeed[1]; Aliakbarian, Hadi[1]; Faraji-Dana, Reza[2]; A. E. Vandenbosch, Guy[1]; De Raedt, Walter[3]
[1]K.U.Leuven, BELGIUM;
[2]University of Tehran, IRAN, ISLAMIC REPUBLIC OF;
[3]IMEC, BELGIUM

In this paper, a new design for a Log-periodic antenna with omni-directional radiation pattern in the horizontal plane and broad-band characteristics is investigated. This antenna covers the 500 – 3000 MHz band with VSWR < 3:1 and the gain better than 0 dBi with maximum deviation ±1.5 dB in the entire frequency bandwidth.

| 09:10 | **Broadband Printed Cross-Shaped Microstrip Antenna for Multifunctional Wireless Applications.** | A13-3 |

M.S, Nisha mol[1]; V.P, Sarin[1]; D, Tony[1]; C.K, Aanandan[1]; P, Mohanan[1]; Vasudevan, kesavath[2]
[1]Cochin University of Science and Technology, INDIA;
[2]CUSAT, INDIA

A simple electromagnetically coupled broadband printed microstrip antenna suitable for multi-functional wireless communication bands is presented. Ring slot and corner notches are employed in a rectangular patch to achieve compact broadband operation. The proposed antenna has a 2:1 VSWR bandwidth of 33% with good radiation characteristics and gain in the entire operating frequency band

| 09:30 | **Dual and Triple Band Stacked Patch Antenna with Slots** | A13-4 |

Lee, K F[1]; Luk, K M[2]; Mak, T[2]; Yang, S[1]
[1]University of Mississippi, UNITED STATES;
[2]City University of Hong Kong, HONG KONG

It was shown that by cutting one or two U-slots on the patch of an L-probe patch antenna, dual or triple band characteristics can be obtained. This is a specific case of a general technique of designing dual and triple band patch antennas: if one cuts U-slots in the patches of a broadband patch antenna, band notches will be introduced and the broadband antenna becomes a multi-band antenna. In this paper, we applied this technique to coaxial fed and aperture coupled stacked patch antennas.

| 09:50 | **Evaluation of a Wideband Crossed Exponentially Tapered Slot Printed Antenna with Cavity Back for Wireless Access Points.** | A13-5 |

Medeiros, C.[1]; Lima, E.[1]; Costa, J.[2]; Fernandes, C.[1]
[1]Instituto de Telecomunicações/IST, PORTUGAL;
[2]Instituto de Telecomunicações/ISCTE, PORTUGAL

A new wideband antenna for multi WLAN services is presented. The operating bandwidth extends from 2.4 to 4.8 GHz. The design is based upon an ultrawideband antenna altered by the introduction of a rectangular cavity back that allows having a frequency stable unidirectional radiation pattern. The proposed configuration presents linear polarization with cross polarization level below 20dB. The overall size of the antenna is 0.46 × 0.46 × 0.17 of the wavelength at the lower operating frequency.

| 10:10 | **Resonator-Loaded Monopole Antenna with Triple Band Performance for WLAN/WiMAX Applications** | A13-6 |

Gemio, Joan; Parron, Josep; Junkin, Gary
Universitat Autónoma de Barcelona (UAB), SPAIN

This paper presents an asymmetric loaded monopole for applications requiring efficient triple band performance. The design is based on the concept of non resonant traps using two different loading resonators to obtain the triple band performance. As proof of concept an asymmetric triple band monopole for WLAN (802.11) / WiMAX (802.16) systems has been designed, fabricated and measured.

Session: **P04P2: Mobile Channel Modeling 2**
Type: Propagation Session
Date: Wednesday, April 14, 2010
Time: 11:00 - 13:00
Room: Room 113
Chairs: S. Gligorevic
F. Falcone

Time	Title	Abs No
11:00	**Comparing Ray Tracing Based MU-CoMP-MIMO Channel Predictions with Channel Sounding Measurements**	P04P2-1

Fritzsche, R.[1]; Voigt, J.[2]; Jandura, C.[1]; Fettweis, G.[1]
[1]Dresden University of Technology, GERMANY;   [2]Actix GmbH, GERMANY

The need of incorporating MIMO technology into radio network planning rises currently. A question is how accurate MIMO channel models reflect the real channel. A tool to learn about MIMO channels is measurements. A channel model used for network planning purposes is ray tracing. In this contribution, we verify a ray tracing channel simulator by means of channel measurements in the 2.53 GHz range by comparing simulated and measured eigenvalue characteristics for various Multi-User scenarios.

11:20	**Introduction of Radar Techniques in Urban Propagation to Model Far-Field Building Scattering**	P04P2-2

Ouattara, Y.B[1]; Picon, O[2]; Wiart, J[3]; Richalot, E[2]; Mostarshedi, S[4]
[1]ESYCOM Labs, FRANCE;   [2]ESYCOM, FRANCE;
[3]Whist Lab , Orange Labs, FRANCE;   [4]Université Paris-Est , ESYCOM, FRANCE

we propose a method based on bistatic RCS of building facades to model urban propagation. In this method full tree-dimensional approach, bistatic RCS are calculated by combining the Kirchhoff integral and geometrical optics in order to take into account multiple bounces of electromagnetic waves between buildings. This method is suited to be incorporated into ray-tracing codes and accelerate them.The proposed approach is validated through comparisons with Finite Element Method from HFSS .

11:40	**Review and Update of Mobile Data Processing for the LAND MOBILE SATELLITE CHANNEL Modelling**	P04P2-3

Montenegro Villacieros, Belen[1]; Oestges, Claude[2]; Vanhoenacker Danielle, Danielle[2]; Prieto Cerdeira, Roberto[3]; Martellucci, Antonio[3]
[1]Universite Catholique de Louvain, BELGIUM;
[2]Microwave Laboratory, Université Catholique de Louvain, BELGIUM;
[3]ESA/ESTEC, Noordwijk, NETHERLANDS

Measurements from various Land Mobile Satellite and Satellite Aeronautical experimental campaigns have been homogeneously pre-processed and re-analysed in order to derive concise statistical results for submission to ITU-R statistical databanks. A number of problems in the processing steps were identified and various methods were applied to minimise the effect on the results.

12:00	**Simulation of Indor LTE Behaviour**	P04P2-4

Esparza, F; Torres, V; Beruete, M; Lopez, A; Falcone, F
Universidad Publica de Navarra, SPAIN

In this paper, the behaviour of future 4G Long Term Evolution radio channel is simulated in a confined indoor environment. Full 3D raytracing algorithms have been implemented in order to take into account the complexity of the scenario, including material parameters. Received power bidimensional plots as well as modulation scheme results are obtained. These results can aid in the successful implementation of future wireless systems with optimized coverage-capacity considerations

12:20	**A New Physical-Statistical Model of the Land Mobile Satellite Propagation Channel**	P04P2-5

Abele, Anthony[1]; Fontan, F.P.[2]; Bousquet, M.[3]; Valtr, P.[2]; Lemorton, J.[4]; Lacoste, F.[1]; Corbel, E.[5]
[1]CNES, FRANCE;
[2]Universidade de Vigo, SPAIN;
[3]ISAE, FRANCE;
[4]ONERA, FRANCE;   [5]THALES Alenia Space, FRANCE

This paper proposes a physical statistical modelling of the land mobile satellite propagation channel in various types of environments at L- and S-bands. Of particular interest are the land mobile satellite scenarios including buildings and forested areas. This approach aims at modelling the channel in urban, suburban and rural virtual scenarios drawn from statistical distributions of canonical elements representing isolated trees and buildings.

12:40	**UHF/VHF Air-to-Air Propagation Measurements**	P04P2-6

Walter, M.[1]; Gligorevic, S.[1]; Detert, T.[2]; Schnell, M.[1]
[1]German Aerospace Center (DLR), GERMANY;
[2]Rohde & Schwarz GmbH&Co, GERMANY

This paper presents results of air-to-air channel measurements at a center frequency of 250 MHz. The channel characteristic is evaluated in terms of power delay profile, Doppler power profile, delay spread and Doppler spread. According to the results, the channel might be approximated by a two-path channel impulse response whose parameters depend on the aircraft altitudes and on the type of overflown terrain.

Session:	**C29P2: Recent development of antennas and propagation for body-centric wireless communications - 2**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 119
Chairs:	Y. Hao
	P. Hall

Time	Title	Abs No
11:00	**A Subject-Specific Numerical Study in UWB Body-Centric Wireless Communications**	C29P2-1

Sani, A[1]; Hao, Y[1]; Zhao, Y[1]; Lee, S-L[2]; Yang, G-Z[2]
[1]Queen Mary University of London, UNITED KINGDOM;
[2]Imperial College, London, UNITED KINGDOM

The paper presents the numerical analysis of the subject-specificity of the radio channel in Ultra wide-band Body Area Networks (UWB-WBANs), adopting the dispersive finite difference time domain (FDTD) technique. The analysis has been performed in the frequency range 3-10 GHz considering nine homogeneous digital phantoms of different size and gender. The results demonstrate that the received power in on-body links is subject-specific and associated with the body mass index of the subject.

11:20	**Wave Excitation on Human Body by a Short Dipole**	C29P2-2

Akhoondzade-Asl, Lida; Hall, Peter; Nechayev, Yuri
University of Birmingham, UNITED KINGDOM

the propagation mechanism of a short dipole antenna on a flat phantom made of fat and muscle tissue properties is investigated. Both vertical and horizontal dipoles are considered in this study. It is shown that, the performance of a parallel dipole near to the surface of the body phantom is completely different from the free space. The parallel dipole on the body excites stronger fields along the antenna rather than any other directions on the surface.

11:40	**A Hybrid Multiscale FDTD Methodology for Modeling Fine Features In Body-Centric Communication Systems**	C29P2-3

Mittra, R.; Bringuier, J. N.
Penn State, UNITED STATES

The authors use a hybrid FDTD scheme to analyze some fine featured geometries that are applicable to sensor networks occurring in body-centric communication system. This analysis has been carried out using a dipole moment concept and its hybridization with the FDTD algorithm.

12:00	**Link Characteristics between Wearable Antenna and Receivers Equipped on External Objects at MHz Band**	C29P2-4

Ito, K.; Suga, R.; Haga, N.; Takahashi, M.; Saito, K.
Chiba University, JAPAN

A system that recognizes users when they touch the receiver equipped on a wall has been proposed. However, most of the investigations were conducted with models that include only human body and wearable devices. There have been few reports on communication link characteristics between wearable devices and external devices equipped on surrounding objects. In this paper, a model that includes a receiver on a wall was developed, and basic characteristics were numerically analyzed by using FDTD.

12:20	**Simulation of Millimetre-Wave Channels for Short-Range Body to Body Communications**	C29P2-5

Cotton, S.L.[1]; Scanlon, W.G.[2]; Madahar, B.K.[3]
[1]Queen's University of Belfast, UNITED KINGDOM;
[2]Queen's University, Belfast, UNITED KINGDOM;
[3]Defence Science and Technology Laboratory, UNITED KINGDOM

Operating short-range body centric communications at mm-wave frequencies offers a number of benefits, notably data rates in excess of 2Gb/s. However, developing compact, portable, bodyworn channel sounders is challenging at mm-wave. As an alternative to measurement of these channels, we present the simulation of body centric channels using animation software and ray tracing. Using a soldier-to-soldier example, a number of important channel metrics such as rms angle and delay spread are reported.

Session:	**C26P2: Integral equation techniques for large and multiscale challenging problems - 2**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 120
Chairs:	G. Vecchi
	A. Freni

Time	Title	Abs No
11:00	**Helmholtz-Stable Fast Solution of the Combined Field Integral Equation**	C26P2-1

Andriulli, F. P.; Vecchi, G.
Politecnico di Torino, ITALY

This work presents a new fast matrix-vector multiplication scheme for the solution of the Combined Field Integral Equation. Differently from other fast solvers the effectiveness of CFIE preconditioning techniques such as quasi-Helmholtz decompositions or Calderon approaches is maintained by our method even for very high matrix compression rates. Numerical results will show the effectiveness of our approach and its impact on the solution of realistic problems.

11:20	**A GPU Acceleration for FFT-Based Fast Solvers for Integral Equation**	C26P2-2

Francavilla, M. A.[1]; Attardo, E. A.[1]; Vipiana, F.[2]; Vecchi, G.[1]
[1]Politecnico di Torino, ITALY;
[2]Istituto Superiore Mario Boella, ITALY

This paper presents the advantages that GPUs can bring when used in cooperation with the CPU in solving linear systems arising from electromagnetic applications. In particular we show how FFT-based methods for the integral equation can be sped up with very low effort. Two different applications are shown to prove the gain in computational times achieved by the GPU acceleration.

11:40	**LU-Decomposition Based Integral Equation Solver of Linear Complexity and Higher-Order Accuracry for Large-Scale Capacitance Extraction**	C26P2-3

Chai, W.; Jiao, D.
Purdue University, School of Electrical and Computer Engineering, UNITED STATES

A fast LU factorization of linear complexity and higher-order accuracy is developed to directly solve a dense system of linear equations for the capacitance extraction of any arbitrarily shaped 3-D structure embedded in inhomogeneous materials. It successfully factorizes dense matrices that involve more than one million unknowns in fast CPU time and modest memory consumption. Comparisons with state-of-the-art integral-equation-based capacitance solvers have demonstrated its clear advantages.

12:00	**Hybrid SFX/MLayAIM Method for the Analysis and Optimization of Large Reflectarrays and Planar Arrays with Metallic Lenses**	C26P2-4

Bercigli, M.[1]; De Vita, P.[1]; Guidi, R.[1]; Freni, A.[2]; Pirinoli, P.[3]; Matekovits, L.[3]; Vecchi, G.[3]; Bandinelli, M.[1]
[1]IDS Ingegneria Dei Sistemi S.p.A, ITALY;
[2]University of Florence, ITALY;
[3]Politecnico di Torino, ITALY

In this paper, we present a hybrid technique that combines the Synthetic Functions (SFs) method with the MultiLayer Adaptive Integral Method (MLayAIM). The resulting numerical procedure drastically reduces the computational effort needed in the full-wave analysis and optimization of electrically large antennas as reflectarrays and planar arrays with superimposed metallic lenses.

12:20	**A Technique for Solving Multiscale Problems in CEM Utilizing Dipole Moments and Macro Basis Functions**	C26P2-5

Mittra, R.; Bringuier, J. N.
Penn State, UNITED STATES

The authors present a novel dipole moment (DM) approach for constructing the impedance matrix. In addition, it has been hybridized with the FDTD in order to simulate many fine featured geometries.

Session:	**C35P2: Nano-photonic antennas- 2**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 121
Chairs:	N. van Hulst
	P. Burke

Time	Title	Abs No
11:00	**Antennas, transmission lines and resonators at optical frequencies**	C35P2-1

Hecht, Bert[1]; Johannes, Kern[1]; Feichtner, Thorsten[1]; Geisler, Peter[1]; Grossmann, Swen[1]; Biagioni, Paolo[2]; Huang, Jer Shing[2]
[1]University of Würzburg, GERMANY;
[2]Politecnico di Milano, ITALY

Resonant optical antennas, two-wire transmission lines, and related resonators are investigated by FDTD simulations and realized experimentally. Resonant optical antennas exhibit a large local field enhancement which can be used to efficiently launch a quasi-TE mode into a two-wire transmission line. The high reflectivity at an open end of the waveguide inspires the use of short pieces of two-wire transmission line as efficient resonators to enhance light-matter interaction.

11:20	**Near-field mapping of infrared nanoantennas**	C35P2-2

Schnell, M.[1]; Garcia-Etxarri, A.[2]; Huber, A.J.[3]; Crozier, K.B.[4]; Aizpurua, J.[2]; Hillenbrand, R.[1]
[1]CIC nanoGUNE Consolider, SPAIN;
[2]Centro de Fisica de Materiales (CSIC-UPV/EHU) and Donostia International Physics Center (DIPC), SPAIN;
[3]Neaspec GmbH, GERMANY;
[4]Harvard University, UNITED STATES

We demonstrate amplitude- and phase-resolved near-field mapping of nanoantennas by scattering-type near-field optical microscopy. The technique is applied to monitor the evolution of the near-field oscillations of infrared gap antennas progressively loaded with metallic bridges of varying size. Our results provide direct experimental evidence that nanoscale infrared near fields can be controlled by antenna loading, which is in excellent agreement with numerical calculations.

11:40	**Near-field Antenna as a Scanning Microwave Probe for Characterization of Materials and Devices**	C35P2-3

Imtiaz, A.[1]; Wallis, T.M.[1]; Lim, S.H.[1]; Chisum, J.[2]; Popovic, Z.[2]; Kabos, P.[1]
[1]NIST, UNITED STATES;
[2]Computer and Energy Engineering University of Colorado at Boulder, UNITED STATES

The Scanning Microwave Probe (SMP) is emerging as an important broadband metrology tool for characterizing materials and devices in the micron and sub-micron length scales in the frequency range of 10 MHz to 110 GHz. In this document we establish three important characteristics of SMP which include the sensitivity of this tool to the materials properties; the breaking of the ë/2 barrier for spatial-resolution and detection of sub-surface structures under 2 metal layers in an 8-layer CMOS IC.

12:00	**Near-field Electrical Detection of Optical Surface Plasmons and Single Plasmon Sources**	C35P2-4

Koppens, Frank[1]; Falk, Abram L.[1]; Yu, Chun L.[1]; Kang, Kibum[2]; de Leon Snapp, Nathalie[1]; Akimov, Alexey V.[1]; Jo, Moon-Ho[2]; Lukin, Mikhail D.[1]; Park, Hongkun[1]
[1]Harvard University, UNITED STATES;
[2]Pohang University of Science and Technology, KOREA, DEMOCRATIC PEOPLE S REPUBLIC OF

We demonstrate an efficient nanoscale electrical detector for propagating surface plasmons, tightly confined to nanoscale silver wires. Our technique is based on the near-field coupling between guided plasmons and a nanowire field-effect transistor. We demonstrate that this near-field circuit can efficiently detect the plasmon emission from a single quantum dot that is directly coupled to the plasmonic waveguide.

Time	Title	Abs No

11:00 — **A Frequency Switchable Antenna Based on MEMS Technology** — A10P2-1

Vasylchenko, Alexander[1]; Rottenberg, X.[1]; Broze, B. X.[2]; Nuytemans, M.[2]; De Raedt, W.[1]; Vandenbosch, G. A. E.[2]
[1]IMEC, BELGIUM;
[2]K.U.Leuven, BELGIUM

This work presents a suitable topology of a reconfigurable microstrip patch antenna using RF-MEMS devices. The RF-MEMS devices are activated with a bias voltage applied through RF feeding port. The antenna is designed for switching between two frequency bands of 5.25 GHz and 5.6 GHz. A good matching is obtained in both configurations. The antenna realized using only two lithographic steps, what significantly reduces production costs.

11:20 — **A Frequency-Selective U-Koch Monopole-type PCB Antenna for Wireless Applications** — A10P2-2

Ramadan, A.[1]; Kabalan, K. Y.[1]; El-Hajj, A.[1]; Khoury, S.[2]; Al-Husseini, M.[1]
[1]American University of Beirut, LEBANON;
[2]Notre Dame University, LEBANON

A low-cost multiband PCB antenna that employs Koch fractal geometry and reconfigurability is presented. The antenna is microstrip-line fed and has a partial ground plane flushed with the feed line. The proposed antenna is simulated using FEM for two switching conditions and the return loss is measured for each case. The antenna can cover the bands of several applications including 3G, WiFi, WiMAX as well as a portion of the UWB range.

11:40 — **A Novel Frequency/Pattern-reconfigurable Microstrip Antenna For WLAN Applications** — A10P2-3

Ramadan, A.[1]; Al-Husseini, M.[1]; Tawk, Y.[2]; Kabalan, K. Y.[1]; El-Hajj, A.[1]
[1]American University of Beirut, LEBANON;
[2]University of New Mexico, UNITED STATES

The design of a frequency and pattern reconfigurable monopole-type printed antenna is presented. The antenna features a circular patch, a shape-optimized partial ground plane, and two PIN diodes mounted over slots in the ground plane. Depending on the switching scenario, the antenna can offer single-band operation at 5.2 GHz or dual-band operation at 2.4 and 5.2 GHz. The pattern is omnidirectional at 5.2 GHz, and 180-degree switchable at 2.4 GHz.

12:00 — **Application of the Left-Handed Half-Loop Antenna with Wideband Tuning to a Cognitive Radio Terminal** — A10P2-4

Herraiz-Martinez, Francisco Javier[1]; Hall, Peter S.[2]; Segovia-Vargas, Daniel[1]
[1]Carlos III University in Madrid, SPAIN;
[2]University of Birmingham, UNITED KINGDOM

A compact system for future communication terminals (Cognitive Radio) is presented in this paper. This system is based on two antennas printed on the same substrate board. The first antenna is a printed monopole with an omnidirectional radiation pattern which senses the spectrum. The other antenna is a reconfigurable narrowband half-loop antenna based on metamaterial Left-Handed transmission lines which is used for the communication function. The system is designed to operate over a 2:1 BW.

12:20 — **Basic Cell of a Reconfigurable Antenna with Dual Polarization for Wimax Applications** — A10P2-5

Masa-Campos, José Luis; Luzon-Mesas, V.; Lopez-Colino, R.J.
Autonoma University of Madrid, SPAIN

A 8x8 reconfigurable array antenna with dual lineal/circular polarization for WIMAX applications at 3.5 GHz has been designed. The antenna is composed of 4 elements basic cell sub-arrays with a Butler matrix inside. The basic cell sub-arrays are combined by means of digital phase shifters. The measured results of the radiating elements and RF modules are presented.

12:40 — **A Reconfigurable H-Shape Antenna for Wireless Applications** — A10P2-6

AbuTarboush, Hattan[1]; Nilavalan, R.[1]; Nasr, K.[2]; Al-Raweshidy, H.[1]; Budimir, D.[3]
[1]Brunel University, West London, UNITED KINGDOM;
[2]National Physical Laboratory (NPL), UNITED KINGDOM;
[3]Westminster University, UNITED KINGDOM

This paper presents a novel H-Shaped reconfigurable patch antenna fed by a (GCPW) for wireless applications. The uniqueness in the presented antenna design relies in the ability to select the number of operating frequencies electronically by using a varactor diode. The antenna consists of coplanar waveguide input with an H-shape and a varactor diode for reconfigurability. By electronically varying the value of the diode capacitance the antenna can operate in single band dual band or three band.

Session:	**C08P2: Antenna front-ends for radar applications - 2**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 124
Chairs:	I.E. Lager
	P. Knott

Time	Title	Abs No
11:00	**Array Antennas for Passive Covert Radar Applications**	C08P2-1

Coman, Cristian; Gelsema, S.; Stolk, C.
NATO C3 Agency, NETHERLANDS

Antenna arrays suitable for passive covert radar applications are discussed in this paper. The system design requirements are accurately presented and reflected in the array parameters. Direction finding techniques are evaluated in connection with a circular array antenna configuration. Initial theoretic results obtained with a passive covert radar developed at the NATO C3 Agency are presented as well.

11:20	**A Dual-Band Planar Array of Connected Dipoles: Experimental Validation Based on Bistatic RCS Measurements**	C08P2-2

Cavallo, Daniele[1]; Neto, Andrea[2]; Gerini, Giampiero[1]; Morello, Davide[3]
[1]TNO Defence, Security and Safety / Eindhoven University of Technology, NETHERLANDS;
[2]TNO Defence, Security and Safety, NETHERLANDS;
[3]University of Sannio, ITALY

Rigorous equivalent networks for connected arrays in transmission and reception are derived in this paper. These equivalent networks are not based on reciprocity but on Green's functions. Thus, all components have well identified and physically meaningful roles. A dual-band connected array demonstrator is then presented to validate the theory. The matching properties of the array are characterized via radar cross section measurements without resorting to lossy and expensive feeding network.

11:40	**Evolutions in Naval Phased Array Radar at Thales Nederland BV**	C08P2-3

van Werkhoven, G.H.C.; van Aken, R.H.
Thales Nederland BV, NETHERLANDS

The Thales integrated mast concept (I-MAST) for modern naval surface ships comprises of a well-balanced sensor suite with several new radar systems, electro-optical systems and communication antennas in a single integrated mast structure, in which performances are optimized and in which logistic and installation efforts are minimized. In this paper key subsystems of the integrated mast are discussed, together with main developments on the radar front-end hardware.

12:00	**Design of Active Antennas for Airborne Radar Applications**	C08P2-4

Renard, Christian; Barbier, T.; Hérault, J.; Martinaud, J.P.
THALES Aerospace Division, FRANCE

Increase of functions and improvement of performance required on board aircrafts, associated to the limited amount of available areas and volumes to implement the equipments, and with an objective of cost management, drive an approach leading to the reunion of functions operated in various frequency bands, to the reduction of thickness of the antennas and to the standardization of constitutive building blocks. Technical and technology research is being conducted on wideband and multi-band radiating structures, and the overall architecture has to deal with the various requirements, including optimization of performance and reduction of costs.

12:20	**Mutual Coupling and Platform Effects in the Synthesis of passive Coherent Location Radar Array**	C08P2-5

D'Urso, Michele[1]; Bernardi, Gabriella[1]; Farina, Alfonso[1]; Felaco, Maurizio[1]; Meliadò, Ettore Flavio[2]
[1]SELEX Sistemi Integrati, ITALY;
[2]Università Mediterranea di Reggio Calabria, ITALY

An increasing interest in passive surveillance systems can be observed in last period. The key idea, which is also common to other non-radar applications, is to conveniently exploit opportunity signals, as analogue FM transmitters or Digital Video Broadcasters to detect and/or tracking targets.

Session:	**C20P2: Antennas and propagation aspects for multi-gigabit communication in the mm- and submm-waverange - 2**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 125
Chairs:	P. Smulders
	P. Herrero

Time	Title	Abs No
11:00	**Comparison of In-Car UWB and 60 GHz Channel Measurements** Schack, M.; Jacob, M.; Kuerner, T. Technische Universität Braunschweig, GERMANY	C20P2-1

A comparison of UWB and 60 GHz channels inside a car is carried out in this paper. Measurements with a vector network analyzer in the frequency bands of 5-8.5 GHz and 67-70.5 GHz have been carried out and the large-scale and small-scale parameters have been investigated. The results are shown for different antenna configurations as well as for an empty car and a car occupied with persons. Furthermore, a link budget analysis for both systems based on the measurements is carried out.

| 11:20 | **Reflection and Transmission Properties of Building Materials in D-Band for Modeling Future mm-Wave Communication Systems**
Jacob, M.[1]; Geise, R.[1]; Piesiewicz, R.[2]
[1]Technische Universität Braunschweig, GERMANY;
[2]Wroclaw Research Centre EIT+, POLAND | C20P2-2 |

In this paper, wideband reflection and transmission properties of different materials are presented for a frequency range between 110 and 135 GHz. In particular, bistatic reflection profiles and transmission losses are measured for concrete, medium density fiberboard (MDF), gypsum plasterboard and double pane window glass samples. These measurements are compared with simulation results derived using the transfer matrix method.

| 11:40 | **LTCC or LCP, a Comparison using Cavity Backed Slot Antennas with PIN Curtains at 60 GHz**
Dumanli, S.; Paul, D. L.; Railton, C. J.
University of Bristol, UNITED KINGDOM | C20P2-3 |

LTCC and LCP technologies are compared for 60GHz antenna design in terms of antenna polarization purity and efficiency. Cavity backed slot antennas with pin curtain walls are chosen as the antenna element and modelled using the FDTD technique. The performances of the antennas are analysed while changing the substrate used. Substrate losses and conductor losses are calculated and total radiated powers in lossy and lossless cases are studied to reach the final efficiency figures.

| 12:00 | **60 GHz Channel Characterization Using a Scatterer Mapping Technique**
Papio, A.[1]; Grau, A.[2]; Balcells, J.[3]; Romeu, J.[3]; Jofre, L.[3]; De Flaviis, F.[1]
[1]University of California, Irvine, UNITED STATES;
[2]Broadcom Corporation, UNITED STATES;
[3]Technical University of Catalonia, SPAIN | C20P2-4 |

In this paper, a Scatterer Mapping Technique based on a Multi-Frequency Bi-focusing operator with good imaging capabilities is used to characterize the 60GHz wireless channel in an office environment. The measurement data is also processed to extract the effective number of communication channels. The relation between the 60GHz office scatterer map and the effective number of communication channels is highlighted.

| 12:20 | **Correlation on the Object Surface at mm-Wave**
Yoon, YoungKeun
ETRI, REPUBLIC OF KOREA | C20P2-5 |

This article focuses on the propagation characteristics due to the rough surface of the object. On the rough surface, the reflected wave becomes scattered from different positions on the surface. The degree of the scattering depends on the incident angle and on the roughness of the surface in comparison to the wave length. In this article, the roughness degree of the surface was estimated using the novel analysis method based on ray tracing.

Session:	**A11P2: Active and integrated antennas 2**
Type:	Antennas Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 127
Chairs:	R. Baggen
	S. Toutain

Time	Title	Abs No
11:00	**Performances of Transparent Monopole Antennas Versus Meshed Silver Layers (AgGL)**	A11P2-1

HAUTCOEUR, Julien[1]; Colombel, Franck[1]; Castel, Xavier[1]; Himdi, Mohamed[1]; Motta Cruz, Eduardo[2]
[1]IETR - Institut d'Electronique et de Télécommunication de Rennes, FRANCE;
[2]Bouygues Telecom, FRANCE

In this study, a technology based on a meshed silver/titanium bilayer printed on glass substrate is briefly presented. Three transparent monopole antennas made from such a material show very low sheet resistances and high optical transparencies. The performances of these transparent monopole antennas are compared with those of a reference antenna fabricated from a light reflecting silver/titanium film. Transparent antennas provide radiation efficiency better than 85%.

| 11:20 | **A Phase Conjugating Array for Spectrally Efficient Wireless Signal Retransmission** | A11P2-2 |

Marante , R.[1]; Rizo, L.[2]; Cabria, L.[1]; Garcia, J. A.[1]; Marante, F.[2]; Mediavilla, A.[1]
[1]University of Cantabria, SPAIN;
[2]ISPJAE, Havana, CUBA

In this paper, a compact retrodirective array architecture is proposed, capable of responding with a spectrally efficient communication format to an arriving CW interrogation. Taking advantage of a PHEMT transconductance characteristic, an IQ modulation of the incoming signal is here implemented by active gate mixing. With the introduction of digital predistorting functions, a good linearity is assured in the phase conjugated wireless signal restransmission.

| 11:40 | **Antenna Miniaturization and Integration in a 2.4 GHz System In Package** | A11P2-3 |

Jeangeorges, Mickael[1]; Staraj, R.[1]; Luxey, C.[1]; Le Thuc, P.[1]; El Hassani, C.[2]; Ciais, P.[2]
[1]LEAT, FRANCE;
[2]Insight SiP, FRANCE

In this paper, we present a novel technique to miniaturize an Inverted-F Antenna (IFA) by meandering its principal arm in three dimensions on several layers of a LTCC or a laminate FR4 substrate. Satisfactory performance like the coverage of the ISM band is achieved in a first batch of prototypes. Then, the improvement of the miniaturization technique, the integration of the new antenna in a full System in Package (SiP) and its measurement is demonstrated.

| 12:00 | **Microstrip Heatsink Antenna For Integrated RF Transmitters.** | A11P2-4 |

ALNUKARI, Atef[1]; TOUTAIN, Serge[2]; Scudeller, Yves[3]; Guillemet, Philippe[3]
[1]Nantes University, Ecole polytechnique, IREENA Laboratory, FRANCE;
[2]Nantes University , Ecole polytechnique, IREENA Laboratory, FRANCE;
[3]Nantes University , Ecole polytechnique, LGMPA Laboratory, FRANCE

We present In this paper two topologies based on microstrip heatsink antenna with higher thermal performance. No major influences on the electromagnetic performances of the antenna (gain, radiation pattern and return loss) are consequently observed by the presence of different heatsinks. While a higher thermal efficiency is observed to remove thermal dissipated power by promoting heat exchange with the surrounding medium.

| 12:20 | **Miniaturization Techniques Applied to Standard CMOS Technology Integrated Antennas** | A11P2-5 |

Gemio, Joan[1]; Parron, Josep[1]; Sacristan, Jordi[2]; Vila, Fortia[2]; Serra, Francesc[2]; Baldi, Antoni[2]; de Paco, Pedro[1]
[1]Universitat Autónoma de Barcelona (UAB), SPAIN;
[2]Instituto de Microelectronica de Barcelona (IMB-CNM), SPAIN

This paper presents a comparative analysis of the performance offered by classical miniaturization techniques when they are applied to Standard CMOS technology integrated antennas. Top loaded and meandered dipoles are analyzed. It will be shown as the trade off between miniaturization and efficiency levels becomes much more significant due to the high losses of the low resistivity silicon used in Standard CMOS technologies.

Session:	**C11: Portable and body-worn antennas**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 128
Chairs:	D. Atkins
	S. Benham

Time	Title	Abs No
11:00	**A review of the practical limitations of designing antennas for portable applications**	C11-1

Atkins, David
SELEX Communications, UNITED KINGDOM

In this paper a summary is presented of the practical limitations, both electrical and physical, of designing antennas for body-worn and man-portable applications.

11:20	**Parametric Study of Ground Reflections and Diversity Techniques Effect on Body-Worn VHF/UHF Antenna Performance**	C11-2

Alomainy, Akram[1]; Sani, A[1]; Hao, Y[1]; Pettitt, G[2]; Cushnaghan, P[2]
[1]Queen Mary University of London, UNITED KINGDOM;
[2]Defence Science and Technology Laboratory (DSTL), UNITED KINGDOM

The paper presents numerical investigations of various body-worn antennas and their characteristics when placed at different positions on the body in the band 100-1000 MHz. The parametric study conducted includes the use of multiple elements placed at various locations on the body to investigate the effect of diversity on increasing antenna coverage area.

11:40	**Textile Antenna Bending and Crumpling**	C11-3

Bai, Qiang; Langley, Richard
University of Sheffield, UNITED KINGDOM

This paper presents the performance of two pure textile antennas under different bending and crumpling conditions. The characteristics of a wearable microstrip patch antenna is investigated and compared with a dual-band wearable CPW antenna. The input impedance and radiation pattern are investigated based on numerical and experimental methods at 2.4 GHz.

12:00	**A new technique for modeling in-body and on-body antennas**	C11-4

Bringuier, J.N.; Mittra, R.
EMC Lab, Penn State University, UNITED STATES

This paper presents a novel technique using a hybrid FDTD method based on the dipole moment concept for applications relevant to BANs. The authors provide some numerical results for a pin fed patch and a small loop.

12:20	**Preferentially loaded patch antennas for body-borne applications**	C11-5

Hall, M.E.[1]; Totten, E.J.[1]; Atkins, D.P.[2]
[1]SELEX Communications, UNITED KINGDOM;
[2]SELEX Communications, - Not specified -

In this paper a discussion is given of the design of a preferentially loaded patch antenna and its advantages for effective body-borne applications.

12:40	**Coupling and Correlation Reduction in Compact Arrays with Embedded Ground Defects: Experimental Verification**	C11-6

Kakoyiannis, Constantine; Constantinou, P.
Mobile Radio Communications Laboratory, National Technical University of Athens, GREECE

Future applications of sensor networks include multimedia and mobility; sensors must combine small size, large bandwidth, and diversity. Compact arrays suffer from strong mutual coupling, causing lower antenna efficiency, loss of bandwidth, and signal correlation. A method offering multi-decibel coupling suppression, bandwidth recovery, and in-band correlation reduction is verified here. The bandwidth of reference arrays degraded from 38% to 28% with element distance (0.25ë to 0.10ë). Arrays that employ this method increased their BW to 37-45%; measured coupling was reduced by 15-20 dB.

Session:	**C06P2: Metamaterials and plasmonic antennas - 2**
Type:	Convened Session
Date:	Wednesday, April 14, 2010
Time:	11:00 – 13:00
Room:	Room 129
Chairs:	A. Alù
	N. Engheta

Time	Title	Abs No

11:00   **Highly Directive 2-D Leaky-Wave Antennas Based on Double-layer Meta-Surfaces**   C06P2-1

Mateo-Segura, C[1]; Feresidis, A[1]; Goussetis, G[2]
[1]Loughborough University, UNITED KINGDOM;
[2]Queen's University Belfast, UNITED KINGDOM

This paper presents a fast and accurate analysis and synthesis technique for highly directive 2-D Fabry-Perot leaky-wave antennas (LWA) consisting of two periodic metallo-dielectric arrays over a ground plane. Full-wave method of moments (MoM) together with reciprocity is employed for the estimation of the near fields upon plane wave illumination and the radiation patterns of the LWA. Two designs are studied using this rigorous technique, a subwavelength-thickness and a broadband LWA.

11:20   **Small Wideband Antennas Based on Photonic Crystals**   C06P2-2

Volakis, L.; Sertel, Kubilay; Tzanidis, Ioannis
The Ohio State University, UNITED STATES

In this paper we propose an approach for designing wideband metamaterial antennas. Our design is based on the wave-slow down provided by coupled-TL (Transmission Line) sections that emulate anisotropic volumetric media (Photonic Crystals). These sections are used to couple antenna elements arranged in an array, thus leading to very large bandwidths (10:1) even when the array is conformally installed on a ground plane.

11:40   **Tailoring the Nanoantenna Geometry to Improve Efficiency and Bandwidth**   C06P2-3

Alu, Andrea[1]; Engheta, N[2]
[1]University of Texas at Austin, UNITED STATES;
[2]University of Pennsylvania, UNITED STATES

We explore how geometry, size and loading techniques may affect and improve efficiency, bandwidth and sensitivity of various optical nanoantennas. We show how it may be possible to operate various nanoantenna geometries as efficient optical nanoradiators, and how their tuning and matching properties may be tailored with large degrees of freedom by designing suitable nanoloads placed at their gap. High levels of optical radiation efficiency are achieved, by selecting proper design parameters.

12:00   **Nanoparticle chains coupled with surfaces and twisted chains as optical waveguides and antennas**   C06P2-4

Van Orden, D.; Fainman, Y.; Lomakin, V.
UCSD, UNITED STATES

Nanoparticle chains of two types are studied. The first type involves chains coupled with a dielectric slab. Such chains can operate as optical waveguides or antennas radiating surface wave beams. The second chain type involves twisted chains, where asymmetric chain elements are twisted in the transverse of the chain's axis direction. Such chains support slow (bound) or fast (radiated) waves, with properties determined by the twist angle, periodicity, and plasmonic resonance properties.

12:20   **Remote Sensing Structures based on Surface Plasmon Resonances and Carbon Nanotubes**   C06P2-5

Thai, Trang[1]; Haque, Amil[1]; Ratner, Justin[1]; DeJean, Gerald[2]; Tentzeris, Manos[1]
[1]Georgia Tech, UNITED STATES;
[2]One Microsoft Way, UNITED STATES

A sensor structure based on surface plasmon resonance (SPR) and carbon nanotubes (CNTs) is designed and developed. The device is an ultrasensitive wireless sensor operating in microwave frequencies utilizing the gas sensitivity of CNT mixtures. The sensor consists of a corrugated aluminum plate whose surface is periodically covered with a thin layer of the CNT materials. The incident TM-polarized waves on this surface excite the surface plasmon (SP) mode, thus resulting in a drop of power of the reflected wave. The simulations of the SPRCNT- based wireless sensor show a frequency shift of 400 MHz in operation range around 22.5 GHz.

12:40   **Infrared Focusing Mirror Based on Multilevel Reflectarray**   C06P2-6

Ginn, James C.[1]; Alda, Javier[2]; Boreman, Glenn D.[1]
[1]University of Central Florida, UNITED STATES;
[2]University Complutense of Madrid, SPAIN

This contribution shows the first demonstration of a focusing reflectarray working at infrared wavelengths. The principles of design are based on the resonance of sub-wavelength metallic patches, properly sized to produce a given phase shift between the incoming and reflected wave-fronts. The multilevel phase-shifts are arranged following a Fresnel zone scheme. The designed reflectarray is fabricated and tested, showing the expected focusing behaviour.

Session:	**M04: Measurement Imaging, Algorithms and Processing**
Type:	Measurement Session
Date:	Wednesday, April 14, 2010
Time:	11:00 - 13:00
Room:	Room 131
Chairs:	G. Roqueta
	T. Sakamoto

Time	Title	Abs No
11:00	**Time Domain Reflection Technique for Microwave Non Destructive Testing of Steel Fiber Reinforced Concrete**	M04-1

Roqueta, G.; Romeu, J.; Jofre, L.
Universitat Politècnica de Catalunya, SPAIN

Preliminary results of a time domain reflection approach for the non-destructive testing of Steel Fiber Reinforced Concrete (SFRC) are presented. An open-ended epoxy-filled waveguide and a reflector plate are used to measure SFRC effective permittivity. An electromagnetic model based on the Maxwell-Garnett approach is used to relate the effective permittivity of SFRC to its fiber dosage. Agreement with the expected dosage figures is obtained.

11:20	**Subsurface Imaging Method (SSIM) Based on Phase Compensation of Radar Echoes**	M04-2

Zhang, H.; Plettemeier, D.
Dresden University of Technology, GERMANY

In this paper we describe an inversion approach to analyze the data of radar sounders like MARSIS on board Mars Express and SHARAD aboard the Mars Reconnaissance Orbiter. An equivalent light speed model is designed for stratified subsurface structures and a subsurface imaging method is proposed in combination with a reconstruction algorithm for dielectric subsurface profiles. One example of a dielectric profile shown in this paper indicates a stratified Mars subsurface structure.

11:40	**Super-Resolution UWB Radar Imaging Algorithm Based on Extended Capon with Reference Signal Optimization**	M04-3

Kidera, Shouhei[1]; Sakamoto, T[2]; Sato, T[2]
[1]University of Electro-Communications, JAPAN;
[2]Kyoto University, JAPAN

UWB radars have promise for the high resolution radar imaging. As an accurate imaging algorithm, the RPM method has been proposed. This method still suffers from image distortion in the case of a complicated target surface with variation scale less than a pulsewidth. To overcome the problem, this paper proposes a novel Range estimation algorithm by extending Capon method. The result from numerical simulation proves that super-resolution UWB radar imaging is accomplished by using the proposed method.

12:00	**CANCELLED**	M04-4

12:20	**A Method of Estimating a Room Shape using a Single Antenna in a Multipath Environment**	M04-5

Sakamoto, T; Sato, T
Kyoto University, JAPAN

The TR (Time Reversal) method has been employed to realize a simplified radar imaging system with only a single antenna. The TR method requires prior accurate information about the multipath environment. Since this is usually difficult to achieve in practice, we propose a new method to estimate the multipath environment without any calibration, making the TR method practical in estimating target location.

Time	Title	Abs No

11:00   **Effect of Tropospheric Propagation on Ka Band Spaceborne Radar Altimeters**   P05-1

Jeannin, N.[1]; Lemorton, J.[1]; Steunou, N.[2]
[1]ONERA, FRANCE;
[2]CNES, FRANCE

The next generation of spaceborne radar altimeter such as AltiKa or SWOT will make use of the Ka band instead of the formerly used S, C and Ku bands to get a better spatial resolution. As a consequence the signal will be significantly attenuated during its way through the troposphere. The aim of this study is to assess the impact of the tropospheric attenuation on the shape of the returned echoes and on the overall link budget.

11:20   **Free Space Optical Communication Systems: Modeling of Rain Attenuation Effect in Malaysian Environment**   P05-2

Rahman, AK[1]; Soh, PJ[1]; Ahmad, R.B[2]; Aljunid, SA[1]; MS, Anuar[2]
[1]Universiti Malaysia Perlis, MALAYSIA;
[2]Unimap, MALAYSIA

Heavy rainfall rate above 40 mm/hr was observed to produce a high scattering coefficient, β and thus contribute a high atmospheric attenuation, $\tau(R)$. Consequently, increasing the transmitted-receiver distance also contributed to the rise in total attenuation. This condition became worse at extreme heavy rain above 80 mm/hr. This work aims to present the modelling of rain attenuation for an FSO system and examine its performance in bad weather conditions.

11:40   **Outage Analysis of a Millimeter Wave Triple-Hop Configuration with Arbitrary Position of the Relay Nodes**   P05-3

Sakarellos, Vasileios; Chortatou, Maria; Skraparlis, Dimitrios; Panagopoulos, Athanasios; Kanellopoulos, John
National Technical University of Athens (NTUA), GREECE

Multi-hop transmissions require large bandwidth to support increased data rates leading to the use of frequencies above 10 GHz, where rain attenuation is the dominant fading mechanism exhibiting spatial inhomogeneity. The outage performance of a triple-hop regenerative system is derived using the trivariate lognormal distribution considering spatially correlated fading channels. Numerical results show the impact of operational, geographical and geometrical parameters on the system performance.

12:00   **Route Diversity Characteristics on Two 38 GHz Star Terrestrial Paths**   P05-4

Kvicera, Vaclav; Grabner, Martin
Czech Metrology Institute, CZECH REPUBLIC

The cumulative distributions of attenuation due to all combined hydrometeors obtained on two 38 GHz star terrestrial paths over a 5-year period are presented. These distributions are compared with distributions calculated in accordance with the relevant ITU-R recommendation. The deduced route diversity characteristics are given.

12:20   **Outage Performance of Terrestrial Radio Communication Networks Operating Above 50GHZ: Impact of Rain Attenuation**   P05-5

Sakarellos, V.; Skraparlis, D.; Panagopoulos, A. D.; Kanellopoulos, J. D.
National Technical University of Athens, GREECE

A combined physical raincell model taking into account both the stratiform and the convective structure of the rainfall medium is studied for extremely high frequencies. Moreover, the impact of the spatial inhomogeneity parameter on rain attenuation exceedance prediction is investigated and the outage probability of a dual branch receive diversity system, and a dual-hop system, is calculated using the bivariate lognormal distribution.

12:40   **Long-Term Measurments of Slant-Path Propagation at 20 GHz in Madrid**   P05-6

Riera, Jose M[1]; Garcia-Rubia, J M[2]; Garcia, P[3]; Benarroch, A[3]
[1]Universidad Politécnica de Madrid, SPAIN;
[2]Universidad de Jaen, SPAIN;
[3]Universidad Politecnica de Madrid, SPAIN

A propagation experiment is being carried out in Madrid, Spain, with the objective of characterizing the propagation channel in the Ka-band downlink sub-band. Propagation results can be related to meteorological data obtained from co-located instruments. Results obtained from the first three years of the experiment are presented in this paper. Being rain attenuation the main propagation impairment in Ka-band, its effects are analyzed in more detail.

Session: **C37: Antenna development in Latin America**
Type: Convened Session
Date: Wednesday, April 14, 2010
Time: 14:30 - 16:10
Room: Room 121
Chairs: O. Martynyuk
M. Sierra Perez

Time	Title	Abs No

14:30 — Design of a Planar Antenna with Wide Pattern and Impedance Bandwidth — C37-1

Suárez, C.[1]; Rodriguez, R.[2]
[1]Universidad Sergio Arboleda, COLOMBIA;
[2]Universidad Distrital Francisco José de caldas, COLOMBIA

This paper presents a PIFA design, using capacitive feed technique. The antenna shows a measured wide pattern and impedance bandwidth of about 65.04% (1,66GHz to 3,26GHz), for VSWR less than 2.0 and 13.51% (3,45GHz to 3,95GHz). A constructed prototype is enough to simultaneously cover: DSC 1800, DSC 1900, UCDMA, UMTS, IMT 2000, DMB, Wi-Fi, 2,4GHz, WiMAX (2,3 to2,5 GHz) and (3,4 to 3,5 GHz) and Bluetooth systems. Radiation patterns are reasonably omnidirectional.

14:50 — Ongoing research and development on antennas in Brazil — C37-2

Assis, M. S.[1]; Dias, M H C[2]; Santos, J C A[2]
[1]Universidade Federal Fluminense, BRAZIL;
[2]Instituto Militar de Engenharia, BRAZIL

This paper presents an overview of the ongoing research and development on antennas in Brazil. The main Brazilian research groups on the field of Antennas are listed, indicating their respective recent main contributions in the open literature. Furthermore, this work summarizes a few results of the authors on analysis and design of antennas for HF tactical communications and low power UHF/SHF electronic warfare.

15:10 — Aerotransported Radar Antenna for Oil Spills Monitoring Antennas and Propagation — C37-3

Alves, A. M. P.; Duplat, D. N.; Oliveira, L. P.; Hernandez-Figueroa, H. E.
UNICAMP, BRAZIL

This work presents an antenna array design for monitoring oil spills on ocean surface operating within X-band. Its feed system comprises coupling slots and metallic coupling tuning ridges designed to individually control the signal amplitude of each antenna module and form the squared cosecant profile. The tuning ridges introduce two degrees of freedom to control the amplitude in each module. Phase is individually controlled by capacitive or inductive irises.

15:30 — Enhancement of H-Plane Scanning Characteristics in Beam-Steering Grids — C37-4

Martynyuk, Alexander E.[1]; Iturri-Hinojosa, Alejandro[1]; Martynyuk, Ninel A.[2]
[1]UNAM, MEXICO;
[2]KPI, UKRAINE

Scanning characteristics of RADANT-type lens are improved in H-plane with introducing additional shunts that reduce a mutual influence between the lens elements. Numerical simulations reveal that three-bit RADANT-type lens can ensure the scanning sector in H-plane up to 30º and in E-plane up to 90º with conversion coefficient better than -3.5dB in the frequency range from 9.5 to 10.5GHz.

Time	Title	Abs No
14:30	**True Polarization Diversity for Non-Isotropic Fading Scenarios**	C02P1-1

Valenzuela-Valdes, Juan Fco[1]; Sanchez-Heredia, Diego[2]; García-Fernandez, Angel[2]
[1]EMITE ING, SPAIN;
[2]UPCT, SPAIN

The full potential of TPD is evaluated with measurements and compared to conventional orthogonal polarization diversity (OPD). MIMO system performance with respect to capacity and diversity gain is obtained through the use of multimode-stirred chambers for both isotropic and non-isotropic environments. Likewise, it has been demonstrated that TPD can be effectively combined with spatial diversity to nearly double the diversity gain and MIMO capacity for the same available handset volume

14:50	**On Small Antenna Measurements in a Realistic MIMO Scenario**	C02P1-2

Yanakiev, B.[1]; Pedersen, G.F.[2]; Nielsen, J[2]
[1]Molex Interconnect Denmark, DENMARK;
[2]Aalborg University, DENMARK

The paper presents a method for measuring small terminal antennas with a non-galvanic optical fiber link. A small device, easily fitted in a mobile phone prototype is developed. The device is shown to solve the "conductive cable problem" and provide reliable radiation pattern results. Also a large scale channel sounding measurement campaign is described utilizing multiple optical devices integrated into a range of handsets. Various use cases have been considered.

15:10	**Reactive Near-Field Multiplexing and Reliable Diversity Communication Method**	C02P1-3

Kwon, D.-H.
University of Massachusetts Amherst, UNITED STATES

A previously unrecognized dimension for wireless communication channel multiplexing is presented and the associated new multiplexing technique is introduced. The electric and magnetic field components of an electromagnetic wave are utilized as separate channels in the near-field range of a transmitting array comprising a crossed pair of electric and magnetic dipoles. A multiplexing gain can be obtained in free space in the absence of scattering.

15:30	**A Novel Green Multi-antenna Topology for Concurrent 4G Cellular and RFID-enabled Wireless Sensor Data Bundling**	C02P1-4

Tentzeris, Manos[1]; Traille, Anya[1]; Katsibas, Konstantinos[2]; Konstas, Zissis[1]
[1]Georgia Tech, UNITED STATES;
[2]COSMOTE Mobile Telecommunications, GREECE

A novel "Z-shaped" antenna optimized for RFID 860-960MHz and 4G 2.3-2.4 GHz is presented. The antenna is printed on paper substrate, providing the advantages of being lightweight, conformal, flexible and environmentally friendly. The proposed approach could enable the efficient data bundling of RFID-enabled wireless sensors utilizing the high-data-speed of 4G technologies for the development of ubiquitous telemedicine and "Internet of things" application

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Time	Title	Abs No
14:30	**Analysis of Multi-Slot Microstrip Patch Antennas using Neural Networks**	A15P1-1

Mendonca, L; Assuncao, A; Araujo, W
UFRN, BRAZIL

This paper presents a study of implementation procedures for characterization of multi-slot microstrip patch antennas used for wireless communication. An artificial neural network multilayer perceptron is used to locate the bands of operational frequencies of the antenna for different geometrics configurations. The antenna is projected, simulated and tested in laboratory. The results obtained are compared in order to validate the performance of the antennas and that resulted in a good agreement.

| 14:50 | **Helix Antenna with Parasitic Element for Axial Ratio** Improvement | A15P1-2 |

Werker, Stephan; Kronberger, R.; Wienstroer, V.
Cologne University of Applied Sciences, GERMANY

In this paper we present a classical circularly polarized helix antenna. The axial ratio of this antenna is improved by a new method using a parasitic element. We describe the effectiveness of this element for various shapes and placements. Finally, we demonstrate the results on a six turn helix antenna.

| 15:10 | **Balanced Antenna Structures of Mobile Terminals** | A15P1-3 |

Ilvonen, J.; Holopainen, J.; Kivekas, O.; Valkonen, R.; Icheln, C.; Vainikainen, P.
[2]Aalto University School of Science and Technology, FINLAND

In this paper the feasibility of balanced antenna structures in the mobile terminal environment has been investigated concerning bandwidth and radiation properties. It has also been studied if the effect of the user's hand on frequency de-tuning and decrease in radiation efficiency could be reduced with the balanced antenna structures compared to the traditional antenna structures. In addition, emphasis has been put on the SAR and HAC performance of balanced antenna struct

| 15:30 | **Mutual Coupling between Multiple-Band Antennas on Small Ground Plane** | A15P1-4 |

Chen, Z. N.[1]; Yang, F.[2]; See, Terence S. P.[1]
[1]Institute for Infocomm Research, SINGAPORE;
[2]National University of Singapore, SINGAPORE

The mutual coupling of planar inverted F-antennas on a small ground plane is investigated. Dual band 900MHz+1800/2000MHz PIFA, 2.4 GHz PIFA and 4.9-5.9GHz PIFA were used in the study. These antennas were placed on the 120mmx50mm ground plane in different orientations. From simulations that were validated by measurements, it has been observed that the mutual coupling becomes quite significant when antennas were placed very near to each other, even when they were operating at different bands.

| 15:50 | **Rigorous Design of RF Multi-Resonator Power Harvesters** | A15P1-5 |

Costanzo, A.; Donzelli, F.; Masotti, D.; Rizzoli, V.
University of Bologna, ITALY

An integrated design methodology to predict the real RF to DC conversion capability of power harvesters is tackled. By combining nonlinear harmonic-balance-based analysis with electromagnetic simulation the method is able to compute the actual RF power at the rectifier input in general operating conditions. The effectiveness of the method is demonstrated through the comparison between computed and experimental performance of a multi-band circularly polarized rectifying antenna (rectenna)

Session:	**We-Poster Session A5: Antenna Modeling**	
Type:	Poster	
Date:	Wednesday, April 14, 2010	
Time:	14:30 - 16:10	
Room:	Foyer 2	
Chairs:	A.K. Skriverik	
	J. Anguera	

Time	Title	Abs No
14:30	**Internal Planar Loop/Monopole Combo Antenna for Eight-Band LTE/GSM/UMTS Porationn in the Laptop Computer**	We-1

Wong, K.-L.; Kang, T-.W.
National Sun Yat-sen University, TAIWAN

An internal laptop computer antenna capable of generating two wide bands to respectively cover the LTE700/GSM850/900 and GSM1800/1900/UMTS/LTE2300/2500 operation is presented. The antenna occupies a size of 85 x 10 x 4 mm3 along the top edge of the laptop display. The antenna is a printed loop/monopole combo antenna formed by a 0.25-wavelength printed loop and a printed monopole. The combo antenna leads to reduced size yet wide bandwidth to cover the eight-band LTE/GSM/UMTS operation.

14:30	**Frequency Reconfigurable Vivaldi Antenna**	We-3

Hamid, M.; Hall, P. S.; Gardner, P.; Ghanem, F.
University of Birmingham, UNITED KINGDOM

A novel Vivaldi antenna with a capability to operate in wideband or narrowband operations is presented. Four pairs of switchable ring slots were introduced to change the wideband properties into narrower pass bands. A wideband of 1 – 3.2 GHz and three narrowband operative states were achieved.Experimental results on a prototype antenna with pin diodes switches fully demonstrate the performances of the proposed designs.

14:30	**Frequency-Tunable Mobile Phone Antennas with Matching Circuits**	We-5

Liu, L.; Langley, R.J.
University of Sheffield, UNITED KINGDOM

In this paper results of a study of two antenna tuning techniques are presented. The first antenna is a dual-port antenna which is comprised of two capacitive-fed plates sharing one lower-band patch, operating at 5 mobile phone bands. The third port incorporating matching circuits will also be presented covering 2400–3600MHz. The second antenna is a compact single-port PIFA antenna with a tunable matching network, enabling the impedance bandwidth to gradually operate at the DVB-H band.

14:30	**Application of Characteristic Modes Analysis in the Design of Multi-Access Antennas for an Opportunistic Radio System**	We-7

EL HAJJ, W.; GALLEE, F.; PERSON, C.
Lab-STICC - Telecom Bretagne, FRANCE

A new design method for multi-access antennas is presented. This method is based upon characteristic modes analysis assuming the microstrip antennas as a resonant cavity, independently of its geometry. The principle is illustrated by the design of a multi-ports hexagonal patch for opportunistic systems. Two access ports are positioned, and the spatial distribution of the two excited modes are accurately analysed for recovering perfect matching and isolation conditions at the same frequency band.

14:30	**Frequency Agile Small Smart Antenna**	We-9

Liu, Haitao[1]; Gao, Steven[1]; Loh, Tian Hong[2]
[1]University of Surrey, UNITED KINGDOM;
[2]National Physical Laboratory, UNITED KINGDOM

In this paper, a frequency agile small smart antenna composed of ESPAR antenna is presented. The frequency agile range from 2.3GHz to 2.6GHz is examined in terms of return loss, antenna gain and radiation pattern. Proposed frequency agile smart antenna is electrically small in size. Tightly coupled top-disk loaded monopole and folded monopoles are used to reduce height of ESPAR antenna. Proposed antenna reports a maximum gain of 4.0dBi. Beamforming can be achieved by tuning reactive loads.

14:30	**How much can be reduced the internal FM antenna of mobiles phones?**	We-11

Borja, Carmen[1]; Anguera, Jaume[2]; Puente, Carles[3]; Verges, Jordi[3]
[1]FRACTUS, S.A., SPAIN;
[2]FRACTUS, SPAIN;
[3]FRACTUS, S.A, SPAIN

The paper introduces both a new internal FM antenna for mobile phones based on the fractal Hilbert curve, and a new evaluation criterion for quantifying the quality of the signal received by the FM antenna of mobile phones. The main attribute of the new internal FM antenna is its reduced size. Despite the lower level of the power received by the internal FM antenna, the evaluation criterion guarantees to listen to the FM radio channels clearly without noise nuisance and without interferences.

14:30   **Evaluation of Array Calibration Methods for DOA Estimation in Presence of Ground, Mutual Coupling and Near Zone Objects**   We-13

Mirkamali, A.[1]; Nateghi, J.[2]; Hadidian, H.[3]
[1]Zanjan University, IRAN, ISLAMIC REPUBLIC OF;
[2]Iran University of Science and Technology, IRAN, ISLAMIC REPUBLIC OF;
[3]Iran Telecommunication Research Center, IRAN, ISLAMIC REPUBLIC OF

It is shown that the calibration method based on the signal subspace approach cannot estimate the DOA when the angle of the signals varies in a wide range of azimuth angles. Also it is shown that the ground reflections and near zone objects have remarkable effect on the calibration methods which are based on the actual radiation patterns of the array elements. In fact, changing the distance of the array from the ground plane and scattering objects destructs the array calibration.

14:30   **A design guide for Co-Siting and sharing of mobile radio access network resources**   We-15

Romo, Juan Antonio[1]; Del Portillo, Álvaro[2]; Fernández Anitzine, Ignacio[3]
[1]University of The Basque Country, SPAIN;
[2]Services Engineer at Ericsson, SPAIN;
[3]University of the Basque Country, SPAIN

Co-siting solutions of Mobile Radio Acces Networks resources leading to the operators to use the existing equipment, minimizing visual impact and reducing costs. In this paper, a proposal for a standardized co-siting design guide is described. It is based on the specifications and recommendations given by the 3GPP forum and the ETSI. The main goals is to promote co-sited solutions for the operators and provide the technical staff with a well defined guide of design.

14:30   **Power and Rate Adaptation in Body-Area Networks**   We-17

Ghanem, Khalida; Hall, P.s.
University of Birmingham, UNITED KINGDOM

This paper investigates the power and rate allocation policy in body-area-networks (BANs) when using MIMO antenna arrays. The on-body channel model which considers different propagation mechanisms in different spatial subchannels is derived by using the measured statistical parameters. At low SNR range, the discrete and continuous schemes yield similar spectral efficiency performance. Also, the achievable Shannon capacity is lower than the equivalent Rayleigh channel.

14:30   **Widely Tunable Multiband Reconfigurable Patch Antenna for Wireless Applications**   We-19

AbuTarboush, Hattan[1]; Nilavalan, R.[1]; Nasr, K. M.[2]; Al-Raweshidy, H.[1]; Budimir, D.[3]
[1]Brunel University, West London, UNITED KINGDOM;
[2]National Physical Laboratory NPL, UNITED KINGDOM;
[3]Westminster University, UNITED KINGDOM

A design of a low profile reconfigurable microstrip patch antenna is presented. The antenna consists of four sup-patches connected to one feed line, each sub-patch generates a single band. By placing a variable capacitor at the input of the sub-patches, the impedance matching frequency of the antenna can be tuned over a wide range starting from 0.92 GHz to 2.98 GHz with total tunability rang of 2060 MHz.

14:30   **CRLH Leaky Wave Antenna with Tunable Polarization**   We-21

Piazza, D.; D'Amico, M.; Capacchione, M
Politecnico di Milano, ITALY

A novel reconfigurable leaky wave antenna that takes advantage of the characteristics of Composite Right Left Handed (CRLH) materials to achieve polarization reconfigurability is presented in this paper. The antenna polarization can be continuously changed from linear to circular varying the propagation constant of the CRLH transmission line while radiating in broadside direction.

14:30   **Solid Reconfigurable Reflector Antenna by Means of Few Mechanical Actuators**   We-23

Graña, M.; Arias, A. M.; Rubiños, J. O.; Varas, F.; Rivas, D.
Universidad de Vigo, SPAIN

This communication presents a realistic method for designing reconfigurable reflectors for satellite applications that can modify its coverage in a local way using only a few mechanical actuators. An example of a reflector made of honeycomb sandwich panel with nine actuators is presented.

14:30   **Capacitively Fed Annular Ring Microstrip Antenna with Reconfigurable Circular Polarisation**   We-25

Debogovic, T.; Bartolic, J.
University of Zagreb, CROATIA

A single fed polarisation reconfigurable antenna that can provide orthogonal circular polarisations is presented in this paper. The antenna consists of an annular ring that is excited capacitively in positions which enable orthogonal modes. Correct phase conditions are provided by an incorporated feeding network located on the bottom side of the antenna ground plane. The feeding network employs four pin diodes which enable switching between RHCP and LHCP.

14:30 **Reconfigurable Printed Aantenna for a Wideband Tuning** We-27
Hossain, M. G. Sorwar; Yamagajo, Takashi
Fujitsu Laboratories Ltd, JAPAN

A reconfigurable printed antenna is proposed that combines a tunable monopole and an adjustable loop antenna. The loop section controls a tuning operation for an upper frequency band while the monopole part contributes to a tuning for a lower frequency band of the antenna. It has been analyzed through simulations and measurements that the proposed antenna can operate for a tuning range as wide as 700MHz to 6GHz.

14:30 **Design of Two Way Multiantenna AF Relay Systems Under Perfect CSI** We-29
Taniguchi, T.; Karasawa, Y.; Nakajima, N.
The University of Electro-Communications, JAPAN

This paper presents design methods of two way AF (amplify and forward) relay systems equipped with multiantenna assuming perfect knowledge of CSI (channel state information). A simple SVD (singular value decomposition) based method using separable relay weights and an iterative design based on maximum SINR (signal to interference plus noise ratio) criterion adopting nonseparable relay weights are considered. Throught computer simulations, their peformances under fading channels are investigated.

14:30 **A Systematic Method to Design Broadband Matching Networks** We-31
Andujar, A.; Anguera, J.; Puente, C.
Fractus, SPAIN

The narrow BandWidth associated to small antennas can be enhanced by the addition of a matching network. A systematic method for broadening the BW of handset antennas is proposed. In order to develop the proposal, a mathematical analysis is carried out using a simple electrical model and the theoretical results are validated through simulations and by an experimental process. The method described herein ensures one half of Fano's limit BW increment through a simple and methodic matching design.

14:30 **Mitigation of Finger Loading Effect in Handset Antennas** We-33
Anguera, J.[1]; Andujar, A.[1]; Puente, C.[1]; Camps, A.[2]; Picher, C.[1]
[1]Fractus, SPAIN;
[2]Universitat Ramon Llull, SPAIN

The effect of the human body over the radiation of handset antennas is a critical issue that has to be considered to ensure a good handset antenna performance. Among the human body effect, the finger is of particular interest since it is usually placed over the antenna area which may cause detuning and/or reduction of the efficiency. To mitigate the finger loading effects, a novel handset antenna consisting of two small antennas distributed along the ground plane is proposed.

14:30 **A Pattern Reconfigurable Slot Antenna with Hybrid Feed** We-35
John, Matthias; Ammann, Max J; Shynu, S.V.
Dublin Institute of Technology, IRELAND

In this paper we investigate the design and operating principle of a pattern reconfigurable multi-mode slot antenna with a hybrid feed. The slot antenna is excited by an orthogonal arrangement of a co-planar waveguide (CPW) fed circular disc and a microstrip fed square patch. The design objective is to be able to change the direction of the main lobe by feeding the two orthogonal elements with different phases.

14:30 **Non Iterative Subreflector Shaping for Reflector Antenna Distortion Compensation** We-37
Gonzalez-Valdes, Borja[1]; Martinez-Lorenzo, J. A.[2]; Rappaport, C.[2]; G. Pino , A.[1]
[1]Universidad de Vigo, SPAIN;   [2]The Gordon CenSSIS, Northeastern University, UNITED STATES

The behavior of the distorted reflector antennas can be improved by using different techniques to compensate the reflector distortions. This paper presents a new non iterative approach to synthesize shaped subreflectors to achieve such a compensation. The method is not based in any optimization nor repeated calculation process, achieving low calculation times when applied to large antennas.

14:30 **High Isolation Compact Four-port MIMO Antenna Systems with Built-in Filters as isolation structures** We-39
Li, H[1]; Xiong, J[1]; Ying, Z[2]; He, S[3]
[1]Zhejiang University, CHINA;
[2]Sony Ericsson Mobile Communications, SWEDEN;
[3] Division of Electromagnetic Engineering,, SWEDEN

A built-in filter method is proposed to enhance the isolation level between closely packed MIMO antennas. The filter is composed of several slits etched on the ground of antenna structure. The number and length of slits depend on both the resonance frequency and the structure of the MIMO antenna system. To illustrate its usefulness, two designs of compact planar four-port MIMO antenna systems are proposed. In both cases, with the built-in filters, the isolation level can be improved by 10dB.

14:30 **Multi-Port Frequency-Reconfigurable Antenna Optimization** We-41
Araque Quijano, Javier Leonardo; Vecchi, Giuseppe
Politecnico di torino, ITALY

This work deals with the automated optimization of highly functional antennas as required for advanced mobile terminals. The focus is on multi-port antennas since these devices afford appealing capabilities such as as diversity gain and/or simplified duplexing (isolation of different operation bands) at the cost of a significantly stronger challenge with respect to the single port case.

14:30   **On Diversity Performance of Two-Element Coupling Element Based Antenna Structure for Mobile Terminal**   We-43

Abdullah Al-Hadi, Azremi[1]; Toivanen, Juha[1]; Laitinen, Tommi[1]; Vainikainen, Pertti[1]; Jamaly, Nima[2]; Chen, Xiaoming[2]; Carlsson, Jan[2]; Kildal, Per-Simon[2]; Pivnenko, Sergey[3]
[1]Aalto University School of Science and Technology, FINLAND;
[2]Chalmers University of Technology, SWEDEN;
[3]Technical University of Denmark, DENMARK

This paper presents a diversity analysis of a two-element antenna structure based on coupling element antenna concept on mobile terminal in isotropic (statistically uniform) propagation channel by simulation and two different measurement techniques, i.e. ideal free space line-of-sight environment (anechoic chamber) using spherical near-field technique and inside reverberation chamber.The results show that the diversity performance can be estimated accurately using both measurement techniques.

14:30   **Active MIMO Performance Measurements in Connected Reverberation Chambers**   We-45

Orlenius, Charlie[1]; Franzén, Magnus[1]; Aijaz, Naveed[2]
[1]Bluetest, SWEDEN;
[2]Chalmers University of Technology, SWEDEN

In this paper a fast and repeatable way of characterizing active, MIMO-enabled wireless communication units is presented. The measurement setup utilizes two connected reverberation chambers, which introduces the possibility of controlling the wireless channel in detail. Throughput is used as performance metric, and will in this case include the effect of the antenna array on the total performance.

14:30   **Design and Analysis of an UTeM antenna**   We-47

Misman, Dalila; Abd. Aziz, Mohd Zoinol Abidin; Husain, Mohd Nor
Universiti Teknikal Malaysia Melaka, MALAYSIA

Meander line antenna design with parasitic element was investigated. The overall antenna design structure referred to the UTeM logo. This antenna has been designed to operate at 2.4GHz which are specified by IEEE 802.11b/g for WLAN. The antenna designed has been done for both microstrip and planar type. Microwave Studio CST Microwave Office software was used for the simulation processed. The antenna was fabricated on a double-sided FR-4 printed circuit board.

14:30   **Genetic Algorithms for Synthesis of Radiation Patterns in Ring-Reconfigurable Reflectors**   We-49

Gutierrez-Rios, Julio[1]; Vassal'lo-Sanz, J[2]
[1]Facultad de Informatica - Universidad Politecnica de Madrid, SPAIN;
[2]Universidad Politecnica de Madrid, SPAIN

The purpose of this paper is to present a family of algorithms to synthesize a desired radiation pattern by means of Ring Reconfigurable Reflectors (RRRs). A so-called Ring Configurable Reflector (Fig. 1) consists of a set of flat coaxial rings with a degree of freedon in z-axis in order to be able to configure any discretized profile of reflector with central revolution symmetry. Rings only should be shifted in a maximum of $\lambda/2$, that is, the Fresnel level.

14:30   **Optically Reconfigurable RF Circuits**   We-51

Draskovic, D[1]; Christodoulou, C[2]; Budimir, D[1]
[1]University of Westminster, UNITED KINGDOM;
[2]2University of New Mexico, UNITED STATES

In this paper, two novel concepts that use optically reconfigurable RF circuits are presented. In the first example, a Silicon switch was implemented in the input matching network of a power amplifier. The silicon gap-loaded switch properties were changed from insulator state to near conducting state under illumination and resulted in the change of the effective length of the stub in the input matching network, while the output matching network was not changed.

14:30   **Element Position Error Compensation in Active Phased Array Antennas**   We-53

Svensson, B[1]; Lanne, M[2]; Wingard, J[3]
[1]Saab AB, Saab Microwave System, SWEDEN;
[2]Saab AB, Saab Microwave Systems, SWEDEN;
[3]Saab Microwave Systems, SWEDEN

A backtransform method for correcting active phased array antenna position errors has been evaluated. An equivalent set of excitations is computed from the measured far-field and compared to the ideal excitations. The difference is corrected for and an improved radiation pattern is obtained. A number of simulations with different errors have shown that the sidelobe level can be considerably improved.

Session:	**We-Poster Session A6: Large Antennas**
Type:	Poster
Date:	Wednesday, April 14, 2010
Time:	14:30 - 16:10
Room:	Foyer 2
Chairs:	F. Torres
	A. Cardama

Time	Title	Abs No

14:30   **Improved Butler Matrix Configuration for Smart Beamforming Operations**   We-2

Gotsis, K. A.[1]; Kyriacou, G. A.[2]; Sahalos, J. N.[1]
[1]Aristotle University of Thessaloniki, GREECE;
[2]Democritus University of Thrace, GREECE

The authors propose a Butler Matrix (BM) based beamforming network that feeds a linear antenna array. A BM 8×8 is integrated with a specific Switching Network (SN) and a group of Switched-Line Phase Shifters (SLPS). The resulting configuration provides enhanced beamforming flexibility compared to a Switched Beam System (SBS) fed by a typical BM. Thus, a smart beamforming structure can be designed that combines the simplicity of a SBS with some of the advantages of an Adaptive Array System (AAS).

14:30   **An ITD Formulation for the Double Diffraction by a Pair of Wedges Illuminated by an EM Complex Source Point Expansion**   We-4

Canta, S.M.[1]; Erricolo, D.[1]; Toccafondi, A.[2]
[1]University of Illinois at Chicago, UNITED STATES;
[2]University of Siena, ITALY

In this work we discuss an Incremental Theory of Diffraction (ITD) formulation for the double diffraction by a pair of wedges illuminated by a Complex Source Point (CSP) expansion. Numerical results and comparisons with MoM will also be shown.

14:30   **Performance Comparison of Corrugated and Smooth-Walled Spline-Profile 31.3-45 GHz Horns for ALMA**   We-6

Granet, Christophe[1]; Mena, P.[2]; Zorzi, P.[2]; Davis, I.M.[1]; Kot, J.S.[1]; Pope, G.[1]
[1]BAE Systems Australia Ltd, AUSTRALIA;
[2]Electrical Engineering Department, Universitad de Chile, CHILE

The performance of an optimized corrugated horn is compared with that of an optimized smooth-walled spline-profile horn for the 31-3-45 GHz band for ALMA.

14:30   **Circularly Polarized Electronically Steerable Parasitic Array Radiator for Satellite Communication**   We-8

Liu, Haitao[1]; Gao, Steven[1]; Loh, Tian Hong[2]
[1]University of Surrey, UNITED KINGDOM;
[2]National Physical Laboratory, UNITED KINGDOM

This paper presents a circularly polarized electronically steerable parasitic array radiator (ESPAR) antenna. Its parasitic array is composed of reconfigurable periodic structures. By this novel structure, the radius of ESPAR antenna has been significantly reduced. The driven element is a proximately coupled circular path antenna, which connected with RF source. Parasitic array is controlled by PIN diode. There is no phase shifters employed for patter steering.

14:30   **Advanced Antenna of Microwave Imager/Sounder for Spacecraft "Meteor-M"**   We-10

Cherny, I.V.[1]; Chernyavsky, G.M.[1]; Gorobets, N.N.[2]
[1]Science and Technology Center for Space Monitoring of Earth, Russian Institute of Space Device Engin, RUSSIAN FEDERATION;
[2]Kharkov National University, UKRAINE

The following paper describes the microwave imager/sounder MTVZA-GY for spacecraft "Meteor-M". The spacecraft has been launched On September 17, 2009. MTVZA-GY instrument will be used as the meteorological imaging/sounding system for remote sensing of ocean and land surface, as well as, for measuring global atmospheric temperature and water vapor profiles.

14:30   **Beamforming Networks Using Reduced Size and Cascaded Butler Matrices**   We-12

A. Rahim, S.K; Muhammad, N. A; A. Rahman, T
Universiti Teknologi Malaysia, MALAYSIA

This paper presents the design and realization of reduced size branch-line coupler operating at 2.45GHz. Nowadays people tend to choose the compact and smaller size for wireless devices. Therefore, size reduction of branch-line coupler using eight two-step stubs has been proposed in this work, where the area of branch-line coupler has been reduced up to 50% from the normal size. The practical application of this reduced size branch-line coupler has been implemented on a 4x4 Butler Matrix.

14:30   **A New Concept for Dual Gridded Reflectors**   We-14

Ekstrom, H; Petersson, M; Baunge, M; Ingvarson, P
RUAG Space AB, SWEDEN

The performance of existing dual gridded reflector designs at Ku-band and above is rather limited. The main reason is the use of dielectric materials, which are not as thermally stable as CFRP, and also introduce dielectric losses. RSE have developed a new concept with a minimum of dielectrics, giving lower losses and better accuracy and thermal stability. The theory is verified by measurements of a 1 m diameter dual gridded antenna at Ku/Ka bands.

14:30   **Analogue Versus Digital for Baseband Beam Steerable Array Used for LEO Satellite Applications.**   We-16

Aliakbarian, H.[1]; Volski, V.[1]; van der Westhuizen, E.[2]; Wolhuter, R.[2]; A. E. Vandenbosch, G.[3]
[1]KULeuven, BELGIUM;
[2]Stellenbosch University, SOUTH AFRICA;
[3]KULeuven, SOUTH AFRICA

This paper presents an implementation of analogue baseband beam steering and its digital counterpart as an attempt to compare between both methods for LEO satellite applications. Both methods are explained, implemented and compared in terms of different aspects such as power consumption, space qualification, flexibility, and speed of steering for a 1×2 prototype.

14:30   **Comparison of Two Decade-Bandwidth Feeds for Reflector Antennas:the Eleven Antenna and Quadridge Horn**   We-20

Yang, J.[1]; Pivnenko, S.[2]; Kildal, P.-S.[1]
[1]Chalmers University of Technology, SWEDEN;
[2]Technical University of Denmark, DENMARK

This paper presents a comparison the Eleven Antenna and the ETS-Lindgren quadridge horn in terms of their radiation performance as feeds for reflector antennas. They are both candidates for feeding future radio telescopes for Square Kilometer Array and VLBI2010. The comparison is done by processing measured radiation field functions and input reflection coefficients of both antennas to determine expected reflector antenna performance.

14:30   **Radiation Pattern Optimization of Skobelev Networks**   We-22

Petrolati, Daniele[1]; Angeletti, P[1]; Morini, A[2]; Toso, G[1]
[1]European Space Agency, NETHERLANDS;
[2]Università Politecnica delle Marche, ITALY

This paper presents a new optimization method for computing the coupling coefficients of the directional couplers constituting a Skobelev Network. The adopted method succeeds in improving the Sub-Array Radiation Pattern performance in terms of sidelobe level with negligible effects on the main beam.

14:30   **Optimal Waveform Selection For Software Defined Data Acquisition System**   We-24

Ruuben, T; Berdnikova, J; Müürsepp, I; Madar, U
Tallinn University of Technology, ESTONIA

This paper describes specific digital beamforming methods and prototype of the data acquisition system. Moreover, the detailed description of the beamforming and reception algorithms would explain the possible estimation criteria for given system. The modelling results and software radar prototype performance are presented. Concerning the use of spread spectrum waveforms with wideband beamforming methods, possible modes of data acquisition applications will be discussed.

14:30   **Design of a Closed Cylindrical Beam Forming Network fed Circular Array for Space Diversity**   We-26

Applications
FONSECA, Nelson J.G.; FERRANDO, Nicolas
CNES, FRANCE

A new family of 3D multiple beam forming networks is introduced. They are particularly well adapted for azimuth multiple beam circular array applications as they naturally direct the power related to each beam towards a specific sector of the circular array while providing sufficient overlap between adjacent beams to cover a full 360° azimuth angular range. The general concept is described. Proposed network is characterized by a Gaussian amplitude and coherent (in-phase) distribution.

14:30   **ROSA: an advanced new Technological Design for Radio Occultation Antenna**   We-28

Catalano, Valeria[1]; Ivagnes, M.[2]; Valle, P.[2]
[1]Italian Space Agency, ITALY;
[2]Thales Alenia Space Italia SpA, ITALY

The Italian Space Agency is funding several technological activities related to the study of the Atmosphere using the Radio Occultation Technique, a technique able to derive atmospheric vertical profiles of temperature, pressure and humidity. In this context ASI has committed Thales Alenia Space Italia to develop the ROSA (Radio Occultation Sounder for the Atmosphere) instrument made by two Radio Occultation antennas, one navigation antenna and one receiver.

| 14:30 | **Analysis and Simulation of Neural Network-Based Adaptive Beamforming Techniques** | We-30 |

Alencar, Gilson; Costa, Renata; Canella, Andre
Federal Center of Technological Education Celso Suckow da Fonseca, BRAZIL

The aim of this paper is to carry out studies about neural network-based adaptive beamforming through simulations in a special design computational tool. Different models of neural networks can be implemented to run in it to identify potential architectures for future accomplishments. Applications of neural networks are growing in the field of signal processing mainly because of their general-purpose nature, fast convergence rates and very suitable for Field Programmable Gate Array (FPGA).

| 14:30 | **Far Field Condition in Passive Interferometry for Security Screening Applications** | We-32 |

Torres, F.; Abril, J.; Nova, E.; Broquetas, A.; Jofre, L.
Universitat Politècnica de Catalunya, SPAIN

The feasibility of passive millimeter wave imaging systems for security screening applications has been demonstrated by a number of authors by means of real aperture sensors. Passive interferometers may achieve the goal of real time imaging by performing snap-shot acquisition times of the synthesized images well below 1 s. This paper will describe the main tradeoff parameters in designing the array configuration of the interferometer by reviewing the concept of far field range.

| 14:30 | **RCS Simulations on Deformed Corner Reflectors Applying SBR Code Sigray** | We-34 |

Kemptner, Erich
DLR, GERMANY

Corner reflectors play a major role in the calibration of radar systems. The influence of geometry deformations, caused by insufficient production accuracy or outside exposure on the RCS is often neglected. Investigations on these regards have been done by applying the 'Shooting & Bouncing of Rays' (SBR) code SIGRAY which has been developed at DLR. The comparison of simulation results on corner reflectors with sagging base areas and on an ideal reflector is presented.

| 14:30 | **Modeling and Manufacturing of a Series of Identical Antennas for a P-Band Ice Sounder.** | We-36 |

Lopez-Pena, S.; Zurcher, J.F.; Torres, R.; Polimeridis, A.G.; Mosig, J.R.
EPFL LEMA, SWITZERLAND

The modeling and manufacturing of the basic antennas of a P-Band ice sounder are described. A robust design fulfilling electrical and very demanding mechanical specifications is presented. These goals were attained after an exhaustive HFSS simulation campaign, efficiently performed with the help of a home made software tool, also presented here. A series of 8 identical antennas, able to operate in the harsh arctic environment, has been entirely in home manufactured at EPFL.

| 14:30 | **Architecture of GAIA Satellite Phased Array Antenna** | We-38 |

Alonso, Eduardo[1]; BAZAN, Antonio[2]; GARCIA, Quiterio[2]
[1]EADS CASA Espacio, SPAIN; [2]EADS CASA ESPACIO, SPAIN

This article describes the main features of the Phased Array Antenna for GAIA. GAIA is a new scientific ESA programme aimed to build a 3D map of the stars in the galaxy.

| 14:30 | **Dual use Ku/K band Corrugated Horn for Telecommunication Satellite** | We-40 |

Addamo, Giuseppe[1]; Peverini, O.A.[1]; Tascone, R.[1]; Virone, G.[1]; Cecchini, P.[2]; Mizzoni, R.[2]; Orta, R.[3]
[1]IEIIT-CNR, ITALY;
[2]Thales Alenia Italia Space, ITALY;
[3]Politecnico di Torino, ITALY

This paper describes the design of a dual-frequency compact corrugated horn for use on Ku/K telecommunication satellite antennas. Very stringent requirements for matching, cross polarization and power handling have been satisfied by means of a suitable design strategy. The good comparison between measurements and computations provides a validation of the present design methodology.

| 14:30 | **Final Design and Testing of the 94 GHZ Quasi-Optical-Feed for the Earthcare' s Cloud Profiling Radar** | We-42 |

Hartmann, Juergen[1]; Hartwanger, Christian[1]; Cappellin, Celilia[2]; Wylde, Richard[3]
[1]Astrium GmbH - Satellites, GERMANY;
[2]TICRA, DENMARK;
[3]Thomas Keating Ltd., UNITED KINGDOM

Within the paper, the modeling of the QOF will be explained in detail and a description of QUAST will be given. Finally, a validation with measurement performed at the National Physical Laboratory (NPL) in UK will be provided.

| 14:30 | **Techniques for Accurately Manufacture a Sub-mm Wavelength Mixer To Detect Sub-mm Wave Radiation** | We-44 |

Palacios, I.; Ederra, I.; Teniente, J.; Gonzalo, R.
Public University of Navarra, SPAIN

This paper describes some manufacturing techniques that can be employed in order to manufacture sub-mm wavelengths circuitry. In particular the manufacturing process of a sub-mmw mixer is analysed.

Session: **C14: Ultrawideband sensors for biomedical applications**
Type: Convened Session
Date: Wednesday, April 14, 2010
Time: 16:40 - 18:20
Room: Room 119
Chairs: F. Thiel, J. Sachs
M.A. Hein, M. Helbig

Time	Title	Abs No
16:40	**Performance of Ultra Wideband Antennas for Monitoring Water Accumulation in Human Bodies**	C14-1

Pancera, Elena; Li, X.; Zwirello, L.; Zwick, T.
IHE-Karlsruhe Institute of Technology (KIT), GERMANY

In this paper the performance and the applicability of different UWB antenna concepts for the detection and the monitoring of water accumulation in the human bodies are investigated. Through a theoretical analysis and measurement results, requirements are derived on UWB antennas time domain behaviour and time domain parameters in order to be usable for this purpose.

17:00	**Could we Use UWB for Breast Cancer Detection?**	C14-2

Hilger, I.[1]; Geyer, C.[1]; Rimkus, G.[1]; Helbig, M.[2]; Sachs, J.[2]; Schwarz, U.[2]; Hein, M.A.[2]; Kaiser, W.A.[1]
[1]Universitätsklinikum Jena, GERMANY;
[2]Ilmenau University of Technology, GERMANY

In consideration of the current developments on UWB sensors for biomedical applications, this lecture deals with the status of breast cancer detection in diagnostic imaging, as well as with the molecular and cellular biology of cancer initiation and progression. In this context the question will be addressed, how UWB imaging could distinctly help to improve woman health in the long term, particularly in conjunction with currently established image based technologies for breast cancer detection.

17:20	**Versatile Ultrawideband Sensor for Near-Field Microwave Imaging**	C14-3

Bourqui, J.; Fear, E.C.; Okoniewski, M.
University of Calgary, CANADA

A new ultrawideband sensor for breast microwave imaging is presented. The design consists of a tapered slot antenna loaded with dielectric and fed by a transverse microstrip balun. The sensor is designed to come into contact with the breast skin and to be independent to electrical property variation of the immersion medium. Simulation shows that it can keep good performance across 1 to 12 GHz for different liquid conductivity and permittivity.

17:40	T**oward 3D UWB Tomographic Imaging System for Breast Tumor Detection**	C14-4

Guardiola, M.; Jofre, L.; Capdevila, S.; Blanch, S.; Romeu, J.
Universtitat Politecnica de Catalunya, SPAIN

A novel 3D tomographic algorithm for short range cylindrical geometries using UWB frequency range is presented. The algorithm has been applied to breast tumor detection, nevertheless, its non application-specific character permits the use in other applications. The detection capability of the tomographic algorithm is proved through numerical simulations and experimental measurements of canonical and more realistic body-attached breast phantoms.

18:00	**Vital Signs Monitoring with a UWB Radar Based on a Correlation Receiver**	C14-5

Leib, Mario; Menzel, Wolfgang; Schleicher, Bernd; Schumacher, Hermann
University of Ulm, GERMANY

Vital signs detection observing small amplitude changes due to the movement of a target in front of the radar is shown. Several measurement results for respiration and heart beat monitoring are presented and discussed. In addition, advanced signal post-processing by deconvolution with a Wiener filter is presented, leading to an improved resolution performance for the realized UWB radar system. Promising results of this method show that small targets can be identified in a multi-target scenario.

Session: **C02P2: MIMO Systems - 2**
Type: Convened Session
Date: Wednesday, April 14, 2010
Time: 16:40 - 18:20
Room: Room 120
Chairs: N. Czink
             C. Oestges

Time	Title	Abs No
16:40	**Multi-Link Level Simulation Model of Indoor Peer-to-Peer Radio Channels**	C02P2-1

Castiglione, P.[1]; Oestges, C.[2]; Czink, N.[1]; Bandemer, B.[3]; Kaltenberger, F.[4]; Paulraj, A. J.[3]
[1]FTW, AUSTRIA;
[2]UCLouvain, BELGIUM;
[3]Stanford University, UNITED STATES;
[4]Eurecom, FRANCE

This paper presents a link-simulation model for cooperative indoor communication systems at 2.4 GHz, based on empirical data. The channel simulator relies on a simple formulation, and takes into account the impact of the node mobility on fading and shadowing statistics. This implementation is then applied to the evaluation of the cooperative system performance in terms of network lifetime.

17:00	**Significance of Common Scatterers in Multi-Link Wave Propagation**	C02P2-2

Poutanen, Juho[1]; Haneda, Katsuyuki[1]; Salmi, Jussi[1]; Kolmonen, Veli-Matti[1]; Hult, Tommy[2]; Tufvesson, Fredrik[2]; Vainikainen, Pertti[1]
[1]Aalto University School of Science and Technology, FINLAND;
[2]Lund University, SWEDEN

Correlation between links is an essential characteristic for many forthcoming systems that utilize MIMO technology. This paper introduces a measure to quantify the amount of energy that propagates via similar propagation mechanisms in different links. The "significance of common scatterers" is studied based on two dual-link measurements. The present work forms indispensable basis for the channel modeling of multiuser MIMO communications.

17:20	**On a Characterisation of Large-Scale Channel Parameters for Distributed (Multi-Link) MIMO – the Impact of Power Level Differences**	C02P2-3

Narandzic, M.; Kotterman, W.; Kaeske, M.; Schneider, C.; Sommerkorn, G.; Hong, A.; Thomae, R.
TU Ilmenau, GERMANY

Differences in peak-power levels from cooperative links are determined from multi-pass measurements, by performing distance-based pair-wise snapshot matching. The obtained statistics of 'relative-shadowing' is anticipated to represent measured radio-environment in the form of probability density function. Due to interaction between cooperative links, their effective dynamic ranges will be modified. Therefore, power spreads are characterized as a function of effective dynamic range.

17:40	**Channel Covariance Modeling for Multi-User MIMO Systems**	C02P2-4

Jensen, M. A.; Shi, Y.; Yang, Y.
Brigham Young University, UNITED STATES

This paper uses the channel covariance matrix both as a means for enabling high performance multi-user MIMO communication and as the basis for multi-user channel models. It first shows how to use conventional covariance models to dramatically reduce the required feedback complexity while maintaining good performance. It then focuses attention on the modeling of multi-user channels by exploring the position-dependent properties of the covariance using an analytical framework.

18:00	**Analytical Dual-Link-MIMO Channel Model Using Correlated Correlation Matrices**	C02P2-5

Hult, Tommy[1]; Tufvesson, Fredrik[1]; Kolmonen, Veli-Matti[2]; Poutanen, Juho[2]; Haneda, Katsuyuki[2]
[1]Lund University, SWEDEN;
[2]Helsinki University of Technology, FINLAND

Analytical Multiple-Input Multiple-Output (MIMO) models are often attractive due to their low complexity when analyzing possibilities and limitations in the system. In this paper we outline a a possible dual link extension of an analytical MIMO channel model and investigate its suitability based on measurements of a dual link MIMO scenario.

Session:	**A14: Reconfigurable antennas 3**
Type:	Antennas Session
Date:	Wednesday, April 14, 2010
Time:	16:40 - 18:20
Room:	Room 121
Chairs:	R. Haupt
	S. Vaccaro

Time	Title	Abs No

16:40   A Frequency Agility Technique on a Miniature Omnidirectional Antenna   A14-1

Sufyar, S.[1]; Delaveaud, C.[1]; Staraj, R.[2]
[1]CEA-LETI MINATEC, FRANCE;
[2]LEAT - Université de Nice-Sophia Antipolis, FRANCE

This paper presents a compact omnidirectional antenna based on the concept of frequency reconfigurability.To fight bandwidth reduction created by miniaturization, a varactor diode is placed on the structure to fulfil modern telecommunication standard requirements using frequency reconfigurability. Based on this technique, an electronically tunable antenna knwon as a top loaded folded monopole with a frequency range of 670-730MHz is designed.

17:00   Compact and Multiband Dielectric Resonator Antenna with Recofigurable Radiation Pattern   A14-2

Huitema, Laure; Koubeissi, Majed; Decroze, Cyril; Monediere, Thierry
Xlim, FRANCE

A compact multiband antenna using dielectric resonator antenna (DRA) is investigated in this paper. This antenna operates at three bands for different wireless applications. In order to improve the quality and reliability of wireless links, diversity techniques can be applied. To accomplish this goal, two antennas are integrated side by side on a same PCB card, that would allow to reconfigure the radiation pattern at all three frequency bands.

17:20   Design of Multiband Reconfigurable Antennas   A14-3

Raines, B. D.; Rojas, R. G.
The Ohio State University, UNITED STATES

Using the theory of network characteristic modes, a planar inverted-F antenna and a microstrip patch antenna are systematically modified to obtain multiband performance at arbitrary frequencies. Each is loaded at multiple points with reactive loads consisting of multiple lumped resonators computed directly using equations derived from network characteristic mode theory.

17:40   Dynamic Array Thinning for Adaptive Interference Cancellation   A14-4

Haupt, Randy[1]; Rocca, Paolo[2]
[1]Pennsylvania State University, UNITED STATES;
[2]University of Trento, Dept. Information Engineering and Computer Science, ITALY

This paper describes an approach to adaptive nulling that changes an array thinning configuration to move sidelobe nulls. Dynamically thinning an array requires that each element in the array can be made active by connecting it to the feed network with a switch. If the number of active elements remains constant, then the gain of the array remains constant. Our results show that nulls can be placed in the array factor by changing the thinning configuration.

18:00   Low Cost Phased Array for Mobile Ku-Band Satellite Terminal   A14-5

Vaccaro, Stefano[1]; Llorens del Río, D.[1]; Torres Sánchez , R.[2]; Baggen , R.[3]
[1]JAST SA, SWITZERLAND;
[2]LEMA-EPFL, SWITZERLAND;
[3]IMST GmbH, GERMANY

This article presents the design of a low cost fully active phased array antenna with specific emphasis on the realization of an elementary radiating cell. The phased array antenna is designed for mobile satellite services and dedicated for automotive applications. Details on the radiating element design as well as its implementation in a multilayer's build-up are presented and discussed. Results of the measurements and characterization of the elementary radiating cell are also presented.

Time	Title	Abs No
14:30	**Patch Antennas Based on A Pair of DPS And SNG Metamaterial**	C05-1

He, Sailing[1]; Xiong, Jiang[2]; Li, Hui[2]; Jin, Yi[2]
[1]Division of Electromagnetic Engineering, School of Electrical Engineering, SWEDEN;
[2]Center for Optical and Electromagnetic Research, Zhejiang University, CHINA

In this talk we propose two novel patch antennas, based on a pair of DPS and SNG metamaterial. One is a dual-band rectangular patch antenna, filled with a pair of juxtaposed DPS and MNG metamaterial blocks. With the modified TM_{020} mode, broadside radiation can be simultaneously achieved at both bands. The other is a rectangular patch antenna with a bi-layer of DPS and ENG metamaterial as its substrate. The antenna size is reduced to a quarter of the conventional ¦Ë/2 patch antennas.

14:50	**Multi-Bank Cylindrical Antenna Using ε-Near-Zero Gap** Launchers	C05-2

Maci, Stefano[1]; Alu', A.[2]; Engheta, N.[3]; Chen, P-Y[4]; Engheta, N.[3]; Maci, S.[5]
[1]university of Siena, ITALY;
[2]The University of Texas at Austin, UNITED STATES;
[3]University of Pennsylvania, UNITED STATES;
[4]University of Texas at Austin, UNITED STATES;
[5]University of Siena, ITALY

The ε-near-zero (ENZ) tunneling phenomenon has been shown to allow full transmission of waves through narrow channels, even in the presence of a strong geometric mismatch. Here we propose an application of this principle to realistic 3D cylindrical antenna geometries, with the purpose of realizing a frequency-hopping multi-band radiator working in a 5:1 bandwidth in the millimetre-wave regime, of interest for a variety of real-life antenna applications.

15:10	**Through-Wall Radar Imaging System Utilizing a Light-Weight Low-Profile Printed Array**	C05-3

Browne, K.; Burkholder, R.; Volakis, J.
The Ohio State University, ElectroScience Laboratory, UNITED STATES

An UWB through-wall imaging system is proposed based on a planar low profile aperture array operating from 0.9 to 2.3 GHz. The goal is to provide a lightweight, fixed array to serve as an alternative to synthetic aperture radars (SAR). Several high resolution fused 3-D images containing a few sparsely distributed targets are presented. Future work to optimize image quality is discussed, including algorithms for resolution enhancement, clutter mitigation, and image fusion treatments.

15:30	**Broadband and High-Gain Metematerial Miocrostrip Antenna Arrays**	C05-4

Li, Joshua Le-Wei; Li, Y. N.; Xiao, K.
National University of Singapore, SINGAPORE

A novel rectangular patch antenna was specifically designed using planar-patterned metamaterial concepts. The patterned metal patch and finite ground plane form a coupled capacitive-inductive (C-L) circuit of negative index metamaterial. For the wideband, high efficiency, low loss and low VSWR, the novel type of antenna is used to design meta array, the array still have bandwidth significantly broadened than the original patch arrays, and high gain can also be obtained in a wide frequency band.

15:50	**Near-Isotropic Negative Refraction Simulation in Metamaterials Using Geomtrical Optics and Scattering Matrix Parameters**	C05-5

Wang, X.[1]; Zaghloul, A.[2]
[1]Virginia Polytechnic Institute and State University, UNITED STATES;
[2]Virginia Tech/ US Army Research Laboratory, UNITED STATES

The paper presents simulation of the negative refraction of a metamaterial structure that shows near-isotropic characteristics. The calculation of the negative refractive index is done using ray tracing and full-wave scattering matrix simulations. The unit cell is a cross arrangement of two planes that contain a capacitively-loaded loop plus post (CLL-P) patterns. The agreement between the two methods and the incidence-angle-independent results show that the structure is nearly isotropic.

Time	Title	Abs No
16:40	**Broadband Coupler using Improved Vertically Installed Planar Structure**	A15P2-1

Zheng, S.Y.; Chan, W.S.; Man, K.F.
Department of Electronic Engineering, City University of Hong Kong, HONG KONG

A novel vertically installed planar structure with patterned ground plane had been presented in this paper. It eliminates the existing limitations of conventional vertically installed planar structure, resulting in a simple structure with less fabrication efforts. For demonstration purpose, a 3-dB hybrid coupler was designed based on the proposed improved structure. It was measured to have a good performance both in amplitude and phase from 2.5 to 5.5 GHz.

| 17:00 | **Cicular Polarization Generating Coaxial to Waveguide Adapter for Horn antenna** | A15P2-2 |

Jeon, K.J.; Lee, K; Lee, T.K.; Lee, J.W.; Lee, W.K.
Korea Aerospace University, KOREA, REPUBLIC OF

This paper deals with a coaxial-to-waveguide adapter generating circularly polarized wave to be connected with horn antennas. By combining the polarization twisting structure and the phase delay structure, the circular polarization is successfully generated in the waveguide. The designed and implemented adaptor shows that the present structure can significantly reduce the size of the adapter for circularly polarized horn antenna

| 17:20 | **Compact CPW-FED Defected Ground Antenna** | A15P2-3 |

Sujith, R; Mridula, S; Binu, Paul; Laila, D; Aanandan, C K; Vasudevan, Kesavath; Mohanan, P
CUSAT, INDIA

A multiband antenna by perturbing the ground of a Coplanar Waveguide (CPW-Fed) transmission line is studied and presented. The Antenna comprises of two asymmetrical slits on either side of a CPW transmission line. The real and imaginary part of impedance can be independently tuned by adjusting the central strip and the slot parameters to achieve the impedance matching for the required resonant frequency band. The experimental and simulation studies are presented and discussed.

| 17:40 | **Multilayer Antennas for Directive Beam Steering Broadside Radiation and Circular** Polarization | A15P2-4 |

Podilchak, Symon[1]; Freundorfer, A.P.[2]; Antar, Y.M.M.[1]
[1]The Royal Military College of Canada, CANADA;
[2]Queen's University, CANADA

Antennas that utilize surface waves for leaky wave excitation are presented. By placing two superstrate dielectric layers on top of a base grounded dielectric slab a resonant cavity structure can be realized for pencil beam, two-sided conical sector, and broadside beam patterns in the far field. These planar leaky-wave antenna designs are fed by printed surface-wave launcher sources. In addition, by using an array of such sources, beam steering can be achieved as well as circular polarization.

| 18:00 | **Superb Gaussian Beam Efficiency Corrugated Horn Antennas** | A15P2-5 |

Teniente, J.; Gonzalo, R.; del Río, C.
Public University of Navarra, SPAIN

Corrugated horn antennas have been widely used as feedhorns for radiotelescopes and radiometers. It is well known the corrugated horn high performance radiation patterns that have made them famous for very stringent applications as radio astronomy requires. However, in the last decade some very important improvements have been made to corrugated horns in terms of length, return loss, sidelobe level and manufacture simplicity; maintaining their other well known properties .

Session:	**We-Poster Session P3: Propagation & Measurements**
Type:	Poster
Date:	Wednesday, April 14, 2010
Time:	16:40 - 18:20
Room:	Foyer 2
Chairs:	R. Prieto-Cerdeira
	I. Peña

Time	Title	Abs No
16:40	**Prediction of Fading and Path Loss in Land-Satellite Communication Links Based on the Unified Stochastic Approach**	We-55

Blaunstein, Nathan; Cohen, Yaniv
Ben Gurion University of the Negev, ISRAEL

This work presents a unified physical-statistical approach for predicting fading phenomena and path loss usually occurring in land-satellite communication links caused by influence of the terrain features on radio signal propagation from the ground-based to the satellite antennas

| 16:40 | **Long Term Rain Attenuation Statistics from Short Term Experiments** | We-57 |

Matricciani, Emilio
Politecnico di Milano, ITALY

Based on a large data bank of rain rate time series, we have simulated a large data bank of rain attenuation time series at 18.7 GHz in slant paths to Italsat (13.2° E), circular polarisation, with the Synthetic Storm Technique (SST). The paper shows that 4 years of data can predict long term ($\sim$ 10 years) rain attenuation probability distributions with an average error practically zero, and an RMS in the range 2 $\sim$ 6% in the probability range 0.0001-0.01

| 16:40 | **Schumann Resonances in the Earth-Ionosphere Waveguide** | We-59 |

Rai, Jagdish; Chand, Ramesh; Israil, M.
Indian Institute of Technology Roorkee, INDIA

The electromagnetic waves emitted from lightning in the ELF and VLF ranges propagate to large distances without any appreciable attenuation. Schumann (1952) studied theoretically the electromagnetic wave propagation in the earth-ionosphere waveguide and predicted several resonant modes due to constructive interference [6]. These are known as Schumann resonances. Since then many investigators ([1], [2], [3], [4], [5] and others) have studied the Schumann resonances in detail.

| 16:40 | **Measurement of the Eletrical Characteristics of Vegetation in a Dense Jungle** | We-61 |

Assis, Mauro[1]; Pinto Filho, Rafael[2]
[1]Fluminense Federal University, BRAZIL;
[2]ANATEL, BRAZIL

This paper deals with an experimental work aiming to estimate the electrical characteristics of vegetation in the Amazon forest. Measurements were carried out in the HF band. The electrical parameters of the jungle were deduced by matching the experimental data to the values derived from a mathematical model based on the propagation of a lateral wave along the boundary between the forest and the troposphere.

| 16:40 | **Specific Usage of a Wire-Grid Polarizer For Millimeter Waves** | We-63 |

Piksa, Petr[1]; Zvanovec, Stanislav[2]
[1]Czech Technical University in Prague, CZECH REPUBLIC;
[2]Czech technical University in Prague, CZECH REPUBLIC

A polarization grid and a roof top mirror enable to multiply measured path in spectroscopy tube. Therefore properties of the grid substantially influence the measurement sensitivity. Particular properties of grids were determined for both electromagnetic wave polarizations from the measurement and the simulations of the developed 10 times enlarged sample of the grid. The improvement of sensitivity of the spectroscopic measurement inheres in use of polarizer within the vertical polarization.

| 16:40 | **Circular Polarization Bennefits in HSDPA and MIMO Networks** | We-65 |

Urbano, J; Dominguez, F; Tenorio, S
Vodafone, SPAIN

Linear polarization has been the traditional transmission scheme used in the mobile radio networks so far. However, the upcoming MIMO technology in the WCDMA is bringing problems which can be firmly mitigated with the usage of circular polarization. The MIMO co-existence with legacy HSDPA users is a big that circular polarization can fix. Moreover, circular polarization enhances the Receive Diversity performance in terminals in high geometry scenarios where benefits were very limitted until now.

16:40 **Combining Multiple Knife-Edge Diffraction and Ground Reflections for Terrain Path Loss Calculation** We-67

Komijani, J.[1]; Mirkamali, A.[2]; Nateghi, J.[3]
[1]University of Tehran, IRAN, ISLAMIC REPUBLIC OF;
[2]Zanjan Univesity, IRAN, ISLAMIC REPUBLIC OF;
[3]Iran University of Science and Technology, IRAN, ISLAMIC REPUBLIC OF

A new method based on the image theory and multiple knife-edge diffraction for calculating the terrain path loss is proposed. It can be extended for the structures which include arbitrary number of the knife edges. The mathematical computation involved in this method is less than the other methods which consider the ground reflections as well as multiple knife-edge diffractions. Based on the proposed method, some insignificant paths can be omitted to reduce the amount of the computation.

16:40 **Study on Ducting Phenomena in Abu Dhabi** We-69

Al-Ansari, K.; Al-Mansour, L.; Al-Bluoshi, A.
Ajman University of Science and Technology, UNITED ARAB EMIRATES

Propagation of radiowaves through the atmosphere is strongly dependent on local meteorological conditions, specifically air temperature, pressure and humidity profiles in the lower atmosphere. A rapid change in these parameters with height generates anomalous propagation or what is called tropospheric ducts. In this case, radiowaves can propagate for long distances inside the duct and cause interferences for both terrestrial and slant path links. Some communication systems in the Gulf region are exposed to these interferences. Therefore, duct detection and evaluation is essential to predict and to counteract such effects.

16:40 **Conjugate and Inter-Hemispheric Observations of the Phase Fluctuations of GPS Signals in the Ionosphere** We-71

Shagimuratov, Irk; Ephishov, I.; Tepenitsyna, N.; Koltunenko, L.
IZMIRAN, RUSSIAN FEDERATION

The effect of geomagnetic storms on GPS phase fluctuations have been studied using GPS observation of Arctic and Antarctic regions. It was found that during storm fluctuation activity essentially increase in polar cap and auroral ionosphere. The strong fluctuations are observed at subauroral area. In paper the features in development of phase fluctuations at geomagnetic conjugate point and inter-hemispheric differences and similarities during winter and summer conditions are discussed.

16:40 **Ground Wave Propagation Analysis for DRM Local Coverage in the 26 MHz Band** We-73

Peña, I.[1]; Lauterbach, T.[2]; Gil, U.[1]; Angueira, P.[1]; Arrinda, A.[1]; de la Vega, D.[1]; Guerra, D.[1]
[1]University of the Basque Country. UPV-EHU, SPAIN;
[2]Georg Simon Ohm Hochschule, GERMANY

This paper presents an analysis of the ground wave propagation in the 26 MHz band based on a comparison between measured and predicted field strength values. Empirical data were obtained from a measurement campaign of a DRM experimental local service. Simulated values were calculated applying 2 models that account for the space and surface wave propagation respectively. The prediction errors were analyzed and a correction factor due to the terrain irregularity was obtained.

16:40 **Sky Wave Interfering Signals Evaluation for Digital Local Broadcasting Services in the 11 Meter Band** We-75

Peña, I.; Murga, A.; Angulo, I.; Angueira, P.; Velez, M.; Eizmendi, I.; Prieto, G.; Ordiales, J.L.
University of the Basque Country. UPV-EHU, SPAIN

A characterization of the long distance ionospheric interferences for DRM local services in the 26 MHz band is presented in this paper. The study is based on MUF and the field strength received levels. Monthly median values were predicted by using 2 simulation tools referenced by the ITU. Also, upper deciles were calculated to obtain results more appropriate for planning digital services. Simulations were carried out for every month of the year, hour of the day and a wide range of SSN values.

16:40 **Statistics of Duration and Number of Rainfall Events in Brazil** We-77

Miranda, Erasmus[1]; Pudwell, M.[1]; Souza, R.[1]; Pontes, M.[2]; Silva Mello, L.[2]; Rodrigues, M.[2]; Pina, T.[2]
[1]INMETRO, BRAZIL;
[2]CETUC-PUC/Rio, BRAZIL

In this paper, the statistics of number and duration of rainfall events exceeding given thresholds, are investigated for four sites in Brazil. Results include the parametric estimation of the cumulative distribution functions of rainfall events duration based on a Weibull distribution.

16:40 **Atmospheric Refractivity Sensing Improvement Using Artificial Neural Networks** We-79

Mudroch, M.[1]; Pechac, P.[1]; Grabner, M.[2]; Kvicera, V.[2]
[1]CTU in Prague, CZECH REPUBLIC;
[2]Czech Metrology Institute, CZECH REPUBLIC

This paper describes a new progress in evaluating measured data from a unique, experimental, multiple-receiver terrestrial radio link used for remote sensing. The refractivity index height profile of the lowest troposphere layers is evaluated and the classification process is discussed. We are comparing different sizes and architectures of feed-forward artificial neural networks and their learning parameters.

16:40   **Ionospheric Propagation Activities during GIOVE Mission** Experimentation   We-81

Prieto-Cerdeira, Roberto[1]; Binda, S.[1]; Hidalgo, I.[2]; Rodriguez, D.[2]; Borrel, V.[3]; Giraud, J.[3]
[1]European Space Agency - ESA/ESTEC, NETHERLANDS;
[2]GMV, SPAIN;
[3]Thales Alenia Space, FRANCE

This document presents the activities related to ionospheric assessment obtained after several months of experimentation with the two Galileo experimental satellites: GIOVE-A and GIOVE-B. The performance analysis covers the majority of ionospheric aspects, from Slant Total Electron Content (TEC) and Inter-Frequency Bias (IFB) estimation up to Single Frequency Ionospheric Correction Algorithm performance, that relates directly to the user error budget and hence to positioning performance. Finally, different methods for the detection of ionospheric scintillations using raw data from geodetic-type receivers in sensor stations are reviewed using observables from equatorial stations of the GIOVE Mission network. These results have proved to be a very useful input for the next development phase of the Galileo system.

16:40   **Scattering Analysis of Flat Electric Dipoles on Multilayer Chiral Structures**   We-83

Rabelo, N.[1]; SantAnna, S.[2]; Lacava, J.[1]; Fernandes, D.[1]
[1]ITA, BRAZIL;
[2]INPE, BRAZIL

The outlined methodology permits the spectral domain analysis of a confined chiral layer stacked up between free space and ground, containing flat electric and magnetic scattering elements at any layer interface, and illuminated by an elliptically polarized plane wave at oblique incidence. From the closed-form field expressions so obtained, scattering parameters, including the scattering matrix and the directivity, of an electric dipole atop the chiral layer are determined and analyzed.

16:40   **dRET Modelling of Time-Variant Foliage Channels**   We-85

Morgadinho, S[1]; Caldeirinha, R.[2]; Fernandes, T[2]; Al-Nuaimi, M[1]; Richter, J[1]
[1]University of Glamorgan, UNITED KINGDOM;
[2]Instituto de Telecomunicações, PORTUGAL

In this paper, the discrete Radiative Energy Transfer (dRET) theory is proposed to model time-variant channel effects in vegetation media at millimetre-wave frequencies. The proposed methodology makes use of the dRET input parameters time-varying properties to estimate the dynamic radio channel effects caused by wind-induced foliage movement.

16:40   **CANCELLED**   We-87

16:40   **Physical Optics Formulas for the Scattering from Metallic and Dielectric Plates with Cubic Spline Curved Boundaries**   We-89

Vallecchi, A.
University of Siena, ITALY

Closed-form expressions of the physical optics (PO) field scattered in the far zone by metallic and dielectric plates with cubic spline curved boundaries are derived in terms of incomplete cylindrical functions (ICFs). The developed expressions can constitute a useful tool for an accurate and numerically efficient prediction of the radar cross section (RCS) of targets with complex shapes.

16:40   **Analysis of Rain Attenuation from Experimental Drop Size Distributions**   We-91

Riera, Jose M.[1]; Garcia-Rubia, J M[2]; Benarroch, A[3]; Garcia, P[3]
[1]Universidad Politécnica de Madrid, SPAIN;
[2]Universidad de Jaén, SPAIN;
[3]Universidad Politecnica de Madrid, SPAIN

More detailed measurements of the rain phenomena can be obtained with the use of modern equipment. This kind of equipment provides experimental drop size distributions (DSD) that can be used to analyze the effects of past rain events. In this paper, the use of the experimental drop size distributions of rain to predict its effect on the propagation of millimetre wave is discussed, taking into account the available measurements of the different instruments.

16:40   **Frequency Scaling of Attenuation between 12 and 100 GHz**   We-93

Riera, Jose M; Lucas, M J
Universidad Politecnica de Madrid, SPAIN

The estimation of attenuation at a frequency from measurements taken at a different one is a problem that find applications in different scenarios. In this paper, some results are presented with regard to this topic, with the use of physical models to calculate gas and cloud attenuation at different frequencies. The work carried out makes use of radiosounding data from 60 sites all over the world, taking into account, in most cases, five years of data.

| 16:40 | **On the Optimum Estimation of 1-Minute Integrated Rainfall Statistics from Data with Longer Integration Time** | We-95 |

Emiliani, L. D.[1]; Luini, L.[2]; Capsoni, C.[2]
[1]SES-ASTRA S.A., LUXEMBOURG;
[2]Politecnico di Milano, ITALY

The 1-minute integrated cumulative distribution of rain is the most relevant input for several propagation applications. Several techniques exist for the prediction of such a distribution, among them the conversion of statistics with longer integration time. In this study, a comparison of the predictions obtained from various statistics conversion models against an extensive database of measured statistics is conducted, with the objective of determining the best performing conversion technique.

| 16:40 | **Enhanced Analysis of Propagation Over Irregular Terrain** | We-97 |

Schejbal, Vladimir[1]; Fiser, Ondrej[2]
[1]University of Pardubice, Studentska 95, 532 10, Pardubice, CZECH REPUBLIC;
[2]Faculty of Electrical Engineering and Informatics, University of Pardubice, Studentska 95, 532 10 Pa, CZECH REPUBLIC

An enhanced analysis of propagation over irregular terrain using physical optics approximation of vector problem is presented. It offers more reliable numerical simulations for low altitude propagation and diffraction field zone without any auxiliary procedures. Numerical simulations are compared with measurement results and various approximate methods. Keywords: Microwave propagation; rough surface; physical optics; numerical analysis

Time	Title	Abs No
16:40	**Wide Angle SAR for Stationary Applications**	We-46

Essen, Helmut; Wahlen, A; Sommer, R.; Johannes, W.
Fraunhofer Institute for High Frequency Physics and Radar TEchniques, GERMANY

A millimeterwave radar mounted on a fixed rail is used to survey a terrain using a synthetic aperture approach. Different SAR algorithms are tested with respect to best imaging quality and processing speed.

16:40	**Advanced Radar Cross Section Clutter Removal Algorithms**	We-48

Bati, Andre[1]; To, Long[2]; Hilliard, Don[2]
[1]US Navy, UNITED STATES;
[2]Dept of Navy, UNITED STATES

Producing good quality radar cross section (RCS) measurement data of a target is proportional to the extent of clutter mitigation. Although RCS measurements usually include clutter reduction methods, typically some level of clutter remains in the target data. In order to achieve maximum RCS data quality several computational clutter removal algorithms have been developed, each having strengths and weaknesses, which is the subject of this paper.

16:40	**Far - Field Reconstruction Using Outdoor Transient Measurements for Narrow and Wide Band Radiating Sources**	We-50

RAMMAL, Rabia[1]; Lalande, Michele[2]; Martinod, Edson[2]; Feix, Noel[2]; Jouvet, Marc[2]; Jecko, Bernard[2]
[1]XLIM, FRANCE;
[2]xlim, FRANCE

in order to get far field radiation patterns for any radiating source from transient acquisition, an outdoor transient Ultra-Wideband near-field measurement base has been installed; a single time pulse radiated by the source covers the desired spectrum, and the accurate determination of far field radiations is accomplished by means of cylindrical waves' modal development. This method uses simplified test equipments, easy to be installed, and it reduces measurement cos

16:40	**Experimental Analysis of Electromagnetic Scattering by Rotating Blades**	We-54

Meng, Z.J.; L¨[1], M.Y.; Wu, Z.
Beihang University, CHINA

The high frequency backscattering by rotating skew-plated metal blades was investigated experimentally. Radar cross section (RCS) was measured in an anechoic chamber. The RCS spectra, relating to Doppler effect, were got by fast Fourier transform (FFT) from time-domain signature. The main characteristics are the periodic fluctuating of time-domain RCS and the asymmetry of RCS spectrum. The results agree well with the computational analysis of past literature.

16:40	**Reconstruction of Antenna Radiation Pattern at 310 GHz Using Image Compression Methods**	We-56

Puskely, Jan; Novacek, Zdenek
Department of Radio Electronics, BUT, CZECH REPUBLIC

The novel phase retrieval approach combines a global optimization with a compression method. The global optimization method (PSO) is used to minimize the functional, and the compression method (DWT, DCT) is used to reduce the number of unknown variables. Pros and cons of the compression methods are investigated and reported for the solution of the problem. The method is examined measuring the lens antenna.

16:40	**The Use of Infinitesimal Dipoles and the Spherical Wave Expansion for Planar Antennas** Modeling	We-58

SERHIR, MOHAMMED[1]; BESNIER, Philippe[2]; Ribiere-Tharaud, Nicolas[3]; DRISSI, M'hamed[4]
[1]Supelec, FRANCE;
[2]INSA de Rennes/Institut d'Electronique et Telecommunication de Rennes, FRANCE;
[3]Supelec / Laboratoire des Signaux et Systemes, FRANCE;
[4]INSA de Rennes/Institut d'Elec, FRANCE

In this paper, a method to derive an equivalent radiation model for planar antennas is presented. This method uses the spherical near-field (NF) data to ascertain an equivalent set of infinitesimal dipoles placed over the main antenna surface. The spherical wave expansion (SWE) of the NF data is written in terms of infinitesimal dipoles using a transition matrix. This matrix expresses the linear relations between the spherical wave coefficients (SWC) of the antenna and the SWC of each dipole.

16:40 **Robust Antenna Diagnostics Method Using Equivalent Elemental Dipoles and the Spherical Wave Expansion** We-60

SERHIR, Mohammed; Ribiere-Tharaud, Nicolas; Picard, Dominique
Supelec / Laboratoire des Signaux et Systèmes, FRANCE

A robust method for antenna diagnostics that can provide the reconstruction of the aperture field from spherical near- or far-field measurements, is presented. This method is based on the equivalence principle which consists in the rewriting of the spherical wave expansion of the radiated field in terms of infinitesimal electric and magnetic dipoles distributed over the antenna main surface. This method presents the advantage of being very stable and extremely robust beside the measurement noise

16:40 **Review of Instruments and Techniques for Tropospheric Calibration in Radio Science Experiments** We-64

Graziani, Alberto[1]; Tortora, P[1]; Martellucci, A[2]
[1]University of Bologna, ITALY;
[2]ESA/ESTEC, NETHERLANDS

In the framework of the Mercury Orbiter Radioscience Experiment, stringent noise level requirements have been defined for Earth troposphere calibration systems. The use of a stable microwave radiometer can guarantee the expected experiments results. An analysis of the novel ESA/ESTEC radiometer has been carried out in order to evaluate its characteristics.

16:40 **An Accurate and Efficient Error Predictor Tool for CATR Measurements** We-66

Cappellin, Cecilia[1]; Sørensen, S.B.[1]; Paquay, M.[2]; Østergaard, A.[2]
[1]TICRA, DENMARK;
[2]ESTEC, European Space Research and Technology Centre, NETHERLANDS

An accurate and efficient numerical model is developed to simulate the far field of an antenna under test measured in a Compact Antenna Test Range, on the basis of the known quiet zone field and the theoretical aperture field distribution of the AUT. The model takes into account the movement of the AUT within the quiet zone and is valid for any CATR and AUT of which the quiet zone and aperture field, respectively, are known. Simulated results as well as real measurements data are provided.

16:40 **2x2 Real-Time Code-Division Multiplexed MIMO Channel Sounder** We-68

García-Pardo, C.; Molina-Garcia-Pardo, J.M.; Rodríguez, J.V.; Juan-Llácer, L.
Technical University of Cartagena, SPAIN

In this paper, a 2x2 time-domain Multiple-Input Multiple-Output (MIMO) channel sounder is presented. The developed system is based on Code Division Multiplexed (CDM) signals. It is formed by a base band pulse generator, a wideband I/Q modulator and a digital store oscilloscope. This system is compared to a frequency domain channel sounder by means of measurements in order to assure the accuracy of such measurements.

16:40 **Innovative Technique for Indoor Large Radar Arrays Testings** We-72

D'Urso, Michele[1]; Buonanno, Aniello[2]; Prisco, Giancarlo[2]
[1]SELEX Sistemi Integrati, ITALY;
[2]Selex Sistemi Integrati, ITALY

A flexible approach for synthesizing linear sparse arrays able to radiate plane waves in near zone is proposed and applied to cases of practical interest. The number of radiating sources, the dimensions, the array element positions and their weights are deterministically determined such to achieve the desired goal. Numerical examples, dealing with linear arrays are presented, thus fully confirming potentialities of the proposed tools and algorithms.

16:40 **Interference Minimisation of Antenna-to-Range Interface for Pattern Testing of Electrically Small Antennas** We-74

Loh, Tian Hong[1]; Alexander, Martin[1]; Miller, Philip[1]; Betancort, Andrés López[2]
[1]National Physical Laboratory, UNITED KINGDOM;
[2]University of Las Palmas de Gran Canaria, SPAIN

Accurate radiation characterisation of electrically small antennas (ESAs) requires a reflectionless environment and minimal antenna support and cable disturbance. A study was carried out at the UK NPL of disturbance minimisation in the radiation pattern measurement of ESAs. Electro-optical transducer was employed and the shielding effect of different transducer designs is assessed. Numerical and measured results for the radiation pattern of an ESA using an EO transducer or a cable are compared.

16:40 **Miniature Antenna Radiation Pattern Measurement Using Fiber-Optic Link** We-76

Hachemi, Mohamed; Bories, S; Haj Khlifa, K; Delaveaud, C
CEA-LETI Minatec Grenoble, FRANCE

The coaxial cable used to characterize small antennas causes performances degradation. To avoid the cable perturbations a test-bench, composed by fiber optic link components, is used in the miniature antenna radiation pattern characterization.

16:40 **A SVD-Based Approach to Helicoidal NFFF Transformations** We-78

Capozzoli, Amedeo[1]; Curcio, C[1]; D'Elia, G[1]; Ferrara, F[2]; Gennarelli, C[2]; Guerriero, R[2]; Liseno, A[1]
[1]Università di Napoli Federico II, ITALY;
[2]Università di Salerno, ITALY

We propose a NFFF technique for aperture antennas and cylindrical scanning. It exploits an aperture field representation, using Prolate Spheroidal Wave Functions. It allows a fast acquisition by an helicoidal scan based on a nonredundant field representation. The problem is faced as the inversion of a linear relation and solved by a regularized SVD approach. Experimental results show how it enables a serious reduction of the field samples without impairing the accuracy.

16:40 **P-Band Feed Design and Optimisation for Compact Antenna Test Range** We-80

Foged, Lars Jacob[1]; Duchesne, Luc[2]; Rosa, Alessandro[3]; Lopez, Jean-Marc[4]; Belot, Daniel[4]
[1]SATIMO, ITALY;
[2]SATIMO, FRANCE;
[3]Consultant, ITALY;
[4]CNES, FRANCE

A single polarized P-band feed, consisting of an array of 4 high gain log-periodic elements has been designed, manufactured and tested for use as illuminator in a compact antenna test range. This paper describes the antenna design trade-off activity, selection of the candidate antenna technology, manufacturing and final testing including considerations on the associated measurement uncertainty in the SATIMO SG-64 multiprobe spherical near field test range used for the acceptance testing.

16:40 **On the number of OTA antenna elements for plane-wave synthesis** We-82

Laitinen, Tommi[1]; Kyosti, P.[2]; Nuutinen, J.[2]; Vainikainen, P.[1]
[1]TKK, FINLAND;
[2]Elektrobit, FINLAND

To provide background scientific information for the on-going development process of an over-the-air (OTA) test standard for MIMO (multiple input multiple output) terminals, this paper presents a theoretical study on the generation of the plane-wave conditions to the test zone with a finite number of OTA antennas. In particular, such a MIMO-OTA test system is considered, where the OTA antennas lie in the horizontal plane on a circle around the test zone.

Session:	**P06P1: Mobile Channel Modeling 3**
Type:	Propagation Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 113
Chairs:	N. Cardona
	R. Prieto

Time	Title	Abs No
08:30	**Radio Propagation Models for DVB-H Networks**	P06P1-1

Salieto, Ariana; Roig, Gema; Gómez-Barquero, David; Cardona, Narcís
Universidad Politécnica de Valencia, SPAIN

This article studies the suitability of different propagation models for the European mobile TV standard DVB-H. Three propagation models are analyzed: Okumura-Hata, Xia-Bertoni, and a model based on the Hata formulae adding a diffraction term calculated using the Deygout method. The performance of the different models is evaluated with several measurement campaigns carried out in several scenarios with different conditions such as transmitter height, UHF frequency or geographical data.

| 08:50 | **Impact of the Correlation Matrix Estimation Accuracy on the Computation of Stationarity Intervals** | P06P1-2 |

Renaudin, O.[1]; Kolmonen, V.M.[2]; Vainikainen, P.[2]; Oestges, C.[1]
[1]Universite catholique de Louvain, BELGIUM;
[2]TKK Helsinki University of Technology, FINLAND

The correlation matrix distance (CMD) measures the amount of change in the spatial structure of the MIMO channels, for the transmit (Tx) or receive (Rx) side but also for the full channel. Based on the CMD definition, stationarity intervals can then be characterized. In this paper, we analyze the influence of the correlation matrix estimation on the computation of these stationarity intervals, using measured vehicle-to-vehicle (V2V) channels.

| 09:10 | **Mobile Satellite Channel with Angle Diversity: the MiLADY Project** | P06P1-3 |

Heyn, Thomas[1]; Eberlein, Ernst[1]; Arndt, Daniel[2]; Matuz, Balazs[3]; Lazaro Blasco, Francisco[3]; Prieto-Cerdeira, Roberto[4]; Rivera-Castro, Juan[4]
[1]Fraunhofer Institut für Integrierte Schaltungen, Erlangen, GERMANY;
[2]Fraunhofer Institut für Integrierte Schaltungen, Ilmenau, GERMANY;
[3]German Aerospace Center (DLR), GERMANY;
[4]European Space Agency, ESTEC, NETHERLANDS

Future broadcasting to mobile services may consider satellite angle diversity to overcome fading propagation effects on the Land Mobile Satellite (LMS) channel. Two experimental campaigns for gathering relevant experimental data and improve angle diversity models has been carried out in the MiLADY project, one in the US using the XM Sirius satellites, and one in Europe using GPS. Project main focus is on the analysis of multi-satellite systems and the consolidation of narrowband channel model.

| 09:30 | **Propagation Measurements a 3.5 GHZ in a Dense Urban Area** | P06P1-4 |

da Silva Mello, L.; Rodriguez Ron, C.
PUC/Rio, BRAZIL

This paper presents partial results of wideband propagation channel measurements at 3.5 GHz in an urban area in Rio de Janeiro, Brazil. Results include multipath delay profile characterization and comparison of measured path loss and predictions using ITU-R and SUI models.

| 09:50 | **Statistical Characterization of the MW Field Spatial Variability in Urban Environments Using the Generalized Lee Method.** | P06P1-5 |

Gil, Unai; Pena, I.; Angulo, I.; Angueira, P.; de la Vega, D.; Guerra, D.
University of the Basque Country, SPAIN

This paper present an analysis and validation of the Generalized Lee Method in order to statistically characterize the spatial variability of the field strength in the medium wave band and urban environments. The statistical characterization of both, the two components forming the field strength signal, the long and short-term variability are studied and finally a validation of this method for this particular case of application is analyzed.

| 10:10 | **Validation of Estimated Dense Multipath Components with Respect to Antenna Calibration Accuracy.** | P06P1-6 |

Käske, Martin; Thomä, Reiner
Ilmenau University of Technology Germany, GERMANY

The paper will propose a method to determine the accuracy of measured antenna array beampatterns. Furthermore, it will show how this method can be used to verify results from high resolution parameter estimation. The focus is on the estimation of diffuse scattering and how it can be distinguished from estimation artifacts.

Session:	**C34P1: Terahertz antennas and systems - 1**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 119
Chairs:	N. Llombart
	M. Siegel

Time	Title	Abs No
08:30	**Trade-Offs in Multi-Element Receiving Antennas with Superconducting Feed Lines**	C34P1-1

Iacono, A.[1]; Coenen, T. J.[2]; Bekers, D. J.[2]; Neto, A.[2]; Gerini, G.[2]
[1]TUe, NETHERLANDS;
[2]TNO, NETHERLANDS

Kinetic Inductance Detectors are widely accepted as receivers for Terahertz imaging. They are realized on superconductors and, exploiting the Cooper-pairs breaking by photons, they are able to sense incoming Terahertz radiation. In this paper we investigate the impact that the related absorption mechanism has on the angular dependence of the receiving system.

08:50	**Terahertz Subsurface Imaging System**	C34P1-2

Nova, E.; Abril, J.; Guardiola, M.; Capdevila, S.; Broquetas, A.; Romeu, J.; Jofre, L.
Universitat Politecnica de Catalunya, SPAIN

A subsurface imaging system based on a terahertz time-domain spectrometer (THz-TDS) is described in this paper. The system performance has been simulated in terms of spatial resolution, penetration capabilities and SNR. Moreover, a commercial THz-TDS has been used to perform the proof-of-concept of the described system.

09:10	**Measurements of High-Gain Antennas at THz Frequencies**	C34P1-3

Raisanen, A.V.; Ala-Laurinaho, J.; Karttunen, A.; Mallat, J.; Tamminen, A.; Vaaja, M.
Aalto University School of Science and Technology, FINLAND

Measurements of high-gain antennas at THz present challenges for traditional antenna measurement techniques. Far-field measurements are not feasible because of the large far-field distance requirement and therefore inevitable signal attenuation and distortions. Adequate accuracy in the collimating element manufacturing is the major issue in the compact antenna test ranges, and the realisation of the accurate planar movement of the probe is the main challenge in the planar near-field measurements.

09:30	**A New Analytical Model for Log-Periodic Terahertz Antennas**	C34P1-4

Scheuring, A.; Stockhausen, A.; Wuensch, S.; Ilin, K.; Siegel, M.
Karlsruher Institut fuer Technologie (KIT), GERMANY

In this paper a novel model about the principle of operation of log-periodic Terahertz (THz) antennas is proposed. In the theoretical part analytical calculations are opposed to the results of electromagnetic field simulations. For the experimental validation of the novel theory large-scale models in the GHz range were investigated. All considered antenna structures exhibit an excellent coincidence between calculations, simulations and measurements.

09:50	**Active and Passive THz Systems for Short-Range Imaging Applications**	C34P1-5

Abril, J.; Nova, E; Capdevila, S; Broquetas, A; Torres, F; Jofre, L
UPC, SPAIN

In this paper three different systems at 94 GHz for short-range imaging applications are presented; both active and passive methodologies are described. A T-shape interferometric radiometer is first exposed. Then, a Mills-Cross based active system is presented; recovered images are shown. Finally, a reflectarray setup is described; presenting its geometry of exploration and operation principles. For both active systems the minimum detectable Radar Cross Section, RCS is computed.

Session:	**C25P1: Fast and asymptotic methods for large antennas and scatterers - 1**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 120
Chairs:	C. Letrou
	A. Boag

Time	Title	Abs No
08:30	**Solving Multi-Scale Low Frequency Electromagnetic Problems**	C25P1-1

Qian, Z.G.[1]; Li, M.K.[2]; Ma, Z.-H.[3]; Jiang, L.-J.[4]; Chew, W.C.[5]
[1]University of Illinois at UC, UNITED STATES;
[2]Schlumberger-Doll Research, UNITED STATES;
[3]University of Hong kong, HONG KONG;
[4]University of Hong Kong, HONG KONG;
[5]The University of Hong Kong, HONG KONG

We discuss two methods to tackle the low-frequency, multi-scale electromagnetics problem. First we will discuss the augmented electric field integral equation (AEFIE), and then, we will discuss the equivalence principle algorithm (EPA). The AEFIE allows the solution of such problems without the need to perform a loop search of a complex structure. The EPA allows the separation of circuit physics from wave physics in a multiscale problem.

Time	Title	Abs No
08:50	**Physical Optics for Large Scale Electromagnetic Scattering Problems**	C25P1-2

Pouliguen, Philippe[1]; Hémon, Régis[2]; Damiens, Jean-François[3]
[1]DGA/CELAR, FRANCE;
[2]DGA, FRANCE;
[3]DGA Information Superiority, FRANCE

Physical Optics (PO) has been used for a long time to compute RCS of targets and antenna radiation in situ, for structures larger than the wavelength. In this communication, problems as near field scattering, shadow region diffraction and cavity radiation are particularly investigated. Enhancements of PO to solve such large scale problems are presented, followed by validations obtained by comparison with measurements and exact method.

Time	Title	Abs No
09:10	**Application of Gaussian-Beam Based Techniques to the Quasi-Optical Systems of Radiofrequency Radiometers**	C25P1-3

Chabory, Alexandre[1]; Sokoloff, Jérôme[2]; Bolioli, Sylvain[3]; Elis, Kevin[1]
[1]ENAC, FRANCE;
[2]Université Paul Sabatier, FRANCE;
[3]ONERA, FRANCE

The electromagnetic performances of the quasi-optical systems may be critical in the design of a mm-wave radiometer. we propose to compute these performances by means of gaussian-beam based techniques. Numerical and experimental tests reveal a good trade-off between the accuracy and the computational effort.

Time	Title	Abs No
09:30	**Scaling of the MultiLevel Physical Optics Parallel Algorithm on a Large Grid**	C25P1-4

Parrot, C.[1]; Millot, D.[1]; Letrou, C.[1]; Boag, A.[2]
[1]TELECOM SudParis, FRANCE;
[2] Tel Aviv University, ISRAEL

The MultiLevel fast Physical Optics (MLPO) algorithm, based on hierarchical domain decomposition and phase compensated interpolation, allows to perform Physical Optics integrals with a computational complexity comparable to that of FFT. An optimized distributed memory parallelized MLPO algorithm has been designed by partitioning not only the radiating aperture but also the grid of far field directions. The scalability of this algorithm on a large grid is discussed, based on an MPI-parallelized code.

Time	Title	Abs No
09:50	**Fast Physical Optics for Smooth Surfaces**	C25P1-5

Ferrando-Bataller, M; Vico-Bondia, F; Valero-Nogueira, A.
Universidad Politecnica de Valencia, SPAIN

A technique to compute the physical optics (PO) integral is presented. This technique is based on a decomposition of the surface in small triangles and a fast evaluation of each triangle by means of a deformation of the integration path in the complex plane. This algorithm permits a fast and accurate evaluation of the PO integral for smooth large surfaces. The technique consist of a blind code that computes the different contributions (stationary phase points, end points, etc.) numerically.

Time	Title	Abs No
08:30	**A ThIn Surface Wave Antenna Using a Via-Less EBG Structure for 2.45 GHz On-Body Communication Systems**	A17-1

Khouri, Rami[1]; Ratajczak, P.[1]; Brachat, P.[1]; Staraj, R.[2]
[1]Orange Labs, FRANCE;
[2]LEAT- Université de Nice, FRANCE

A 2mm-thick surface wave antenna suited for On-Body communication systems is presented. The antenna consists in an artificial ground plane excited by a center-fed circular patch and exhibits a monopole-like radiation pattern. The proposed antenna performances are evaluated thanks to a tissue-equivalent numerical phantom and compared to other existing wearable antennas found in the literature.

08:50	**Characterization of Phantom Size and Link Budget for Off-Body Communications**	A17-2

García, J.[1]; Arriola, A.[2]; Sasiain, G.[2]; Valderas, D.[1]; Sancho, J.I.[1]; Chen, X.[3]
[1]CEIT and Tecnun (University of Navarra), Pº Manuel Lardizabal 15, 20018 San Sebastian, SPAIN;
[2]Ikerlan,Pº. J. Mª. Arizmendiarrieta 2, 20500 Arrasate-Mondragón, SPAIN;
[3]Dept of Electronic Eng, Queen Mary, University of London, London E1 4NS, UNITED KINGDOM

This paper presents a characterization of antennas for off-body communications on a minimal size phantom, which is still representative of the whole human body. Two equivalent PIFA antennas have been designed at different scales to study the body impact at 868 MHz and 2.45 GHz bands. The average gains on the horizontal plane are -0.93 dBi and 0.16 dBi respectively. The link budgets at these two frequencies show their different features in physiological parameters monitoring applications.

09:10	**Circularly Polarized Textile Antenna for Personal Satellite Communication**	A17-3

Kaivanto, E.[1]; Berg, M.[1]; Salonen, E.[1]; Lilja, J.[2]
[1]Centre for Wireless Communications, FINLAND;
[2]Patria Aviation Oy, FINLAND

In this paper an antenna constructed completely of textile materials is presented. The antenna is designed for Iridium satellite system at frequency band from 1621.35 MHz to 1626.5 MHz. Measurements prove that this antenna radiates very efficiently and maintains good performance and right hand circular polarization even when bent.

09:30	**SAR Reduction of Wearable Antennas Using Polymeric Ferrite Sheets**	A17-4

Augustine, Robin[1]; Alves, Thierry[2]; Zhadobov, Maxim[1]; Poussot, Benoit[2]; Sarrebourse, Thierry[3]; Sauleau, Ronan[1]; Mathew, Thomas. K[4]; Laheurte, Jean Marc[2]
[1]IETR, FRANCE;
[2]ESYCOM, FRANCE;
[3]France Telecom, FRANCE;
[4]CUSAT, INDIA

Specific Absorption Rate (SAR) reduction has now become a buzz word due to the growing health concerns over microwave exposure. Ferrites are found to be effective in diminishing electromagnetic influence. In this work flexible polymeric ferrite sheets are characterised on the basis of their shielding efficiencies. SAR measurements are done with planar wearable antenna and polymeric ferrite shielding to confirm its competence.

09:50	**A Bluetooth Antenna for On-Body Communications**	A17-5

SUBRAMANIAM, SANKARALINGAM; Gupta, Bhaskar
Jadavpur University, INDIA

This paper presents design and development of a circular patch antenna for on-body wireless communications. The conducting parts of this antenna are made up of copper and polyester fabric is chosen as the dielectric substrate material. Both input impedance and radiation patterns are determined experimentally when the antenna is kept in flat position. The impedance characteristics of the antenna are investigated under bent conditions too to check compatibility with wearable applications.

10:10	**Wearable Textile GPS Antenna For Integration In Protective Garments.**	A17-6

Vallozzi, L.; Vandendriessche, W.; Rogier, H.; Hertleer, C.; Scarpello, M.
Ghent University, BELGIUM

In the context of wearable textile systems for rescue workers, the knowledge of the position of the mobile operator is a crucial information for coordination of interventions. A GPS textile wearable patch antenna, fully integrable into protective garments and resilient to real-work disturbances, is proposed. Performance, studied by means of measurements in open space and in two real-work situations, are sufficiently satisfactory and promising for application in wearable textile systems.

Session:	**A18P1: Metamaterial 1**
Type:	Measurement Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 122-123
Chairs:	O. Kilic
	J. Esteban

Time	Title	Abs No
08:30	**Bio-Inspired Optimization Techniques for the Design of Millimeter Wave Antireflective Surfaces**	A18P1-1

Kilic, Ozlem[1]; Mirotznik, M.[2]; Good, B.[3]
[1]The Catholic University of America, UNITED STATES;
[2]University of Delaware, UNITED STATES;
[3]NSWCCD, UNITED STATES

This paper presents the application of bio-inspired optimization algorithms to electromagnetics problems. The problem considered is the design of antireflective surfaces with sub-wavelength gratings. The rigorous coupled wave analysis is used to model the reflection properties of the material. Bio-inspired optimization methods such as the particle swarm optimization and ant colony optimization are used to determine the optimal parameters for the desired performance.

| 08:50 | **Composite Right-/Left-Handed Interdigital Leaky-Wave Antenna** | A18P1-2 |

on a Substrate Integrated Waveguide
Weitsch, Y.; Eibert, T.F.
Technische Universität München, GERMANY

The successful concept of a composite right-/left-handed (CRLH) leaky-wave antenna based on a periodically loaded and dielectrically-filled rectangular hollow waveguide as proven before is realised by single layer printed technology. The dispersion results are validated on two independent methods. The input reflection as well as the radiation behaviour of a fabricated prototype is measured. The gain is promising and the cross-polarisation is especially low.

| 09:10 | **Constraints on the Temporal Dispersion of Metamaterials** | A18P1-3 |

Gustafsson, Mats; Sjoberg, D
Lund University, SWEDEN

The frequency dependence of the permittivity, permeability, and index of refraction restrict metamaterial applications such as cloaking and perfect lenses. Here, the principles of causality and passivity together with identities for Herglotz functions are used to construct various sum rules. The sum rules relate the frequency dependence of the material parameters with their high- and low-frequency values.

| 09:30 | **Control of the Radiation Properties of a FSS Loaded Leaky-Wave Antenna** | A18P1-4 |

Garcia-Vigueras, M; Guzman-Quiros, R; Gomez-Tornero, J. L.; Quesada-Pereira, F.D.; Alvarez-Melcon, A.
Technical University of Cartagena, SPAIN

This work presentsa novel leaky-wave antenna (LWA), conceived from the insertion of a dipole-based frequency selective surface (FSS) into a top-open rectangular waveguide. It is explained how the printed circuit has the ability to control the radiation rate of the leaky modes that propagate through this structure at a certain frequency. This attribute makes possible the tapering of the radiation diagram of the LWA. In particular, it is possible to reduce the sidelobes level.

| 09:50 | **MU and Epsilon-Near-Zero Metamaterial-Assisted Horn Antenna** | A18P1-5 |

Semenenko, Vladimir; Lagarkov, Andrey; Chistyaev, Vladimir; Krasnolobov, Igor; Basharin, Alexey
Institute for Theoretical and Applied Electromagnetics of Russian Academy of Sciences (ITAE RAS), RUSSIAN FEDERATION

The suppression of horn side lobes and backward radiation due to application of metamaterial in the horn design have been demonstrated experimentally. It was shown that the electromagnetic frequency corresponding to zero values of real parts of metamaterial permittivity and permeability is preferable for side lobes suppression in comparison with positive and negative parameters. The experimental antenna patterns are in good compliance with numerical simulation results.

| 10:10 | **New Approach to the Analysis of Bi-periodic Cylindrical Structures and its Application to a Wire Medium.** | A18P1-6 |

Varela, J. E.[1]; Esteban, J.[1]; Camacho-Penalosa, C.[2]
[1]Universidad Politécnica de Madrid, SPAIN;
[2]Universidad de Málaga, SPAIN

The characterization of discontinuities in periodic structures with the generalized scattering matrix (GSM) is proposed. These GSMs are obtained by means of a field-matching method and used in combination with the generalized transverse resonance technique (TRT) to analyze bi-periodic structures. In this contribution the proposed method is described and the particular example of a wire medium is analyzed.

Session:	**C32P1: New waveguides for millimeter wave based on metamaterials - 1**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 124
Chairs	E. Rajo-Iglesias
	A. Polemi

Time	Title	Abs No

08:30 Planar metamaterial guiding from the perspective of geometrically induced surface plasmons   C32P1-1

Navarro-Cia, M.[1]; Agrafiotis, S.[2]; Beruete, M.[1]; Falcone, F.[1]; Sorolla, M.[1]; Maier, S. A.[2]
[1]Universidad Pública de Navarra, SPAIN;
[2]Imperial College London, UNITED KINGDOM

Engineering concepts like equivalent circuit models are effective tools to design surface waves-like plasmons for planar guiding with subwavelength confinement. These concepts allow merging plasmonics and metamaterials with engineering perspective. In this work, classical geometrically induced surface plasmons have been analysed. A complementary split-ring resonators-based configuration has been proposed with an improved energy in- and out-of-plane confinement compared with classical proposals.

08:50 Power Divider in Ridge Gap Waveguide Technology   C32P1-2

Alfonso, E[1]; Baquero, M[1]; Valero-Nogueira, A[1]; Herranz, J.I[1]; Kildal, P.-S[2]
[1]ITEAM, Universidad Politecnica de Valencia, SPAIN;
[2]Chalmers University of Technology, SWEDEN

A power divider in ridge gap waveguide technology has been designed to work at 15GHz. Measurements and simulations are provided. Besides, a broad numerical study of the characteristic impedance of a ridge gap waveguide is presented.

09:10 Efficient Spectral Domain Green's Function Analysis of Novel Metamaterial Bandgap Guiding Structures   C32P1-3

Bosiljevac, M.[1]; Sipus, Z.[1]; Kildal, P.S.[2]
[1]University of Zagreb, CROATIA;
[2]Chalmers University of Technology, SWEDEN

The purpose of the presented paper is to give the derivation of the Green's functions of oversized waveguides with wall realized as a periodic structure. Two different realizations of the were considered: bed-of-nails model and the mushroom surface. The applied analysis method avoids the complexity of the Floquet mode approach by using appropriate asymptotic boundary conditions for the observed periodic structure.

09:30 Approximated Closed Form Characteristic Impedance for the Bed of Nails-based Gap Waveguide   C32P1-4

Polemi, A.[1]; Maci, SM[2]; Kildal, P-S[3]
[1]University of Modena, ITALY;
[2]University of Siena, ITALY;
[3]Chalmers University, SWEDEN

The parallel-plate ridge gap waveguide has been introduced recently. The metamaterial surface is designed to provide a frequency band where parallel-plate modes are in cut-off. In this paper, the investigation upgrades the analytical expression of the modal dispersion equation given previously, by including the first higher order mode. Furthermore, the characteristic impedance of the dominant mode is analytically calculated, by means of three different closed form expre

09:50 Losses in Ridge Gap Waveguide compared with Rectangular Waveguides and Microstrip Transmission Lines   C32P1-5

Pucci, E.[1]; Uz Zaman, A.[1]; Rajo-Iglesias, E.[2]; Kildal, P.-S.[1]; Kishk, A.[3]
[1]Chalmers University of Technology, SWEDEN;
[2]Universidad Carlos III de Madrid, SPAIN;
[3]University of Mississippi, UNITED STATES

A study and quantification of losses in ridge gap waveguide, compared to losses in ideal standard rectangular waveguide and microstrip transmission line is presented. The study is performed by evaluating the quality factor of resonators made of ridge gap waveguide, rectangular waveguide and microstrip line. Results will show that the ridge gap waveguide is very low loss.

Session:	**C13P1: Research projetcs on EM biointercation - 1**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 125
Chairs	I. Karlsson
	M. Persson

Time	Title	Abs No
08:30	**2D Microwave Tomographic System for Extremities Imaging: Initial Performance Assessment in Animal Trial**	C13P1-1

Semenov, Serguei[1]; Kellam, J.[2]; Williams, T.[2]; Quinn, M.[2]; Nair, B.[1]
[1]Keele University, UNITED KINGDOM;
[2]Carolinas Medical Center, UNITED STATES

Extremities soft tissues imaging is one of potential applications of Microwave Tomography. Early, in non-imaging experiments we have demonstrated the feasibility of the technology for such applications. We have recently developed a 2D MWT system dedicated for imaging of animal extremities. The goal of this work was to assess the technical performance of the system in sensing physiological signatures within measured complex signals and to obtain initial imaging results in animal experiments.

08:50	**Stroke Detection Using a Broad Band Microwave Antenna System**	C13P1-2

Fhager, Andreas; McKelvey, T; Persson, M
Chalmers University of Technology, SWEDEN

In this paper we describe a microwave based measurement setup and a signal processing algorithm for stroke detection and diagnostics.

09:10	**Antenna System for Clinical Microwave Tomography**	C13P1-3

Fhager, Andreas; Romputtal, A; Persson, M
Chalmers University of Technology, SWEDEN

Microwave tomography is currently being widely researched for breast cancer detection. Our research has shown that clinical imaging preferably has to be made in a full 3D setting. In this presentation we discuss numerical studies in order to design a clinical system and to evaluate its expected performance.

09:30	**Clinical Trials of a UWB Imaging Radar for Breast Cancer**	C13P1-4

Klemm, M; Craddock, I.; Leendertz, J; Preece, A; Gibbins, D.; Shere, M.; Benjamin, R.
University of Bristol, UNITED KINGDOM

This contribution presents a selection of phantom and clinical results from a prototype multistatic imaging radar designed and built at Bristol. Complex phantoms are employed in order to approximate the difficulty in imaging breast tissue, however, even so, imaging in a clinical environment poses particular challenges.

09:50	**Time-Reversal System for Microwave Hyperthermia**	C13P1-5

Hana , Dobsicek Trefna[1]; Togni, Paolo[2]; Shiee, Reza[1]; Persson, Mikael[1]
[1]Chalmers University of Technology, SWEDEN;
[2]Czech Technical University in Praque, CZECH REPUBLIC

In this contribution, we present the first experimental results obtained with a prototype of a new system for microwave hyperthermia based on time-reversal algorithm.

Session:	**A19: Array design 3**
Type:	Antennas Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 127
Chairs	C. Montesano
	M. Schneider

Time	Title	Abs No
08:30	**A Compact Ku-Band Transmit/Receive Low-Profile Antenna for Broadband Mobile Satellite Communications**	A19-1

Tiezzi, F.; Llorens, D.; Dominguez, C.; Fajardo, M.
JAST SA, SWITZERLAND

This paper presents the design of a low-profile planar array antenna for Ku-band mobile satellite communications systems. Thanks to an original design of the radiating elements and combining networks, the antenna uses the full aperture surface for simultaneous transmit and receive operation. The steering approach is hybrid, with mechanical rotation for the azimuth scan and electronic control for the elevation and polarisation angles.

08:50	**Circular Polarized DVB-T Transmitting Antennas**	A19-2

Hahnel, R.[1]; Plettemeier, D.[1]; Wolf, K.[1]; Müller, M.[2]; Mugler, A.[2]
[1]Dresden University of Technology, GERMANY;
[2]MUGLER AG, GERMANY

In the past 40 years the structure of the terrestrial video broadcasting never changed, both for analog and digital broadcasting: One station supplies a large area with a radius of 50km or more. However, to ensure the supply of the entire area, high transmission power is required. Another disadvantage is the fact that there is nearly no possibility to adjust the transmitter with respect to the local topography. To mitigate the above mentioned disadvantages, a new antenna structure is developed.

09:10	**Test Campaign of the IOV (In Orbit Validation) Galileo System Navigation Antenna for Global Positioning**	A19-3

Monjas, Fernando[1]; Montesano, Antonio[1]; Montesano, Carlos[1]; Llorente, Juan José[1]; Cuesta, Luis E.[1]; Naranjo, Margarita[1]; Arenas, Silvia[2]; Madrazo, Israel[2]; Martínez, Leticia[2]
[1]EADS CASA Espacio, SPAIN;
[2]TTI Norte S.L., SPAIN

Within the Galileo project, EADS CASA ESPACIO has been developing the navigation antenna for the space segment of the future European Global Positioning System.The navigation antenna is a flat array with isoflux corrected pattern, circular polarisation, two independent self-diplexed L band (1.15-1.6 GHz) transmit bands operation.This article presents the test results over all the antennas, including RF tests, multipactor qualification tests, PIM tests and environmental qualification tests.

09:30	**X- Band High Gain Antenna Qualified for Mars Atmosphere**	A19-4

Olea, A[1]; Montesano, A[1]; Montesano, C[1]; Arenas, S[2]
[1]EADS-CASA espacio, SPAIN;
[2]TTI Norte, SPAIN

EADS-CASA has developed a X-band High Gain Antenna within a Mars Science Laboratory project under NASA (JPL) contract. The MSL will launch a rover on Mars surface in 2011, to operate for a full Martian year. The HGAS; consists of the High Gain Antenna and the High Gain Antenna Gimbal. EADS-CASA is the responsible of the HGAS and of the HGA with SENER as HGAG supplier. The Mars atmosphere requires submitting the antennas to a specific qualified test campaign according with the mission conditions.

09:50	**Planar Antenna Arrays at 60 GHz Realized on a New Thermoplastic Polymer Substrate**	A19-5

Al Henawy, Mahmoud; Schneider, Martin
University of Bremen, GERMANY

We designed and measured a set of seven different planar antenna arrays for the ISM band at 60 GHz. We measured antenna gains of 14.9 dBi, 16.7 dBi, and 20.5 dBi and efficiencies of 70%, 43%, and 26% for the arrays 2×4, 4×4, and 8×8, respectively. Such antennas fit for 60 GHz indoor short range applications. The use of ER182 as a substrate material has the potential to enhance the antenna efficiency and reduce the losses.

Session:	**P07P1: Propagation for Mobile Services**
Type:	Propagation Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 128
Chairs	W. Joseph
	N. Cardona

Time	Title	Abs No
08:30	**In Body Path Loss Model for Homogeneous Human Muscle, Brain, Fat and Skin Tissues.**	P07P1-1

Kurup, Divya; Joseph, W; Vermeeren, G; Martens, L
Ghent University, BELGIUM

In this paper, we study the wave propagation within various lossy homogeneous human tissues such as the muscle tissue, brain, skin, and the fat layer at 2.4 GHz using insulated dipole antennas. Path loss (PL) in these tissues is determined by means of measurements and simulations, based on which suitable path loss models are proposed. We further investigate the influence of the insulation thickness of the insulated dipoles on the antenna resonance frequency.

| 08:50 | **SNR Estimation for On Body Communications in MB OFDM Ultra Wide Band Communications** | P07P1-2 |

Betancur, Leonardo[1]; Barrera, Melisa[2]; Navarro, Andres[3]; Cardona, Narcis[4]; M. Rodrigo, Vicent[4]
[1]Universidad Pontificia Bolivariana, COLOMBIA;
[2]Universidad De Antioquia, COLOMBIA;
[3]Universidad ICESI, COLOMBIA;
[4]Universidad Politecnica de Valencia, SPAIN

In this paper a new signal to noise ratio estimator algorithm based on the moments of the received signal is presented. The algorithm has been designed for Ultra Wide Band communications (MB OFDM) communication systems. The behavior of ultra wide band channels when the time and frequency fading have fast changes were analyzed. We conclude that the proposed model can be used for SNR estimation in adaptive modulation and channel estimation

| 09:10 | **A Statistical Model of Handsets Effective Gain Accounting for User Influence and Local Propagation** | P07P1-3 |

Sibille, A.; Mellah, M.A.
ENSTA-ParisTech, FRANCE

In this work we investigate the statistical modeling of the radioelectric properties of wireless handsets in close proximity to a user head and without or with the presence of the hand. The analysis is based on a previous work highlighting the general value of such statistical models to describe the properties of terminals in their environment.

| 09:30 | **A Study of the Horizontal Structure of Rain Cells in the U.K. Using the EXCELL Model** | P07P1-4 |

Townsend, Adrian; Watson, R J
University of Bath, UNITED KINGDOM

Five years of radar data has been analysed to determine the horizontal structure of rain cells. Both the HYCELL and EXCELL models were fitted to each rain cell to determine the statistical significance of each fitting parameter. Comparisons were made for all data and seasonal data.

| 09:50 | **A Wide Range Propagation Model** | P07P1-5 |

Michael, Willis[1]; Bacon, D[2]; Craig, K[3]; Rudd, R[4]
[1]STFC, UNITED KINGDOM;
[2]dBSpectrum, UNITED KINGDOM;
[3]Signal Science, UNITED KINGDOM;
[4]Aegis, UNITED KINGDOM

This paper introduces a new Wide Range Propagation Model suitable for terrestrial network planning and for network simulation. The new model is applicable to all terrestrial radio services operating in the frequency range 30MHz to 50GHz and is unique in covering all time percentages from 0-100%. It has been developed for the UK regulator, Ofcom under a two year research project and is intend to be submitted to the ITU-R to form the basis of a new recommendation.

| 10:10 | **Azimuth and Delay Dispersion of Mobile Radio Wave Propagation through Vegetation** | P07P1-6 |

Ghoraishi, Mir[1]; Takada, Jun-ichi[1]; Phakasoum, Chaymaly[1]; Imai, Tetsuro[2]; Kitao, Koshiro[2]
[1]Tokyo Institute of Technology, JAPAN;
[2]NTT DOCOMO Inc., JAPAN

This paper reports a preliminary investigation of the influence of the foliage on the radio wave propagation in cellular scenarios. The purpose is to evaluate the dispersion caused by vegetations in mobile radio channels. The dispersion of the direct path caused by the vegetation in delay and azimuth, measured with a full-polarimetric wideband channel sounder, is investigated by deriving the first and second moments for the delay and azimuth-of-arrival of the diffuse component.

Session:	**A23: Conformal antennas**
Type:	Antennas Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 129
Chairs:	S. Benham
	L. Le Coq

Time	Title	Abs No
08:30	**Dual-Polarized Cylindrically Conformal Microstrip Patch Antennas and Arrays**	A23-1

Vallecchi, A.[1]; Biffi Gentili, G.[2]
[1]University of Siena, ITALY;
[2]University of Florence, ITALY

The design of conformal antenna arrays consisting of dual-polarized microstrip patches with a series-type feed mounted on a finite cylindrical ground is addressed. First, we discuss the characteristics of a single dual-polarized cylindrically conformal microstrip patch. Then, we present small cylindrical arrays made of few conformal patch elements producing either an omnidirectional coverage or sectoral patterns with the radiated field oriented along any of two orthogonal polarizations.

08:50	**Effects of Bending a Planar Antenna Array on Its Scan Performance**	A23-2

Huang, Mingda; Herben, M. H. A. J.
Eindhoven University of Technology, NETHERLANDS

The effects of cylindrically bending of a linear planar antenna array is investigated in order to improve the scan range for 60 GHz indoor applications. The scan range of the bent antenna array can be significantly increased by a proper choice of the array bending angle, antenna element number, and element beamwidth. A bent array based on the BFACP antenna is presented as an example. The effects of different rectangular array configurations instead of a linear array have also been examined.

09:10	**EM Modelling Design of a Conformal IFF System on an Aircraft**	A23-3

Benham, Simon[1]; Murphy, T[1]; Totten, E[1]; Knights, D[1]; Schick, M[2]
[1]SELEX Communications, UNITED KINGDOM;
[2]EM Software & Systems, GERMANY

In this paper a detailed description is given of the initial stages of designing a conformal IFF antenna system (based upon a high impedance surface) for a fast jet aircraft, via the application of EM Modelling, with the use of FEKO.

09:30	**Experimental Investigation of Bent Patch Antennas on MID Substrate**	A23-4

Kornek, Daniel; Slottke, Eric; Orlob, Christian; Rolfes, Ilona
Leibniz Universität Hannover, GERMANY

In this paper a rectangular patch antenna, implemented on a MID substrate, is presented and the influence of the bending angle on the antenna performance is generally described. Subsequently, simulation and measurement results for different inclinations are compared in terms of radiation characteristics and input reflection coefficients. Finally, a compensation approach for the effect on the resonance frequency due to the bending is presented.

09:50	**Millimeter-Wave Printed Antennas on Ultrasoft Polymer Substrate**	A23-5

Hage-Ali, Sami[1]; Tiercelin, Nicolas[1]; Coquet, Philippe[1]; Sauleau, Ronan[2]; Le Coq, Laurent[2]; Fujita, Hiroyuki[3]; Preobrazhensky, Vladimir[1]; Pernod, Philippe[1]
[1]Joint European Laboratory LEMAC, Institute of Electronics, Microelectronics and Nanotechnology(IEMN), FRANCE;
[2]Institut d'Electronique et de Telecommunications de Rennes (IETR), FRANCE;
[3]Institute of Industrial Science (IIS), The University of Tokyo, JAPAN

The use of Polydimethylsiloxane (PDMS), an ultra flexible elastomer, as a substrate for microwave devices in the 60 GHz band is reported. A reliable and robust technological process has been developped to micromachine membrane-supported transmission lines and microstrip antennas. A microstrip antenna array has been designed, fabricated and studied. Promising applications for mechanical beam-steering, beam forming and frequency tunable antennas are expected.

10:10	**Wideband Multibeam Antenna for Integration in Small Platforms**	A23-6

Ouacha, A.[1]; Gunnarsson, R.[1]; Pettersson, L.[1]; Huss, L.-G.[1]; Samuelsson, C.[1]; Lindström, S.[1]; Leijon, S.[1]; Alfredsson, M.[2]
[1]Swedish Defence Research Agency, SWEDEN;
[2]Swedish Defence Material Administration, SWEDEN

A wideband multibeam antenna for integration in small platforms such as UAV's has been demonstrated. The demonstration was performed on a single facet comprising an 8×4 bowtie antenna elements array and a beamforming network which includes both transmitter and receiver chains. The operating frequency band chosen is 6 – 15 GHz. The demonstrated facet can either be used stand alone or forming a faceted array. A compact and lightweight phased array concept for 360o coverage is also discussed.

Session:	**A20: Space applications**
Type:	Antennas Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 130
Chairs	E. Carrasco
	J. Mosig

Time	Title	Abs No
08:30	**Sparse Antenna Array for Earth-Coverage Satellite Applications**	A20-1

Viganó, Maria Carolina[1]; Toso, G.[2]; Angeletti, P.[2]; Lager, I.E.[1]; Yarovoy, A.G[1]; Caratelli, D.[1]
[1]TU Delft, NETHERLANDS;
[2]ESA - ESTEC, NETHERLANDS

A novel analytically based synthesis technique for the design of sparse antenna arrays is presented. The proposed technique permits designing linear arrays generating arbitrarily shaped patterns and it is applied here to the design of an Earth-coverage antenna featuring a shaped radiation pattern with an isoflux uniform illumination on satellite the field of view.

08:50	**Antenna Design for a Direct-to-Earth Link of a Planetary Deep Space Probe**	A20-2

Eichelberger, H.[1]; Prattes, G.[1]; Schwingenschuh, K.[1]; Tokano, T.[2]; Jernej, I.[1]; Besser, B.[1]; Stachel, M.[1]
[1]IWF/ÖAW, AUSTRIA;
[2]IGM, Cologne, GERMANY

This document presents an antenna design for a hot air balloon in the atmosphere of the Saturnian moon Titan in the frame of the proposed ESA/NASA Titan Saturn System Mission (TSSM). We investigate the possibility to establish a Direct-to/from-Earth (Dt/fE) link, i.e. by-passing the orbiter as central relay station for the planatary in-situ elements.

09:10	**Design of Low Scattering Struts for Center-Fed Reflector Antennas**	A20-3

Riel, M.[1]; Brand, Y.[2]; Cassivi, Y.[1]; Demers, Y.[1]; De Maagt, P.[3]
[1]MDA Corporation, Space Missions, CANADA;
[2]Eutelsat S.A., FRANCE;
[3]Electromagnetics & Space Environments Division European Space Agency TEC-EE, NETHERLANDS

In this paper, two configurations of low scattering struts using hard electromagnetic surfaces have been designed and fabricated, which significantly improve the forward scattering performance of conventional metallic triangular rooftop struts in TM polarization. Measurements performed on a Ku-band center-fed reflector antenna with four low scattering struts show significant sidelobe level reductions compared to the same antenna measured with four conventional metallic triangular rooftop struts.

09:30	**Wide-band Wide-angle Circular Polarization of a Multilayer Patch Antenna**	A20-4

KOUBEISSI, Majed[1]; ABDALLAH, Yasser[1]; ARNAUD, Eric[1]; THEVENOT, Marc[1]; MONEDIERE, Thierry[1]; KOLECK, Thierry[2]; PERAGIN, Eric[2]
[1]XLIM, FRANCE;
[2]CNES, FRANCE

this paper focuses on the design of a telemetry antenna system intended for agile small satellites. It provides an axial ratio lower than 3dB over ±60° conical space angle and over 15% of bandwidth. We show that this design provides high quality Circular polarization properties for agile small satellites without having to suspend their missions and also without making sacrifices the antenna low profile and wide bandwidth. The antenna performances are presented and followed by a discussion.

09:50	**The Biggest CFRP Antenna in the World for Communication and Navigation:The Normandie Radar Project**	A20-5

DE LORENZI, SIMONE; MARCHIORI, GIANPIETRO; RAMPINI, FRANCESCO
EUROPEAN INDUSTRIAL ENGINEERING, ITALY

The Normandie Project is a French program aimed at the construction of a very high performances Radar onboard a French Navy ship for very large-range detection. Technological innovation and new materials allow to design and realize this sort of structures and to reach a high stiffness-mass ratio. European Industrial Engineering has been awarded with the contract for the design and realization of the antenna's main reflector which is now successfully installed and operating.

10:10	**Pulsed Radiation from a Loop Antenna in the Ionospheric Plasma**	A20-6

Kudrin, A.; Shmeleva, N.
University of Nizhny Novgorod, RUSSIAN FEDERATION

Pulsed radiation from a loop antenna in a magnetoplasma modeled upon the Earth's ionosphere is studied. An expression for the radiated energy is derived and its distribution over the spatial and frequency spectra of the excited waves as a function of parameters of the antenna current is analyzed. Numerical results referring to the case where the frequency spectrum of the antenna current is concentrated in the whistler frequency range are reported and discussed.

Time	Title	Abs No
08:30	**Concurrent 2.4/5-GHz Multi-Loop MIMO Antennas with Wide 3-dB Beamwidth Radiation for Access-Point Applications**	A16P1-1

Su, S.-W.
Lite-On Technology Corp., TAIWAN

A high-gain, wide-beamwidth, six-loop-antenna MIMO system suited for wireless APs in the concurrent WLAN 2.4 and 5 GHz bands is presented. The antenna system comprises an antenna ground and single-band loops designated for 2.4 and 5 GHz operation respectively. The antennas are set in a sequential, rotating arrangement with a symmetrical structure. The results showed good port isolation between antennas and high-gain, directional radiation patterns with wide 3-dB beamwidth in elevation planes.

| 08:50 | **Experimental Evaluation of Antenna Element Spacing with Mixed Polarized MIMO Antenna System in LOS Environment** | A16P1-2 |

Inoue, Yuki; Komiya, Kazuhiro; Yamaguchi, Ryo; Cho, Keizo
NTT DOCOMO, INC., JAPAN

This manuscript investigates the effectiveness of a mixed polarization configuration MIMO antenna system (MPC-MIMO) based on a performance comparison using dual polarized antennas for both the transmitter and receiver antennas (POL-MIMO). The performance is evaluated based on the results of $2\square\sim2$ MIMO measurements conducted in the 2.4GHz band. Even when a single polarized antenna is used in a MT, keeping the antenna element spacing at $0.4ƒÉ$, the capacity is comparable to that of POL-MIMO.

| 09:10 | **Improvement of Channel Capacity of Near-Field Mimo** | A16P1-3 |

Hirayama, Hiroshi; Matsui, Gen; Kikuma, Nobuyoshi; Sakakibara, Kunio
Nagoya Inst. of Tech., JAPAN

A new structure to improve channel capacity of near-field MIMO is proposed. The proposed structure is consist of back reflector and side reflector. FDTD simulation demonstrates a role of back reflector and side reflector. The back reflector increases SNR without improving eigen value distribution. The side reflector equalizes eigen value distribution without enlarging SNR. Consequently, the proposed structure enhances both SNR and eigen value distributions, the channel capacity was improved.

| 09:30 | **Measurements and Simulations of Outdoor-to-Indoor WiMAX Relay Communication** | A16P1-4 |

BELHOUJI, A[1]; FAKIH, K[2]; MOUHAMADOU, M[1]; AKHDAR, O[1]; REYNAUD, S[2]; DECROZE, C[1]; CARSENAT, D[1]
[1]Xlim, FRANCE;
[2]CISTEME, FRANCE

This paper deals with a direct amplification relaying technique associated to an Outdoor to Indoor WiMAX communication system. Contribution of this technique are investigated and compared over a complete 802.16 WiMAX-OFDM chain. Measurement of some propagation conditions feeds the WINNER channel model in order to generate the channel coefficients belonging to different links. Simulation and measurement results show the performances improvement that can make the use of such a relay in such an environment.

| 09:50 | **Multiport Antenna Systems for MIMO and Diversity** | A16P1-5 |

Chaudhury, S. K.[1]; Chaloupka, H.[2]; Ziroff, A.[1]
[1]Siemens AG, CT PS7, GERMANY;
[2]Bergische Universität Wuppertal, GERMANY

Recent trend to minimize the mobile phone antenna size is to use the chassis as the main radiator. Providing multiple antenna support for these small devices is more challenging due to large coupling between the antenna ports. However, with the help of characteristic modes of conducting bodies, it becomes possible to realize up to four port antenna systems that have acceptable return loss over 2.4 GHz ISM band and the cross-talk is less than -20 dB over the band of interest.

| 10:10 | **Uncoupled Impedance Matching for Coupled Multi-Antenna Systems** | A16P1-6 |

Jensen, M. A.[1]; Lau, B. K.[2]
[1]Brigham Young University, UNITED STATES;
[2]Lund University, SWEDEN

This paper explores uncoupled impedance matching for MIMO systems, with specific emphasis on matching to the array active and passive impedances. It further extends matching to the array active impedance to the case where the propagating field is specified stochastically. Simulations demonstrate the relative performance of the different matching techniques.

Session:	**M05: Near-Far Field Measurements**
Type:	Measurement Session
Date:	Thursday, April 15, 2010
Time:	08:30 - 10:30
Room:	Room 133-134
Chairs	V. Degli Esposti
	L. Shafai

Time	Title	Abs No
08:30	**Characterization of WiMAX Propagation in Microcellular and Picocellular Environments**	M05-1

Barbiroli, Marina[1]; Carciofi, C.[2]; Degli Esposti, V.[1]; Fuschini, F.[1]; Grazioso, P.[2]; Guiducci, D.[2]; Robalo, D.[3]; Velez, F.J.[3]
[1]University of Bologna, ITALY;
[2]Fondazione Ugo Bordoni, ITALY;
[3]DEM, Universidade da Beira Interior, PORTUGAL

In this paper different propagation models for coverage prediction of WiMax microcellular and picocellular urban environments and for WiMax indoor femtocells at 3.5 GHz are compared with experimental data. Results obtained for different urban and indoor environments show that statistical models are quite far from good agreement with experimental data while deterministic ray-tracing models provide good prediction in all different complex analyzed environments.

08:50	**A Slotted Waveguide Setup as Scaled Instrument-Landing-System for Measuring Scattering of an A380 and Large Objects**	M05-2

Geise, R.; Schüür, J.; Thiele, L.; Nottè, K.; Beckers, T.; Enders, A.
Institute for Electromagnetic Compatibility, TU Braunschweig, GERMANY

This paper presents a slotted waveguide antenna setup used as a scaled Instrument-Landing-System, disturbance scenarios of which due to scattering of large aircraft on ground are measured. Additional measurements focus on the differences of the aircraft A380 and B747 and on how to identify individual scatterers in comparative measurements. The presented antenna design and its scalability allow individual antenna pattern forming and can be applicable to other radar or navigation systems.

09:10	**Aperture Antenna Modelling by a Finite Number of Elemental Dipoles from Truncated Spherical Field Measurement**	M05-3

SERHIR, Mohammed[1]; GEFFRIN, Jean-Michel[2]; LITMAN, Amelie[2]; Ribiere-Tharaud, Nicolas[3]; Besnier, Philippe[4]
[1]Supelec / Laboratoire des Signaux et Systemes, FRANCE;
[2]Institut FRESNEL Universités Aix-Marseille, Ecole Centrale Marseille, CNRS, FRANCE;
[3]Supelec / Laboratoire des Signaux et Systèmes, FRANCE;
[4]INSA Rennes / Institut d'Electronique et Telecommunication de Rennes, FRANCE

A method to determine a distribution of a finite number of elementary dipoles that reproduce the radiation behaviour of the antenna under test (AUT) from truncated spherical field measurements is proposed. It is based on the substitution of the actual antenna by a finite number of equivalent infinitesimal dipoles, distributed over the antenna aperture. The reliability and the accuracy of the method are shown using experimental data issued from the measurement of an X-band horn antenn

09:30	**Optical Scanner Retrieval of Reciprocal AUT-Probe Positions and its Use in NFFF Transformation Techniques**	M05-4

Amedeo, Capozzoli[1]; Curcio, C[1]; D'Elia, G[1]; Liseno, A[1]; Rizzo, C A E[2]; Strazzullo, G[3]; Vinetti, P[1]
[1]Università di Napoli Federico II, ITALY; [2]MI Technologies Europe, UNITED KINGDOM; [3]Fox Bit s.r.l., ITALY

In this paper the use of a structured-light optical scanner in the near field antenna measurement is proposed. The optical scanner, based on a very cheap hardware, is able to retrieve, with a micrometric resolution, the probe measurement position, with respect to the antenna under test reference system. Such an information can, then, be properly taken into account within the near field-far field transformation thus compensating the effects of uncontrolled misalignment errors.

09:50	**Stochastic Optimization of Sparse Antenna Arrays**	M05-5

Minvielle, Pierre; Bérisset, Ph.
CEA, FRANCE

Formally, the design of sparse antenna arrays can be expressed as a constrained multi-dimensional nonlinear optimization problem. Through lack of convex property, such a multi-extrema problem is very tricky to solve by usual deterministic optimization methods. In this paper, a recent global stochastic approach, called the "Cross-Entropy method", is applied to solve it. Its efficiency is illustrated in the design of a multi-goal narrowband sparse antenna array.

10:10	**Towards Routine Automated Error Assessment in Antenna Spherical Near-Field Measurements**	M05-6

Pelland, P[1]; Ethier, J[1]; Janse van Rensburg, D[2]; McNamara, D[1]; Shafai, L[3]; Mishra, S[3]
[1]University of Ottawa, CANADA; [2]Nearfield Systems Inc, UNITED STATES; [3]Canadian Space Agency, CANADA

This paper describes a measurement process that permits an assessment of spherical near-field (SNF) measurement errors based on a set of practical tests that can be done as part of any SNF measurement. A test system has been implemented that, in an automated fashion, derives error bars for the measured radiation patterns.

Session: **P06P2: Mobile Channel Modeling 4**
Type: Propagation Session
Date: Thursday, April 15, 2010
Time: 11:00 - 13:00
Room: Room 113
Chairs: J. Romeu
                 P. Vainikainen

Time	Title	Abs No

11:00 **Power and Delay Domain Parameters of Channel Measurements at 2.53 GHz in an Urban Macro Cell** Scenario   P06P2-1

Boettcher, Annika[1]; Schneider, Christian[2]; Narandzic, Milan[2]; Vary, Peter[1]; Thomae, Reiner S.[2]
[1]RWTH Aachen University, GERMANY; [2]University TU Ilmenau, GERMANY

This paper presents analysis results of large-scale parameters derived from a multi-user and multi-base station MIMO measurement campaign in urban macro. The focus is on the parameters of the delay and power domains, their distribution as well as auto and crosscorrelations. Parameters from WINNER II channel model could be verified, furthermore missing gaps among them could be closed. A third contribution shows strong variations of the parameters depending on the base station position.

11:20 **Orientation-Free XPD and CPR Model in Outdoor-to-Indoor and Indoor-to-Indoor Channels**   P06P2-2

Panahandeh, Ali[1]; Quitin, Francois[1]; Dricot, Jean-Michel[2]; Horlin, Francois[2]; Oestges, Claude[3]; De Doncker, Philippe[2]
[1]Université Libre de Bruxelles and Université Catholique de Louvain, BELGIUM;
[2]Université Libre de Bruxelles, BELGIUM;
[3]Université Catholique de Louvain, BELGIUM

XPD and CPR are two important parameters describing multi-polarized channels. A measurement campaign has been performed in both Outdoor-to-Indoor and Indoor-to-Indoor scenarios, at a frequency of 3.5 GHz. Small-scale variations of XPD and CPR are analyzed in different spatial positions. The distance-related and large-scale variations of XPD and CPR are also investigated and a model is deduced. The model does not depend on the orientation of the receive antenna.

11:40 **Rain Cell Advection in High Temporal Resolution for Propagation Studies**   P06P2-3

Pastoriza, V.[1]; Carpacho, M.[1]; Nunez, A.[1]; Marino, P.[1]; Perez Fontan, F.[1]; Fiebig, U.-C.[2]
[1]University of Vigo, SPAIN; [2]DLR (German Aerospace Center), GERMANY

This paper presents some first steps given in merging radar and rain gauge data for a better understanding of space-time rain field dynamics. In this work, we have concentrated on providing a considerable finer temporal resolution of rain cell movement (advection). This has been performed analyzing rainfall time series from a tipping-bucket rain gauge network in the neighborhood of the weather radar on the North-West Atlantic coast of Spain.

12:00 **Propagation Model Calibration for DVB-SH in Terrestrial Single Frequency Networks**   P06P2-4

Salieto, Ariana; Roig, Gema; Gómez-Barquero, David; Cardona, Narcís
Universidad Politécnica de Valencia, SPAIN

This article studies terrestrial propagation model calibration for DVB-SH networks. One important particularity of DVB-SH is that it allows the implementation of Single Frequency Networks, where every transmitter emits the same signal at the same frequency. This article analyzes two propagation models suitable to perform propagation calculations in urban areas and S band by means of different metodologies suitable for SFN calibration.

12:20 **Spherical Wave Modelling of Radio Channels using Linear Scanners**   P06P2-5

Khatun, Afroza; Laitinen, Tommi; Vainikainen, Pertti
Aalto University School of Science and Technology, FINLAND

Spherical wave modelling of the radio propagation channels needs to consider the responses of the radio channel for different spherical wave mode fields. A natural scan surface for the direct spherical data extraction would be spherical. This paper describes how the required spherical mode responses of a channel can be extracted from the measurement data acquired on a cubical scanning surface. Rules for the required number of sampling locations on a cubical surface are provided.

12:40 **Study and Test of Rain Attenuation Time Series Synthesizers for Tropical and Equatorial Areas**   P06P2-6

Rodrigues, M. E. C.[1]; Carrie, G.[2]; Castanet, L.[2]; Silva Mello, L. A. R.[1]
[1]PUC-Rio - CETUC, BRAZIL; [2]ONERA, FRANCE

To develop and test real-time Fade Mitigation Techniques control algorithms, propagation time series are needed. An alternative to using real data collected from propagation experiments is to generate typical fading time-series making use of climatological characteristics as well as geometrical and radio-electrical parameters of the link. The aim of this paper is to present and validate rain attenuation time series synthesizers relying on the Maseng-Bakken principle and 2-state Markov chains for tropical and equatorial areas. Brazilian beacon data at 11.5 GHz are used to parameterize and test the models. The three long-term models are tested with respect to long-term statistics and an "event based" methodology is used to test the isolated events generated by the "event-ondemand" model.

Time	Title	Abs No

11:00 UWB Leaky Lens Antenna as an Improved Performance Emitter in a THZ Time Domain System C34P2-1

Llombart, N.[1]; Neto, A.[2]; Siegel, P. H.[1]; Saeedkia, D.[3]
[1]Caltech, UNITED STATES;
[2]TNO, NETHERLANDS;
[3]T-Ray Science Inc., CANADA

In this contribution we introduce the use of the UWB leaky lens antenna as an improved photo-conducting emitter for a THz time domain system. The UWB antenna presents nearly constant impedance and directive symmetric patterns over a decade of bandwidth, improving both the impedance matching and the optical coupling of the system. In this contribution, we compare the performances of the leaky lens antenna with standard resonant geometries by performing simulations with CST.

11:20 Cost-Effective THz Spectroscopy with Continuous-Wave Laser Sources C34P2-2

Hofmann, M.R.[1]; Scheller, M.[2]; Brenner, C.[1]; Baaske, K.[2]; Koch, M.[3]
[1]Ruhr-University Bochum, GERMANY;
[2]Technical University Braunschweig, GERMANY;
[3]Philipps University Marburg, GERMANY

We use a laser diode in an external cavity to operate a photomixer based terahertz spectrometer. The emission spectrum of the laser can be easily switched between two-color operation and multi-line operation by means of a specially designed end mirror. This changes the operation mode of the terahertz spectrometer from continuous wave operation to a scheme called terahertz quasi time-domain spectroscopy.

11:40 Terahertz Imaging and Spectroscopy C34P2-3

Davies, A G; Burnett, A D; Dean, P; Wood, C D; Saat, N K; Hatem, O; Cunningham, J; Linfield, E H
University of Leeds, UNITED KINGDOM

THz frequency radiation possesses a unique combination of desirable properties for non-destructive materials imaging and spectroscopy. We examine the THz spectra of a wide range of drugs-of-abuse, pure explosives and plastic explosives. We discuss the use of THz frequency quantum cascade lasers for imaging and spectroscopy of such materials. Finally, we highlight a future perspective for spectroscopy systems in which the reliance on expensive and bulky femtosecond laser sources is eliminated.

12:00 Terahertz Antennas and Systems for Space Borne Platforms C34P2-4

Chattopadhyay, Goutam
Jet Propulsion Laboratory, Caltech, UNITED STATES

Detectors and instruments with appropriate antennas at far-infrared and submillimeter wavelengths (100 GHz to about 5 THz) provide unprecedented sensitivity for astrophysical, planetary, and earth observing instruments. In this talk, an overview of the state of the art antennas, detectors, and instruments operating in the terahertz frequencies for space borne platforms will be provided.

12:20 Millimeter-Wave Imaging Systems with Aperture Synthesis Techniques C34P2-5

Krozer, V.[1]; Löffler, T.[2]; Zhurbenko, V.[3]; Kusk, A.[3]; Dall, J.[3]; Jensen, T.[3]
[1]University of Frankfurt am Main, GERMANY;
[2]SynView GmbH, GERMANY;
[3]DTU, DENMARK

The paper describes development of a millimetre-wave imaging system using multi-element aperture filling techniques. Such imaging systems are increasingly demonstrated for security applications and in particular stand-off imaging of persons and bonding flaw and defect detection.

Session:	**C25P2: Fast and asymptotic methods for large antennas and scatterers - 2**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	11:00 - 13:00
Room:	Room 120
Chairs:	C. Letrou
	A. Boag

Time	Title	Abs No
11:00	**Gaussian Beam Shooting Algorithm Based on Iterative Frame Decomposition**	C25P2-1

Ghannoum, I.[1]; Letrou, C.[2]; Beauquet, G.[3]
[1]TELECOM SudParis / CNRS, FRANCE;
[2]TELECOM SudParis, FRANCE;
[3]THALES Air Systems, FRANCE

Adaptive beam re-shooting is proposed as a solution to overcome essential limitations of the Gaussian Beam Shooting technique. The proposed algorithm is based on iterative frame decompositions of beam fields when usual paraxial formulas fail to give accurate enough results. Collimated beam fields are re-expanded on narrow and wide window frames, allowing for re-shooting of collimated beams. Closed form formulas used for these re-expansions are presented, as well as first numerical accuracy tests.

11:20	**A Direct Non Redundant Complex Source Point Expansion of the Electromagnetic Field Radiated by an Arbitrary Source**	C25P2-2

Martini, E.; Carli, G.; Maci, S.
University of Siena, ITALY

A simple closed-form expression for a non-redundant Complex Source Point (CSP) beam expansion of an arbitrary electromagnetic field is derived. To this end, a particular form of the equivalence principle is first applied to a sphere enclosing the real sources, and a continuous equivalent electric current distribution is obtained; then, the continuous current is extended to complex space and properly filtered and sampled to generate the discrete set of CSP coefficients.

11:40	**New Algorithm to Speed-Up the Analysis of Large Antennas and Antenna Interaction with Structures**	C25P2-3

Lozano, L; Algar, Mª J.; González, I; Catedra, F.
Alcalá University, SPAIN

This paper presents an overview of the improvements done over FASANT. A new algorithm based on the combination of a Master Point strategy and an Interpolation method has been implemented to reduce the CPU time in the analysis of the radiation pattern of antennas on board of complex structures. On the other hand, the graphical user interface of the program has been improved in order to make easily to run the code.

12:00	**Complex Source Extension of UTD for Analyzing Large Reflector Antennas**	C25P2-4

Kim, Y; Burkholder, R.J.; Pathak, P
Ohio State University, UNITED STATES

A new uniform geometrical theory of diffraction for a fully three dimensional arbitrary curved wedge, when the illumination is an electromagnetic complex source beam is developed from the uniform asymptotic solution to appropriate canonical problems. This general development is then utilized for the analysis of large reflector antennas by expanding the reflector feed illumination in terms of a convergent complex source beam expansion.

12:20	**Recent Advances in Astimatic Beam Tracing**	C25P2-5

Foged, L.J.[1]; Bencivenga, B.[1]; Sabbadini, M.[2]; Filipone, S.[3]; di Giampaolo, E.[3]
[1]SATIMO, ITALY;
[2]ESTEC, NETHERLANDS;
[3]University of Torvergata rome, ITALY

Asymptotic analysis of antenna on complex and electrically large geometries is commonly used to predict installed antenna patterns on electrically large vehicles. SATSim is an advanced implementation of the Astigmatic Beam Tracer technique dedicated to fast numerical modelling of antennas on large meshed structures. This paper presents recent developments in terms of minimising computational cost and time consumption on increasingly complex antenna structures.

12:40	**Towards GUI Interfaces Handling Complex Multi-Domain Antenna Sitting Computations**	C25P2-6

Barka, Andre[1]; Martel, Cédric[1]; Douchin, Nicolas[2]; Rasoanaivo, Lalaina[2]
[1]ONERA French Aerospace Lab, FRANCE;
[2]OKTAL_SE, FRANCE

W describe a new hybrid weak coupling of asymptotic GO/PO techniques and Boundary Element Methods (BEM) based on the FACTOPO Domain Decomposition Methodology (DDM). In that way the modular DDM approach already assessed with exact techniques as BEM and FEM is conserved with the utilization of GO/PO techniques resulting in important reduction of CPU time during parametric studies. Furthermore a graphical user interface (GUI) has been developed in C++ and QT for controlling the computation st

Session:	**A21: Electromagnetic exposure**
Type:	Antennas Session
Date:	Thursday, April 15, 2010
Time:	11:00 - 13:00
Room:	Room 121
Chairs:	G. Kizer
	J.N. Sahalos

Time	Title	Abs No

11:00   **Analysis of the Specific Absorption Rate in Handset Antennas with Slotted Ground Planes**   A21-1
Picher, C.[1]; Anguera, J.[1]; Andujar, A.[1]; Puente, C.[1]; Kahng, S.[2]
[1]Fractus, SPAIN;
[2]University of Incheon, KOREA, REPUBLIC OF

The study of the interaction between human head and handset antennas should be taken into account in order to guarantee a biological compatibility. This research analyzes several antennas with different slotted ground planes in terms of free space and also in terms of human head interaction. The main objective is to compare the measured bandwidth and efficiency in free space and the measured SAR (Specific Absorption Rate) of such antennas.

11:20   **Aperture Array Model for Rapid Assessment of Base Station Antennas Near Field based on Half Power Beam Width Equivalence**   A21-2
Nanos, Apostolos; Goudos, S. K.; Siakavara, K.; Samaras, T.; Sahalos, J. N.
Aristotle Univeristy of Thessaloniki, GREECE

In this work a fast method is presented, for the approximate estimation of the near field in the vicinity of mobile Base Station Antennas (BSA) comprised of reflector type unit cells. The method is based on the substitution of each unit cell of the BSA with a uniformly excited rectangular aperture of suitable dimensions, so that both have equal half power beam widths in the two main radiation planes. The method utilizes the fast numerical evaluation of the near field of uniform apertures.

11:40   **Application of the Bilateral Dual-Grid FDTD Method to the Calculation of Specific Absorption Rate in Fetal Brain**   A21-3
Miry, Celine; Bosch-Gayan, M.; Loison, R.; Gillard, R.
IETR INSA, FRANCE

This paper presents an application of the bilateral dual-grid FDTD method. We propose to determine in a short computation time the specific absorption rate in the fetal brain of a pregnant woman at 900 MHz. The principle of the new technique consists in splitting the overall simulation into three FDTD simulations sequentially executed with an appropriate mesh. Results obtained with this approach are compared to the original FDTD and DG-FDTD methods.

12:00   **Human Head Interaction with a Pifa in Cellular Mobile Communication**   A21-4
Khodabakhshi, Hamid; Cheldavi, Ahmad
Iran University of Science & Technology, IRAN, ISLAMIC REPUBLIC OF

A numerical simulation of the human head coupling with a Planar Inverted-F Antenna (PIFA) structure based on the Coupled Integral Equation/Method of Moment (CIE/MoM) approach is presented to study the effects of the EM coupling on the antenna performance. A mix-potential integral equation (MPIE) for the surface current of PIFA structure and a volume electric field integral equation (VEFIE) for the head with mutual coupling terms are obtained. Numerical results will be presented at 900MHz band.

12:20   **Microwave Antenna Near Field Power Estimation**   A21-5
Kizer, G.
Alcatel-Lucent, UNITED STATES

The far field power density of fixed point to point microwave antennas is well known. However, the near field power density has not been extensively studied. With the wide deployment of small high frequency antennas, interest in this issue has increased. This paper provides simple but accurate formulas for calculating near field power density for circular and square aperture antennas typically used in fixed point to point microwave systems.

12:40   **Simulation of Human Body Exposure in Extremely Low Frequency Electromagnetic Fields**   A21-6
Chen, Xi Lin[1]; Benkler, Stefan[1]; Chavannes, Nicolas[2]; Kuster, Niels[1]
[1]Foundation for Research on Information Technologies in Society, SWITZERLAND;
[2]Schmid and Partners Engineering AG, SWITZERLAND

This paper investigates the electric field and current density induced in a human body when exposed to low frequency electromagnetic fields. A numerical technique based on the Finite Element Method and electromagnetic quasistatic approximations is employed to compute both the fields generated by low frequency sources and the fields induced inside a human body due to exposure or contact. Case study is conducted to investigate exposure situations for low frequency electromagnetic field

Session:	**A18P2: Metamaterial 2**
Type:	Antennas Session
Date:	Thursday, April 15, 2010
Time:	11:00 - 13:00
Room:	Room 122-123
Chairs:	F. Mesa
	A.Schuchinksy

Time	Title	Abs No
11:00	**Oblique Incidence Optimisation of a Pyramidal Absorber Using a Frequency Selective Surface**	A18P2-1

Ford, Kenneth; Chambers, B; Holtby, D
university of sheffield, UNITED KINGDOM

This paper presents a topology for improving the low frequency performance of pyramidal radar absorbing materials at oblique angles of incidence. The technique uses an embedded frequency selective surface as an impedance matching layer and improves the -40dB reflectivity limit from 6GHz to 4GHz for 102mm pyramidal absorber. The frequency selective surface is based on a resistively loaded dipole FSS and simulations of optimised results of the modified RAM structure are presented.

| 11:20 | **Design of a 45° Linearly Polarized M-PRS Sectoral Antenna** | A18P2-2 |

HAJJ, Mohamad[1]; JECKO, Bernard[2]; CHANTALAT, Régis[3]; MONEDIERE, Thierry[4]
[1]University of Limoges, XLIM laboratory, FRANCE;
[2]University of Limoges-XLIM Laboratory, FRANCE;
[3]CISTEME, FRANCE;
[4]XLIM UMR n°6172-CNRS, University of Limoges, FRANCE

A novel sectoral antenna for 45° linear polarization using Metallic Partially Reflective Surface (M-PRS) is investigated. Double layers of M-PRS working on orthogonal polarizations as a superstrate are used for these cases. This antenna provides two perpendicular polarizations, vertical and horizontal, 45° with a sectoral radiation pattern in the azimuth plane. In order to verify the results a M-PRS Sectoral antenna prototype for WIMAX application [5.15 - 5.35] GHz is realized

| 11:40 | **An Energy-Based Circuit Parameter Extraction Method for CRLH Leaky Wave Antennas** | A18P2-3 |

Otto, S.[1]; Rennings, A.[1]; Liebig, T.[1]; Caloz, C.[2]; Solbach, K.[1]
[1]University Duisburg-Essen, GERMANY;
[2]Ecole Polytechnique de Montreal, CANADA

An energy based circuit parameter extraction method for symmetric CRLH unit cells is presented. The method presented here uses an eigenmode solution along with voltage and current monitoring at the cell boundaries to model the stored energy and the power loss in terms of reactive and resistive circuit elements. Therefore a single unit cell is accurately characterized for the infinite periodic case, taking into account all the mutual coupling effects.

| 12:00 | **Analytical Modeling and Experimental Verification of Fabry-Perot Resonances in Partially-Reflecting Surfaces** | A18P2-4 |

Kaipa, C. S. R.[1]; Butler, C. A. M.[2]; Hibbins, A. P.[2]; Sambles, J. R.[2]; Medina, F.[3]; Mesa, F.[4]; Yakovlev, A. B.[1]
[1]University of Mississippi, Department of Electrical Engineering, UNITED STATES;
[2]School of Physics, University of Exeter, UNITED KINGDOM;
[3]Department of Electronics and Electromagnetism, Faculty of Physics, University of Seville, SPAIN;
[4]Department of Applied Physics I, ETS de Ingeniería Informática, University of Seville, SPAIN

Transmission through stacked perforated metallic screens (2-D metallic meshes) printed on thin dielectric layers is studied at microwave frequencies using simple circuit models. The physical mechanisms of the transmission resonances are clearly explained and the most relevant parameters of the circuit are accurately determined. The results of the circuit model are tested by a proper comparison with previously obtained numerical and experimental results.

| 12:20 | **Entwined Spirals for Ultra Compact Wideband Frequency Selective Surface** | A18P2-5 |

Vallecchi, A.[1]; Schuchinsky, A. G.[2]
[1]University of Siena, ITALY;
[2]Queen's University of Belfast, UNITED KINGDOM

The application of a suitable intertwining scheme to planar periodic quadrifilar spiral frequency selective surfaces (FSSs) is shown to dramatically decrease operating frequencies while greatly expanding the bandwidth. At both normal and oblique incidence the proposed intertwined spiral FSSs provide a very sub-wavelength response at wavelengths 40 times larger than the unit cell size. The high packing density of the array ensures the stability of stopband frequency response at oblique incidence.

| 12:40 | **Substrate Edge Effects in Leaky Wave Antenna based on Complementary Split Ring Resonators** | A18P2-6 |

Eggermont, S.; Huynen, I.
Université catholique de Louvain, BELGIUM

This paper discusses radiation phenomena in a metamaterial transmission line based on series capacitive gaps and CSRRs periodically loading a host microstrip line and acting as a leaky-wave antenna. The analysis performed for different distances between CSRRs and the substrate edges shows that in narrow substrates destructive interference occurs between free-space leaky wave radiation and surface wave modes, reflected at substrate edges.

Time	Title	Abs No

11:00 **Quasi-TEM H-Plane Horns with Wideband Open Hard Side-Walls**   C32P2-1

Kishk, Ahmed[1]; Kildal, P-S[2]
[1]University of Mississippi, UNITED STATES;
[2]Chalmers University of Technology, SWEDEN

Quasi-TEM H-plane horn is usually designed with hard sidewalls to achieve uniform field distribution, but the hard walls limits its bandwidth. Here, open side walls based on the ridge gap waveguide are used to generate the hard walls. The concept is demonstrated numerically by an initial study on an H-plane sector horn. The horn achieves wider bandwidth than dielectric-loaded hard sector horns and has higher gain than normal smooth metal wall sector horns of the same aperture size and length.

11:20 **A 76GHz Phased Array Antenna using a Waffle-iron Ridge Waveguide**   C32P2-2

Kirino, Hideki; Ogawa, Koichi
Panasonic Corporation, JAPAN

A 76GHz phased array antenna using a waffle-iron ridge waveguide with a non-metal contact structure has been developed. The structure has the advantages of avoiding losses due to imperfect metal contact and facilitating the construction of small-size multi-layer stacked structures. The principle of a 16-column phased array antenna is presented. It is shown that the phase difference between all adjacent radiators is the same, confirming the validity of the fundamental operation of the antenna.

11:40 **Validation of Ridge Gap Waveguide Performance Using in-house TRL Calibration** Kit   C32P2-3

Zaman, A. UZ.[1]; Kildal, P.-S.[1]; Ferndahl, M.[1]; Kishk, A.[2]
[1]CHALMERS UNIVERSITY OF TECHNOLOGY, SWEDEN;
[2]University of Mississippi, UNITED STATES

we validated the performance of the ridge gap waveguide. By using the TRL calibration technique, we were able to show that ridge gap waveguides work as good transmission lines with very low loss. The loss of the gap waveguide itself was found to be so low loss that it is not detectable with the present measurement setup. Therefore, more accurate studies such as Q factor measurements for attenuation calculation are required.

12:00 **Groove Gap Waveguide: A Rectangular Waveguide Between Contactless Metal Plates Enabled by Parallel-Plate Cut-Off**   C32P2-4

Rajo-Iglesias, E.[1]; Kildal, P-.S.[2]
[1]Carlos III University of Madrid, SPAIN;
[2]Chalmers University of Technology, SWEDEN

This presents a numerical study of a topology of gap waveguide referred to as groove-type, including dispersion diagrams and field distributions for different geometries. The main difference between this waveguide and the ordinary rectangular waveguides is that there is no need of electrical contact between upper and lower plate. This is a clear advantage at high frequencies when designing cavity filters and other components which require the fabrication of the waveguide based on two pieces.

12:20 **Unidirectional Transmission Using Non-Symmetric Photonic-Crystal Gratings Made of Isotropic Materials**   C32P2-5

Serebryannikov, A.E.
Technische Universitaet Hamburg-Harburg, GERMANY

Unidirectional transmission can be obtained in non-symmetric photonic-crystal gratings at a fixed angle of incidence due to combination of the peculiar dispersion and the properly introduced corrugations. Two main regimes are distinguished, depending on the angle of incidence and number of the transmitted beams. More than 80 percent of the incident plane-wave energy can be transmitted in one direction, while transmission in the opposite direction is vanishing.

Session:	**C13P2: Research projetcs on EM biointercation - 2**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	11:00 - 13:00
Room:	Room 125
Chairs:	R. Langley
	A. Ruddle

Time	Title	Abs No
11:00	**Simulation Approaches for Resonant Environments** Davenport, E.M.; El hachemi, M. BAE Systems, UNITED KINGDOM	C13P2-1

This paper outlines the SEFERE project and describes electromagnetic modelling of a simplified aerospace structure. Two codes were used in the simulations; the first an intermediate level code designed for use by EMC engineers, and the second a hybrid full field finite element/finite difference solver. Results were tested against measurements on the aerospace structure.

| 11:20 | **Impact of Internal Dielectric Components for Vehicle Models**
Ruddle, A.
MIRA Limited, UNITED KINGDOM | C13P2-2 |

Simulations indicate that, apart from glass, many dielectric parts in vehicles have little impact on in-vehicle fields. Above 1 GHz glass increases average fields for internal sources, but at lower frequencies glass has little impact for internal sources or vertically polarized external sources. However, for horizontal plane waves incident from the front, the windscreen reduces the field coupled into the vehicle at lower frequencies. The glazing results agree well with analytical predictions.

| 11:40 | **Measured and Computed In-Vehicle Field Distributions**
Low, L; Zhang, H; Rigelsford, J; Langely, R.J.
University of Sheffield, UNITED KINGDOM | C13P2-3 |

This paper describes an automated in-vehicle field measurement systems that can be used to acquire 3D electric field distribution generated from wireless antenna sources placed within a passenger vehicle.

| 12:00 | **Computed SAR and Field Exposure Threat Assessment for Vehicle Occupants**
Ruddle, A.[1]; Low, L.[2]; Zhang, H.[2]; Rigelsford, J.[2]; Langley, R.[2]
[1]MIRA Limited, UNITED KINGDOM;
[2]University of Sheffield, UNITED KINGDOM | C13P2-4 |

Simulations of SAR in vehicle occupants due to on-board sources have been used to investigate approaches for assessing compliance with human exposure recommendations. Comparing the average empty vehicle field with reference levels provides a reasonable safety factor for the basic restrictions at 400 MHz and 900 MHz. However, comparison of results from identical source positions at 900 MHz, 1.8 GHz and 2.4 GHz suggest that a more cautious approach may be required for frequencies above 1 GHz.

| 12:20 | **Electromagnetic Field Mitigation within a Cavity with Vehicle-like Features**
Zhang, H; Low, L; Rigelsford, J; Langley, R. J.
University of Sheffield, UNITED KINGDOM | C13P2-5 |

This paper presents a method of electromagnetic field mitigation within a cavity with vehicle-like features at one of the GSM bands. The findings can be used for the potential electromagnetic field mitigation within resonant scenarios such as office environments and vehicle cabins.

Session:	**A22: Beamforming**
Type:	Antennas Session
Date:	Thursday, April 15, 2010
Time:	11:00 - 13:00
Room:	Room 127
Chairs:	M. Arrebola
	H. Rabe

Time	Title	Abs No
11:00	**A Multistatic Radar Concept for Increased Robustness in Level Measurements**	A22-1

Rabe, Hanno; Denicke, E.; Zietz, C.; Armbrecht, G.; Rolfes, I.
Universitaet Hannover, GERMANY

Monostatic radar systems are a state-of-the-art solution for precise level measurements in industrial environments. However, the restrictions of the antenna size for its installation in a tank limits the antenna's beamwidth. This leads to parasitic reflections at obstacles in the tank disturbing the radar signal. The proposed solution is to use an antenna array to locate the 3D positions of all reflectors. This enables an algorithm to detect and ignore parasitic components in the radar signal.

11:20	**CANCELLED**	A22-2

11:40	**Comparison Between Known Adaptive Algorithms for Pre-FFT Beamforming in OFDMA Systems**	A22-3

Ribeiro Junior, F. C.; Gomes, I. R.; Castro, B. S. L.; Cavalcante, G. P. S.
Federal University of Para, BRAZIL

This paper presents a study of applicability on using smart array systems on a generic multiuser OFDMA system. In this research, three well-known adaptive algorithms such as LMS, SMI and RLS are employed in Pre-FFT scheme, and their performances are evaluated in terms of speed of convergence, beamforming and null steering capabilities, and analysis of BER over a multipath fading channel.

12:00	**Nolen Matrix with Tapered Amplitude Law for Linear Arrays with Reduced Side Lobe level**	A22-4

Fonseca, N. J. G.; Ferrando, N.
CNES, FRANCE

This paper introduces a design method for Nolen matrices with tapered amplitude law adapted from a design method used for modified Butler matrices. Tapered amplitude law is particularly attractive to reduce side lobe level in linear array antennas. The method is illustrated with the specific design of a 4×8 Nolen matrix in microstrip technology. The performances of this matrix associated with a theoretical 8-element linear array are investigated to confirm the side lobe level improvement.

12:20	**Through-the-Wall Sensing Using Time-Reversal Antenna Arrays**	A22-5

Yavuz, Mehmet E.
American University of Sharjah, UNITED ARAB EMIRATES

We study the time-reversal antenna arrays for through-the-wall sensing scenarios using ultrawideband electromagnetic waves. We show through simulation that the use of differential time-domain signals can be used for localization of the object movement. The differential signals of interest are obtained by comparing the signals received at the time-reversal arrays corresponding to different positions of the moving object. This is particularly helpful in scenarios with strong secondary scatterers.

12:40	**Phase Synthesis of Reflectarray Subreflector in Dual-Reflector Configuration for Beam Scanning Applications**	A22-6

Arrebola, M[1]; Encinar, J.A.[2]
[1]Universidad de Oviedo, SPAIN;
[2]Universidad Politécnica de Madrid, SPAIN

A phase synthesis technique for a reflectarray as subreflector in a dual-reflector configuration is proposed for beam scanning applications. The technique applies the analysis of the antenna in receive mode to determine the phase-shift distribution on the reflectarray that produces a beam with the required deflecting angle. The phase distributions and radiation patterns are obtained for an antenna and several scanning angles.

Session: **P07P2: Propagation aspects in MIMO**
Type: Propagation Session
Date: Thursday, April 15, 2010
Time: 11:00 - 13:00
Room: Room 128
Chairs: J. Alonso
                 R. Dubrovka

Time	Title	Abs No
11:00	**Wideband Over-the-Air Test-Bed Reproducing Channel Delay Dispersion Characteristics**	P07P2-1

Rudant, L.; D'Errico, R.
CEA-LETI, FRANCE

In this paper, we present an Over-The-Air test-bed for broadband communication system. A Power Delay Profile synthesizer has been specifically designed to generate realistic channel impulse responses. Sixteen source antennas are disposed in an anechoic chamber to illuminate a test zone with control of direction of arrival and polarization of the incoming waves.

11:20	**Diffuse Multipath Component Characterization for Indoor MIMO Channels**	P07P2-2

Quitin, F.[1]; Oestges, C.[2]; Horlin, F.[1]; De Doncker, Ph.[1]
[1]University of Brussels, BELGIUM;
[2]Universite catholique de Louvain, BELGIUM

When using high-resolution algorithms to extract individual propagation paths for channel modeling, part of the power is not captured. This residual power is called the diffuse multipath component (DMC). In this work, the spatio-temporal characteristics of the DMC are extracted from measurements, and correlation between specular channel components and DMC are investigated. It is proposed to model the channel by including a diffuse component to each cluster to properly account for the DMC.

11:40	**Experimental Comparison of MIMO OTA Testing Methodologies**	P07P2-3

Kurita, D; Okano, Y; Nakamatsu, S; Okada, T
NTT DOCOMO, JAPAN

In this paper, we describe our developed three MIMO OTA testing systems of the simplified MIMO OTA testing system using the reverberation chamber, that in the anechoic chamber, and the spatial fading emulator. We also conduct measurement campaign to experimentally compare the difference. Based on the results, we conclude that we can employ any type of MIMO OTA testing methodology for the MIMO OTA testing to differentiate overall MIMO OTA performance including multi-antenna characteristics.

12:00	**Mimo Channel Measurement Campaign in Subway Tunnels**	P07P2-4

Alonso, J
Universitat Poliècnica de Catalunya, SPAIN

Recent construction of the new L9 subway line in Barcelona, Spain has provided the opportunity to study the impact of different antenna configurations on the maximum channel capacity inside subway tunnels. In this work the authors present the design tradeoffs inside different kind of tunnels in terms of antenna spacing and applied diversity technique for a 2x2 MIMO system at C-Band. These design tradeoffs are the conclusion of the measurement campaign carried out during last year at L9 subway tunnel.

12:20	**Mobile User Location in Dense Urban Environment Using Unified Statistical Model**	P07P2-5

Tsalolihin, E.[1]; Bilik, I.[1]; Blaunstein, N.[2]
[1]University of Massachusetts Dartmouth, UNITED STATES;
[2]Ben-Gurion University of the Negev, ISRAEL

Statistical approach for mobile subscriber location in urban environment is derived in this work. Implementation of location based services in dense urban environment depends on the ability to locate the subscriber in NLOS propagation conditions. A recently proposed statistical model of the urban propagation conditions is adopted and parameterized by the MS location in this work. The method requires only a single base station. Source localization performance was evaluated using a measured data

12:40	**Radiotransparent Building Materials**	P07P2-6

Dubrovka, Rostyslav; Belov, P
Queen Mary University of London, UNITED KINGDOM

New class of radiotransparent materials are presented and discussed in the paper. Basic principles of operation are presented. Preliminary measurements of a block of the new material have been done and are shown in the paper. Reasonably good agreement with predicted data has been achieved. Possible application areas, and other issues are discussed.

Time	Title	Abs No
11:00	**Conformal Superstrate Loaded Automotive Radar Antenna for Integration in Polymer Car Body Panels**	A32-1

Kilian, A.; Schmidt, L.-P.
University Erlangen-Nuremberg, GERMANY

Starting from material characteristics and investigated fabrication parameters, the design of a conformal microstrip patch antenna array operating at 24 GHz will be demonstrated. The antenna is hot embossed on a polymer foil and embedded within a plastic multi-layer car body panel by laminating a paint foil and reinforcing the part by back injection molding. The results give information about the producibility of conformal integrated antennas for automotive radar applications.

| 11:20 | **High-Impedance Amplifier for a Novel 14cm Short AM/FM Automotive Active Antenna** | A32-2 |

Negut, A.; Reiter, L.; Hopf, J.; Lindenmeier, S.
University of the Bundeswehr Munich, GERMANY

The design of an ultra short capacitive coupled helical AM/FM active automotive antenna with a length of only 14cm is investigated and its performance is presented. The antenna element produces very sharp resonances and is therefore difficult to use for broadband radio reception. The proposed high impedance amplifier concept flattens the frequency response of the very short resonant antenna, while maintaining a low noise level and a good linearity. The design has been realized and measured.

| 11:40 | **In-Situ Vehicular Antenna Integration and Design Aspects for Vehicle-to-Vehicle Communications** | A32-3 |

Thiel, A.[1]; Klemp, O.[1]; Paier, A.[2]; Bernadó, L.[3]; Karedal, J.[4]; Kwoczek, A.[5]
[1]Delphi Delco Electronics Europe GmbH, Bad Salzdetfurth, GERMANY;
[2]Institut für Nachrichtentechnik und Hochfrequenztechnik, Technische Universität Wien, Vienna, AUSTRIA;
[3]Forschungszentrum Telekommunikation Wien (ftw.), Vienna, AUSTRIA;
[4]Department of Electrical and Information Technology, Lund University, Lund, SWEDEN;
[5]Volkswagen AG, Wolfsburg, GERMANY

Vehicle-to-vehicle (V2V) communications aim to enhance driver safety and traffic efficiency by using the recently designated frequency bands in the *5.9 GHz* range in Europe. This paper highlights the integration of a four-element (*N=4*) linear array antenna into the roof-top compartment of a vehicle to conduct Multiple-Input Multiple-Output (MIMO) high-resolution mobile-to-mobile channel measurements.

| 12:00 | **Integrated Miniaturized Antennas for Automotive Applications** | A32-4 |

Orefice, Mario; Vietti, G; Dassano, G
Politecnico di Torino, ITALY

Two miniaturized antennas, working at 2.44 GHz (ISM band) and 4.5 GHz (for UWB signals) with 11% bandwidth), have been integrated into and around a cubic sensor node of about 1 cm side used in automotive applications. The influence of the nearby metallic components has been reduced, and good performances and agreement between simulated and experimental results has been found.

| 12:20 | **Investigation of a Compact Antenna Diversity Set for Satellite Radio Applications** | A32-5 |

Müller, D. J.; Weikert, M.; Lindenmeier, S. M.
University of the Bundeswehr Munich, GERMANY

Antenna diversity sets are presented for mobile reception of satellite digital radio signals in the S-band. Different antenna types are combined to antenna diversity sets with an overall size comparable to a conventional single antenna. Measurements results of the reflection coefficient and the mutual coupling between the antennas are shown. An improved radiation pattern is achieved by phase shifting and combining of independent radiation pattern from two antenna types.

| 12:40 | **Scanning Vehicular Lens Antennas for Satellite Communications** | A32-6 |

Komljenovic, Tin[1]; Sipus, Zvonimir[1]; Daniel, Jean-Pierre[2]
[1]University of Zagreb, Faculty of Electrical Engineering and Computing, CROATIA;
[2]Advanten, FRANCE

This paper presents technique for designing hemispherical dielectric lens antennas for satellite communications enclosed in protective radome based on spectral domain analysis approach. The analysis technique is coupled with the global optimization technique (namely the particle swarm optimization algorithm), to allow optimization or synthesis of that kind of antennas. The developed tool is used to synthesize vehicular antenna structures and study the influence of radome on radiation pattern.

Session: **A24: RFID**
Type: Antennas Session
Date: Thursday, April 15, 2010
Time: 11:00 - 13:00
Room: Room 130
Chairs: M. Egels
Y. Rahmat-Samii

Time	Title	Abs No
11:00	**A Long Read Range RFID Tag Design for Metallic Objects**	A24-1

Chen, S.-L.[1]; Mittra, R.[2]
[1]China Steel Corporation, TAIWAN;
[2]The Pennsylvania State University, UNITED STATES

An RFID tag antenna with a long-read range has been optimized for mounting on metallic objects has been proposed in this paper. The design has been achieved by increasing the gap between the patches, thereby, decreasing the capacitance of the antenna. The designer can extend the antenna dimension to achieve a high gain design; the experimental tests have shown that the maximum read range of the prototype placed on a metallic object is about 2.8 m, with only 0.5 W EIRP radiation power.

Time	Title	Abs No
11:20	**A New Spiral Antenna for Passive Uhf Rfid Tag on Different Substrates**	A24-2

Alarcon, Juvenal; Deleruyelle, T.; Pannier, P.; Egels, M.
Institut Materiaux Microelectronique Nanosciences de Provence IM2NP, FRANCE

This work presents the design of an antenna for UHF RFID tags working on different substrates. This antenna is based on the principle of broadband and frequency independent antenna like spiral antenna. Material's effects on impedance matching and reading range of the proposed antenna have been investigated in simulation and experimentally. All simulations were performed using a simulator based on a finite element method like Ansoft HFSS. Prototypes were measured into an anechoic chamber.

Time	Title	Abs No
11:40	**Characteristics of Wristband Type RFID Antenna**	A24-3

Takahashi, M; Nakajima, T; Saito, K; Ito, K
Chiba University/Japan, JAPAN

The wristband type RFID tag is one of the applications for personal identification. In case an RFID tag is used close to a human, the human body affects the characteristics of the RFID antenna. In this paper, a reflector-loaded antenna that placed close to the human body has been calculated in order to analyze the operation of the wristband type RFID antenna. Moreover, the antenna radiation patterns and input characteristics were measured by use of a biological tissue-equivalent solid phantom.

Time	Title	Abs No
12:00	**Conformal RFID Antenna Design Suitable for Human Monitoring and Metallic Platforms**	A24-4

Rajagopalan, Harish; Rahmat-Samii, Y.
University of California Los Angeles, UNITED STATES

This paper presents the design of a conformal, low profile RFID tag for different applications. For human monitoring study, firstly realized tag gain vs read range curves are presented. Input impedance and radiation pattern measurements are performed for the tag in a realistic setup and compared to simulation human model. For metallic cylinder tracking study, the input impedance and radiation patterns for the tag are evaluated through simulations. Read range measurements are performed.

Time	Title	Abs No
12:20	**Design for License Plate RFID Tag Antenna with Dual Resonance to improve Identification Ratio**	A24-5

Park, Dea-hwan; Kyeong-Sik, Min
Korea Maritime University, KOREA, REPUBLIC OF

The resonance frequency and bandwidth of the proposed active and passive antenna are about 434 MHz (260 MHz ∼ 600 MHz) and 900 MHz (850 MHz ∼ 960 MHz), respectively. The measured return loss and radiation pattern matched the result of calculation well. The measured readable range of tag antenna with car bumper which contained the poly urethane was approximately 8.5 m.

Time	Title	Abs No
11:00	**Antenna Synthesis for Multiple Element Antenna Channels**	A16P2-1

Pontes, Juan; Zwick, T
Karlsruhe Institute of Technology, GERMANY

In this work, it is shown how the communication channel can be spatially sampled with point sources of different polarization and antenna type. As result capacity maximizing current distributions are obtained out of which optimum antenna patterns can be suggested. Results for a complex urban scenario based on ray-tracing simulations are presented and the effectiveness of the method for the study of the achievable capacities in a certain scenario is shown.

11:20	**Diversity Performance of an Optimized Meander Pifa Array for Mimo Handsets**	A16P2-2

Wang, Q.; Plettemeier, D.; Zhang, H.; Wolf, K.; Ohlmer, E.
Dresden University of Technology, GERMANY

This work proposes an antenna design based on a size optimized planar inverted-F antenna (PIFA) with meander structure for MIMO handset applications. Antenna accomodation on half PCB, which cover different translations and rotations, are investigated in terms of diversity performance. Neutralization line technique is also applied to reveal the influence of S-parameters optimization on the diversity performance.

11:40	**Measurements of Diversity Gain and Radiation Efficiency of the Eleven Antenna by Using Different** Measurement Techniques	A16P2-3

Yang, J.[1]; Pivnenko, S.[2]; Laitinen, T.[3]; Carlsson, J.[4]; Chen, X.[1]
[1]Chalmers University of Technology, SWEDEN;
[2]Technical University of Denmark, DENMARK;
[3]Helsinki University of Technology, FINLAND;
[4]SP Technical Research Institute of Sweden, SWEDEN

This paper presents measurement results of diversity gain and radiation efficiency by using three different measurement techniques: reverberation chamber, spherical near-field anechoic chamber, and multi-probe anechoic chamber. The results are measured over a large 2-8 GHz bandwidth which was possible by using the decade bandwidth Eleven antenna as a two-port diversity antenna.

12:00	**Performance Analysis and Optimization of a MIMO Antenna System Based Upon Hybrid Diversity for Wireless HDTV Camera**	A16P2-4

Person, Christian; Deniel, S; Hemery, J; Coupez, J.P.
Télécom Bretagne, FRANCE

We investigate on the analysis of antennas positioning on a wireless camera for optimizing spatial and polarisation diversity, and consequently MIMO performances. Different configurations are evaluated considering isolation and correlation coefficients, determined from either simulated or measured radiation patterns.The diversity efficiency is optimised considering the small available footprint of the antenna support. An original implementation of miniature wideband dipole antennas is discussed

12:20	**Performance of Directive Multi-element Antennas versus Multi-beam Arrays in MIMO Communication Systems**	A16P2-5

Jamaly, Nima[1]; Zhu, Hongxia[1]; Kildal, Per-Simon[1]; Carlsson, Jan[2]
[1]Chalmers University of Technology, SWEDEN;
[2]SP Technical Research Institute of Sweden, SWEDEN

In an isotropic rich scattering environment, the shape of the patterns of the elements has long been considered as irrelevant to their Multiple-Input and Multiple-Output (MIMO) performances. Here it is demonstrated that unless the number of scatterers is high enough, the diversity gain and capacity do not reach their final limits, even though the spatial correlation and radiation efficiencies reside on their ideally best levels.

12:40	**Theoretical Analysis of Adequate Number of Probe Antennas in Spatial Channel Emulator for MIMO Performance Evaluation**	A16P2-6

Imai, T; Okano, Y; Kitao, K; Saito, K; Miura, S
NTT DOCOMO, JAPAN

At present, techniques are under investigation for evaluating MIMO performance of mobile terminals in laboratories. Employing a spatial channel emulator is one promising candidate. In this paper, we propose a theoretical analysis method in order to obtain the adequate number of probe antennas in the emulator, and clarify the adequate number of probe antennas when assuming the SCM and SCME as the power angular spectrum.

Time	Title	Abs No
14:30	**Diversity Textile Antenna Systems for Firefighters**	C30P1-1

Van Torre, P.[1]; Vallozzi, L.[1]; Rogier, H.[1]; Verhaevert, J.[2]
[1]Ghent University, BELGIUM;
[2]Hogeschool Gent, BELGIUM

Off-body communication systems are valuable for rescue workers operating in an indoor environment. In this measurement campaign the performance of an off-body diversity system is compared for two antenna configurations: 2 dual-polarized antennas, versus 4 circularly polarized antennas. The actual data transmission confirms the marginal difference between the two configurations, suggesting the use of dual-polarized systems for reasons of user convenience and ease of practical implementation.

Time	Title	Abs No
14:50	**Quantification of the Effect of the Non-Idealities in Impulse Radio UWB Systems**	C30P1-2

Pancera, E.[1]; Timmermann, J.[2]; Zwick, T.[1]; Wiesbeck, W.[1]
[1]IHE-Karlsruhe Institute of Technology (KIT), GERMANY;
[2]EADS Astrium, GERMANY

In this paper a complete analysis of the non-idealities in Ultra Wideband (UWB) systems is presented, from both a component point of view and a system point of view. The behaviour of a realistic UWB transmission scenario is investigated with both simulations and measurements of fabricated components.

Time	Title	Abs No
15:10	**Antenna Diversity with Opportunistic Combining for ASK Systems with Single Channel Receivers**	C30P1-3

Jobs, M[1]; Gruden, M[1]; Hallbjörner, P[2]; Rydberg, A[1]
[1]Uppsala University, SWEDEN;
[2]Uppsala University, SP Technical Research Institute of Sweden, SWEDEN

This paper proposes the use of multiple phase shifted signal combinations per symbol without a feedback network, in order to facilitate a minimum component diversity switching technique. The proposed technique can be considered as combining N antenna configurations during each symbol. The effect of both a peak detector system and a system with an averaging detector is investigated. Simulations and measurements in both reverberation chamber and office environment are presented.

Time	Title	Abs No
15:30	**Active Antenna Oscillator Systems in Substrate Integrated Waveguide (SIW) Technology**	C30P1-4

Giuppi, F[1]; Georgiadis, A[2]; Bozzi, M[1]; Collado, A[2]; Perregrini, L[1]
[1]University of Pavia, ITALY;
[2]CTTC, SPAIN

Active antenna oscillator and coupled oscillator topologies are proposed, whose elements are cavity backed antenna oscillators implemented in substrate integrated waveguide (SIW) technology. Compact single substrate implementations are demonstrated. EM simulation and harmonic balance analysis are used to design the radiating structures and trace the various existing periodic steady state solutions. Measurements of small size prototypes are presented.

Time	Title	Abs No
15:50	**A Portable Broadband Monitoring System for Electromagnetic Radiation Assessment**	C30P1-5

Mavromatis, Fanis[1]; Samaras, Theodoros[2]; Koukourlis, Christos[1]; Sahalos, John[2]
[1]Department of ECE, University of Thrace, GREECE;
[2]RCLab, Aristotle University of Thessaloniki, GREECE

A portable broadband monitoring system PBMS for measuring the electric field of broadcasting networks and mobile communication systems is presented. The system has been implemented for recording the field either on an instantaneous or on a 24- hour basis. Low cost and high reliability render the PBMS appropriate for the deployment of electromagnetic radiation systematic measurement campaigns necessary for epidemiological studies and an inexpensive alternative for the concerned public.

Session:	**C15P1: New perspectives for electromagnetic fields in medicine -1**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	14:30 - 16:10
Room:	Room 120
Chairs:	T. Isernia
	O. Bucci

Time	Title	Abs No
14:30	**Magnetic Nanoparticles as a Contrast Agent for Microwave Breast Cancer Imaging**	C15P1-1

Bellizzi, Gennaro[1]; Bucci, O. M.[1]; Catapano, I.[2]
[1]University of Naples Federico II, ITALY;
[2]National Research Council - Institute for Electromagnetic Sensing of the Environment, ITALY

This paper presents a microwave strategy for early breast cancer detection, which exploits magnetic nanoparticle as contrast agent to induce a magnetic anomaly localized into the cancer. The strategy estimates the anomaly by processing the difference of two data sets obtained owing to the capability of switching on and off the magnetic susceptibility by means of an applied polarizing magnetic field. Numerical examples provide a preliminary assessment of the achievable performances.

| 14:50 | **Recent Advances in EM Cancer Treatments** | C15P1-2 |

Neufeld, Esra[1]; Paulides, Maarten[2]; Capstick, Myles[1]; van Rhoon, Gerard[2]; Kuster, Niels[1]
[1]IT'IS Foundation, SWITZERLAND;
[2]Daniel den Hoed Cancer Center, Erasmus MC, NETHERLANDS

Both a novel hyperthermia treatment planning tool and a new head&neck applicator have been developed to overcome limitations of existing approaches. The treatment planning tool is optimized for high quality, accurate, realistic simulations of highly detailed models. The applicator offers superior steerability and online control.

| 15:10 | **RadioFrequency Radiation is Capable of Inducing Adaptive Response in Human Blood Lymphocytes** | C15P1-3 |

Sannino, A.[1]; Zeni, O.[1]; Sarti, M.[1]; Vijayalaxmi, V.[2]; Romeo, S.[3]; Scarfì, M.R.[4]
[1]CNR-IREA, ITALY;
[2]Department of Radiology, University of Texas Health Science Center, UNITED STATES;
[3]Department of Information Engineering, Second University of Naples, ITALY;
[4]CNR - IREA, ITALY

In a previous study we demonstrated that 20 h exposure of human blood lymphocytes from five donors to radiofrequency radiation, RFR (900 MHz, GSM, average SAR 1.25 W/kg) induced adaptive response when the cells were subsequently challenged with Mitomycin-C. In this study we confirmed our previous results on a larger number of donors. The observed phenomenon suggests the possibility that RFR may be used to protect individuals from genotoxic treatments employed in clinical/diagnostic procedures.

| 15:30 | **Molecular Simulations of a Water-Micelle System Exposed to High Intense Electric Fields** | C15P1-4 |

Marracino, Paolo[1]; Apollonio, Francesca[1]; Liberti, Micaela[1]; Amadei, Andrea[2]; d'Inzeo, Guglielmo[1]
[1]University Sapienza of Rome, ITALY;
[2]University of Tor Vergata of Rome, ITALY

Molecular dynamics (MD) simulations of a zwitterionic (neutral) micelle in water solution have been performed in order to evaluate the influence of static and pulsed electric fields on such molecular system

| 15:50 | **Nanosecond Pulsed Electric Fields: Microdosimetry on Single Cells** | C15P1-5 |

Merla, C.[1]; Paffi, A.[1]; Liberti, M.[1]; Apollonio, F.[1]; Danei, F.[1]; Leveque, P.[2]; d'Inzeo, G.[1]
[1]"SAPIENZA" UNIVERSITY OF ROME, ITALY;
[2]XLIM, CNRS-University of Limoges, FRANCE

A microdosimetric study on nanosecond pulsed electric fields including cell compartments dispersivity through Debye equation has been detailed in this paper. A quasi-static solution adapted to wide band signals and coupled with an asymptotic electroporation model has been used to face the problem. Main paper results highlight the relevance of Debye modeling, as well as the use of different membrane dielectric models in nsPEF microdosimetry.

Session: **A25: Reflector and lens antennas**
Type: Antennas Session
Date: Thursday, April 15, 2010
Time: 14:30 - 16:10
Room: Room 124
Chairs: J. Ala-Laurinaho
                   J. Alda

Time	Title	Abs No

14:30   **A Study of Extended Hemispherical Lenses for a High-Gain Beam-Steering Antenna**   A25-1

Karttunen, A.[1]; Ala-Laurinaho, J.[1]; Sauleau, R.[2]; Räisänen, A. V.[1]
[1]Aalto University School of Science and Technology, FINLAND;
[2]IETR, FRANCE

In this paper, large extended hemispherical lenses are studied for a high-gain beam-steering antenna as a function of directivity of a feed element, relative permittivity of the lens material, and feed offset. Design guidelines necessary for the feed array design are provided. A wide range of permittivities and feed directivities are studied. The lenses are analysed with ray-tracing simulations using a simplified feed radiation pattern.

14:50   **Design of H-Plane Shaped Flat Lenses Using a 2-D Approach Based on FDTD and Genetic Algorithm**   A25-2

ROLLAND, Anthony[1]; SAULEAU, Ronan[1]; DRISSI, M'Hamed[2]
[1]IETR, University of Rennes 1, FRANCE;
[2]IETR, INSA de Rennes, FRANCE

The paper presents a two-step design methodology with a 2-D modelling approach based on FDTD and Genetic Algorithms to synthesise flat lenses for beam shaping applications. This methodology has been applied to design flat lenses that radiate a stable flat-top beam over a 10% bandwidth in the H-plane and an omnidirectional radiation in the E-plane. A validation of such a lens in V-band with a double-shelled structure, have shown the good reliability of such 2-D approaches to design flat lenses.

15:10   **Optimal Phase Distributions for Pollygonal Fresnel Lenses**   A25-3

Alda, Javier[1]; Salgado-Remacha, F. J.[1]; Sanchez-Brea, L. M.[1]; Rico-Garcia, J. M.[2]; Gonzalez, F. J.[3]
[1]University Complutense of Madrid, SPAIN;
[2]Centre de Recherche Paul Pascal, FRANCE;
[3]Universidad Autónoma San Luis Potosí, MEXICO

Polygonal Fresnel zone plates can be configured in a variety of forms depending on the number of sides of the polygon and the number of phase steps used. This contribution deals with some specific polygonal designs that tessellate the plane: triangles, squares, and hexagons. The phase distribution is chosen as a continuous one to form a polygonal kinoform. The selected designs have been simulated and its behaviour compared.

15:30   **Small Offset Parabolic Reflector Antenna Design and Analysis**   A25-4

Krzysztofik, Wojciech
Wroclaw University of Technology, POLAND

Complete radiation pattern of a focus-fed offset parabolic reflector antenna is presented. Forward radiation and wide-angle radiation is calculated using the geometrical theory of diffraction. Design criteria of an offset reflector satisfying the WARC-DBS requirements for receiving antenna, and for a given feed radiation pattern are presented. It is also shown how to determine the antenna noise temperature experimentally, using direct satellite signal.

15:50   **Spherical Modal Analysis of a Patch Array Dielectric Lens Antenna**   A25-5

Ravishankar, S; Rukmini, T S; Ravishankar, A
R V College of Engineering, INDIA

Steered Patch arrays with a dielectric lens for collimation are well suited for mobile applications due to their small form factor and effective sealing ability. In this paper we present an accurate analytical formulation of a patch array radiating in the presence of a hemispherical Dielectric lens based on spherical modal expansion (SME) and experimentally demonstrate an increase in directive gain due to lens collimation. The Analysis treats the lens as a scatterer.

Time	Title	Abs No
14:30	**Large Radar Antennas Measurement Systems**	C27P1-1

Martín, F.; Torres, J.; Rengifo, L.
Indra, SPAIN

This document presents two measurement systems for testing the new large radar array antennas developed by the Spanish company INDRA Sistemas. The first one is a linear measurement system for testing the array rows. The second one is an outdoor cylindrical near field facility for the complete array test. Different techniques and improvements applied to them are reviewed and results are shown.

14:50	**Automated Measurement Procedure for the Calibration of Planar Active Arrays**	C27P1-2

Salas Natera, M; Martínez Rodríguez-Osorio, R; De Haro Ariet, L
Universidad Politécnica de Madrid, SPAIN

This work has been focused to describe the development and implementation of an automated system for measurement and characterization of planar active arrays. This automated system is capable of reducing time and operative cost and it is based on multilayer hardware architecture and control software. The system has been tested on one triangular active array panel of the GEODA for satellite communication. The measurements and characterization are important tasks in the calibration procedures.

15:10	**Fast Antenna Testing Using Advanced Probe Array Technology**	C27P1-3

Durand, L.[1]; Duchesne, L.[1]; Foged, L. J.[2]
[1]SATIMO, FRANCE;
[2]SATIMO, ITALY

The use of probe array is a well established technology for spherical near field systems offering all the possibilities and accuracies of traditional single probe testing at a much faster speed. Recently the problem of exhaustive testing of the high number of multi beam antennas embarked on future satellite systems has received considerable attention. Solutions based on "hybrid systems" taking full advantage of fast probe array technology can drastically reduce the measurement time.

15:30	**Open Boundary Quadridge Horn Antenna for the 80 MHz to 1 GHz Range: A Dual Polarized Solution for Testing Antennas in the VHF and UHF Ranges**	C27P1-4

Rodriguez, Vince
ETS-Lindgren, UNITED STATES

A large dual linearly polarizaed horn is design to cover the 100MHz to 1GHz range. The design process shows the limitations of simply physically scaling a design to cover a different frequency range. The limitations of machined to implement the physically large design forced some modifications to be implemented. The result is a totally open Horn desing similar to a dual polarized vivaldi. The Horn is flexible and can be used in taper chambers or mounted on the shield a ground plane.

15:50	**A Modified Wheeler Cap Method for Radiation Efficiency Measurement of Balanced Electrically Small Antennas**	C27P1-5

Zhang, J.; Pivnenko, S.; Breinbjerg, O.
Technical University of Denmark, DENMARK

A modified Wheeler cap method is proposed for the radiation efficiency measurement of balanced electrically small antennas and a three-port network model of the Wheeler cap measurement is introduced. The proposed method is wideband, does not require any balun, and both the antenna input impedance and radiation efficiency can be obtained. An electrically small loop antenna and wideband dipole were simulated and measured using the proposed method and the results are found to be in good agreement.

Time	Title	Abs No
14:30	**New Dipole Slot Antenna Design for RFID Communications**	Thur-1

Kimouche, Hocine; Zemmour, Hamadache; Atrouz, Brahim
Ecole Militaire Polytechnique, ALGERIA

New design of a dipole antenna with H-shaped slot at two operating bands for Radio Frequency Identification (RFID) is presented. By using an H-shaped slot over a rectangular patch at the middle associated with four T-shaped slot, the proposed antenna has a wide and dual measured return loss bandwidth. Besides, the omnidirectional radiation pattern of the antenna cover the entire frequency range including Ultra High Frequency(UHF, 915MHz) and microwaves (2.45GHz) bands has been obtained.

| 14:30 | **High-Gain Dual-WLAN-Band Dual-Loop Antennas for MIMO Access Points** | Thur-3 |

Su, S.-W.[1]; Chang, F.-S.[2]
[1]Lite-On Technology Corp., TAIWAN;
[2]Department of Electronics, Cheng Shiu University, TAIWAN

A high-gain, three-antenna system for MIMO AP applications in the 2.4/5.2/5.8 GHz bands is presented. The antenna system is composed of three dual-loop antennas; each dual-loop antenna further comprises a large outer loop and a small inner loop. The antennas are placed in a sequential, rotating arrangement on a ground plane to form a symmetrical structure. The results show that well port isolation can be obtained together with high-gain, directional radiation characteristics.

| 14:30 | **A Low-Profile Dipole Type Passive UHF Band RFID Tag Antenna** | Thur-5 |

Wu, SungJung; Lin, Chia-Ti; Tarng, Jenn-Hwan; Chao, Chi-Hung
National Chiao Tung University, TAIWAN

In this paper, a low-profile dipole type passive UHF radio frequency identification (RFID) tag antenna used in the UHF band is presented. The proposed antenna is anti-symmetrical about the origin and consists of meandered lines and two metal plates. The measured maximum read range of the proposed tag antenna is 6.5 meters at 915MHz

| 14:30 | **A Capacitively-Loaded PIFA Based Reader Antenna for Portable RFID Application** | Thur-7 |

Chao, Chi-Hung; Wu, SungJung; Tarng, Jenn-Hwan
National Chiao Tung University, TAIWAN

A capacitively loaded planar inverted F antenna (PIFA) for a portable RFID application is presented. The antenna consists of four parts: a ground plane, a rectangular radiator with cut slots, an excited stub, and a shorting pin on the right-hand side that connects the ground plane to the rectangular radiator. The capacitive coupling and shorting pin are used to effectively reduce the antenna size.

| 14:30 | **Low Specific Absortion Rate Wearable Antenna for WLAN Band Applications** | Thur-9 |

Kim, J. H.; Lee, H. M.
Kyonggi Univ., KOREA, REPUBLIC OF

In this paper, a wearable antenna for wireless local area network (WLAN: 5.725 GHz ∼ 5.825 GHz) band applications using a stacked square ring patch element is proposed. It consists of a micro strip line with indirect feeding method and a stacked square ring patch. It is designed on a flexible printed circuit board (PCB). The proposed antenna shows good characteristics such as a WLAN band, a backward wave reduction, a suitable gain and a SAR value below international standard, etc.

| 14:30 | **A Dual-Band and Dual-Polarised Patch Antenna for Body Area Network** | Thur-11 |

Ma, Da; Zhang, wen-xun
State Key Lab. of Millimetre Waves, Southeast University, CHINA

A dual-band dual-polarized antenna is proposed for off-body (ISM 2.4 GHz band) and on-body communication(ISM 5.8 GHz band) simultaneously. This antenna possesses good performances of impedance matching (8.5 % for VSWRiÜ2:1) and isolation between two feeding ports are better than 20 dB over both ISM bands by means of a band-stop filter. The performances of the antenna worn on the human body are also investigated, the results shown that antenna is available for the BAN application.

| 14:30 | **A Small Quad-Band Automotive Antenna** | Thur-13 |

Abbasi, Nisar A; Langley, Richard J
University of Sheffield, UNITED KINGDOM

An EBG structure based quad-band antenna for automotive applications is designed. The EBG acting as a HIS is a novel dual band structure with the bandgaps in the 2.7 GHz and 5.9 GHz ranges. A wideband printed monopole antenna uses this novel EBG as a HIS resulting in a low profile quad-band antenna system. The frequency bands covered are UMTS, WLAN (two bands) and V2X using a -10dB reflection coefficient criteria. The gain increases by 0.6 to 8.6 dBi when the EBG is used as a ground plane.

14:30   **Novel Antenna Configuration for HF- and UHF-Band Hybrid Card-Type RFID Tags**   Thur-15

Nishioka, Yasuhiro[1]; Hitomi, Kenzaburo[2]; Mizuno, Tomohiro[1]; Okegawa, Hirokatsu[1]; Fukasawa, Toru[1];
Miyashita, Hiroaki[1]; Konishi, Yoshihiko[1]
[1]Mitsubishi Electric Corporation, JAPAN;
[2]Mitsubishi Electric Engineering Corporation, JAPAN

This paper presents a novel, effective antenna configuration for HF- and UHF-band hybrid card-type RFID tags. The proposed antenna positively utilizes a coil for operation in the HF band as a ground conductor and acts as a monopole antenna in the UHF band. Capacitive coupling of the coil windings is implemented to obtain higher radiation efficiency in the UHF band. The wideband characteristics and effectiveness of the proposed antenna are demonstrated by simulations and experiments.

14:30   **Shirt Collar Tag for Wearable UHF RFID Systems**   Thur-17

Kellomaki, Tiiti; Bjorninen, Toni; Ukkonen, Leena; Sydanheimo, Lauri
Tampere University of Technology, FINLAND

A wearable RFID tag antenna for the European UHF RFID band (866 MHz) is presented. The antenna is a one-layer dipole structure, 7 cm by 2 cm, optimised to operate very near the human body. It fits easily on the collar of a dress shirt. The tag is readable from a 5-metre distance if separated by 1 cm or more from the body. The radiation pattern covers one hemisphere. The effects of antenna placement on the body and separation from the body are examined and results presented.

14:30   **Textile Microstrip Array Antenna on Three Dimensional Orthogonal Woven Composites**   Thur-19

Zhong, Shun-Shi
Shanghai University, CHINA

A novel textile array antenna with special structure at 1.54GHz is introduced. The patch, the substrate and the ground are woven together as a unity. Measured results are compared with the simulated, showing the usefulness of new generation of textile antenna.

14:30   **Near Field / Far Field RFID Tag Antenna**   Thur-21

Iliev, Plamen[1]; Le-Thuc, P.[1]; Staraj, Robert[2]; Luxey, C.[2]
[1]LEAT, FRANCE;
[2]LEAT-CNRS, Université de Nice-Sophia, FRANCE

This paper presents a dual band RFID tag antenna combining HF (13.56MHz) and UHF (860MHz-960MHz) operations. This antenna has two differential feeding points, the first one for UHF chip impedance matching and the second on for chip/antenna HF resonance. HF loop and an UHF dipole are combined by controlling the currents induced by the dipole over the loop.

14:30   **A Compact Circular Horn with High Aperture Efficiency**   Thur-23

Ruggerini, G
Space Engineering, ITALY

This paper describes a novel very compact circular horn with high aperture efficiency. The horn presents a profile very waving to achieve the optimum waveguide mode conversion yielding an extremely reduced horn depth (about 1.2 time the aperture diameter) and an aperture efficiency greater than 90% over a 10% bandwidth for aperture dimensions up to 6λ

14:30   **A New Accurate Model for Receiving Antennas**   Thur-25

NIAMIEN, Constant; COLLARDEY, Sylvain; MAHDJOUBI, Kouroch
Institute of Electronic and Telecommunication of Rennes, FRANCE

A new model for receiving antennas has been proposed based on the classical theory of the scattered field by an antenna. This new model allows predicting the antenna behaviour in terms of the absorbed and scattered powers in connection with the antenna scattering parameters.

14:30   **The Hilbert Monopole Revisted**   Thur-27

Sanz, I.; Anguera, J.; Andujar, A.; Puente, C.; Borja, C.
Fractus, SPAIN

A comparison between the resonant performance of the third iteration Hilbert monopole and a spiral shaped one of the same size and resonant frequency is presented. Although the Hilbert monopole total wire length is longer, it shows nearly the same radiation efficiency and lower quality factor. The Hilbert monopole presents 1.6 times more bandwidth than the spiral shaped monopole.

14:30   **Efficient Dispersion Analysis Of 2D High-Gain Leaky-Wave Antennas**   Thur-29

Mateo-Segura, C.[1]; Garcia-Vigueras, M.[2]; Goussetis, G.[3]; Gomez-Tornero, J.L.[2]; Feresidis, A.P.[1]
[1]Electronic and Electrical Engineering Department, Loughborough University, UNITED KINGDOM;
[2]Department of Information and Communication Technologies, Technical University of Cartagena, SPAIN;
[3]ECIT, Queen's University, UNITED KINGDOM

A new analysis technique is presented to derive the complex dispersion characteristics of periodic 2-D Fabry-Pérot Leaky-Wave Antennas. Full-wave MoM together with reciprocity is employed for the estimation of the antenna radiation patterns from which the phase constant is determined. The leakage rate is obtained by matching these patterns to those estimated using array theory. The method is applicable to thin antennas where other techniques such as transverse equivalent network lose accuracy.

14:30   **Design of Antenna Based Microwave Sensors for Blade Tip Clearance Measurement in Gas Turbines** Thur-33

Violetti, M.[1]; Zurcher, J-F.[1]; Geisheimer, J.[2]; Skrivervik, A. K.[1]
[1]EPFL - LEMA, SWITZERLAND;
[2]Meggitt Sensing Systems, Fribourg, SWITZERLAND

Real time tip clearance measurement in rotating machinery is an interesting way to provide enhanced reliability. This paper presents a novel microwave sensor for blade tip clearance measurement in turbine engines consisting of a miniaturized PIFA antenna shielded by an outer protective shell.The sensor was optimized through simulation, then manufactured and measured showing the sensor capability of providing accurate and reliable data in presence of corrosive gases and high temperature extremes.

14:30   **Research Antenna Made of Gas Plasma on Microwave Band** Thur-35

Bezpalov, A.Y.[1]; Gnatushenko , V.V.[1]; Ovsyanikov , V.V.[1]; Ovsyanikov , V.V.[2]; Reuta , O.V.[1]; Safonov , V.V.[1]; Sydorenko , O.A.[1]
[1]DNU, UKRAINE;
[2]NMU, UKRAINE

The results of researches internal and external microwave characteristics of loop and rod antennas on the basis of cold plasma are presented. The rows of advantages of such antennas above the metallic ones have been pointed.

14:30   **Modifications in Radiation Characteristics of a Yagi Antenna for TV.** Thur-37

Fernández Anitzine, Ignacio; Romo Argota, Juan Antonio; Garate, Judit
University of the Basque Country, SPAIN

The significant development in Digital Terrestrial Television area has led to use higher frequencies, compared to analogue broadcasting. Answering the requirements from antennas market, in this paper, we propose the design of a new TV antenna, modifying the gain characteristic from a common commercial TV antenna, in order to achieve better gain responses in frequencies around 850 MHz.

14:30   **A Small High Performance Metal-Mountable RFID Tag Antenna** Thur-39

Popugaev, A. E.; Wansch, R.
Fraunhofer Institute for Integrated Circuits, GERMANY

In this paper a new metal-mountable RFID tag antenna with the highest read-range-to-volume ratio of all commercially available tags is described. The antenna is designed for an Alien H3 chip and represents a small printed loop antenna (37x7x3.2 mm3) with matching elements integrated into its structure. Two embodiments for monoband and dual band applications described in the paper show a read range of 5 m and 2 m respectively.

14:30   **On-Body Patch Antenna with Parasitic PEC Wall for the Miners Cardiac Rhythm Sensor** Thur-41

Dubrovka, Rostyslav[1]; Shirokov, I[2]
[1]Queen Mary University of London, UNITED KINGDOM;
[2]Sevastopol National Technical University, UKRAINE

A patch antenna with parasitic PEC wall for the minor cardiac rhythm sensor is discussed in the paper. Better bandwidth performance and stability of the resonance frequency distinct the antenna from a conventional patch. The sensor is a part of a system for searching people under rocks. Principles of construction of the system, based on measuring the Doppler effect, are shown.

14:30   **Effect of Asymmetric Feeding and Meander in the Dual-Band Antenna Design** Thur-43

Costa, Crezo[1]; Fontgalland, Glauco[2]; Vuong, Tan-phu[3]; Barbin, Silvio E. [5], Pedro, Raimundo[2]; Freire, Raimundo[2]; Lima, Robson[4]
[1]Federal University of Campina Grande, BRAZIL;
[2]Federal university of Campina Grande, BRAZIL;
[3]LCIS/ESISAR-INPG, FRANCE;
[4]Federal university of Bahia, BRAZIL
[5] Polytechnic School, University of São Paulo, BRAZIL

This paper detail the effects of asymmetric feeding and meander in the dual-band antenna design. The antenna used is electrically small rectangular patch with short circuit. The changed in the feeding position (asymmetric feeding) combined with introduction of meander in the patch to obtain miniaturized antenna with news resonates modes. These antennas could be suitably used in some applications that require compacts antenna operating in dual-band frequency.

14:30   **UHF Tag for Suitcase RFID Application in Airports** Thur-45

R. Medeiros, Carla[1]; R. Costa, J.[2]; A. Fernandes, C.[1]
[1]Instituto Telecomunicacoes - IST, PORTUGAL;
[2]Instituto Telecomunicacoes - ISCTE, PORTUGAL

This paper presents a passive UHF tag configuration for suitcase security and tracking in airport luggage operation. The proposed solution is based on conformal geometry tag, consisting of a folded dipole with orthogonal arms, appropriate for integration into the wall of injection moulded suitcases during fabrication. Simulated frequency dependence is presented and detection range was measured in free space and within the suitcase in several test environments.

| 14:30 | **DESIGN OF A DIRECTIVE ANTENNA WITH FRACTAL GEOMETRY FOR RFID LOCALIZATION APPLICATIONS** | Thur-47 |

FRANCISCATTO, B. R.[1]; FONTGALLAND, G.[2]; NDAGIJIMANA, F.[1]; VUONG, T. P.[1]
[1]IMEP-LAHC-CNRS /MINATEC, FRANCE;
[2]Electrical Engineering Department – DEE, Federal University of Campina Grande – UFCG, BRAZIL

With the increasing needs of miniaturization, multiband, very directive antennas and which allow the integration of various wireless technologies, research is oriented following different ways. One of it consists in using fractal elements. For this project, we propose to design a multiband fractal antenna (RFID reader), with a higher directivity for RFID applications.

| 14:30 | **Design of an Electrically Small Printed Circular Inverted-F Antenna Controlled by a Minimal Set of Parameters** | Thur-49 |

Kakoyiannis, Constantine[1]; Kyrligkitsi, A.[2]; Constantinou, P.[1]
[1]Mobile Radio Communications Laboratory, National Technical University of Athens, GREECE;
[2]RWTH Aachen University, GERMANY

A printed circular inverted-F antenna (CIFA), mirrored against a small, crescent-like ground plane, is printed on a discoid substrate; it is an electrically small antenna (ESA) controlled by only two angles and a radius. The CIFA is resonant and matched at 2.5 GHz, achieving 3.5% bandwidth. The paper also discusses two issues pertinent to ESAs for microsensors: the upper bound on achievable gain and the lower bound on transmit frequency, given the electrical size of the wireless sensor.

| 14:30 | **Reduced-Size,Dual-Band printed Quadrifilar Helix Antenna** | Thur-51 |

Sharaiha, Ala; Rabemanantsoa, JR
IETR-Université de Rennes 1, FRANCE

This paper presents a novel reduced size dual-band printed quadifilar helix antenna using meandering and folding techniques to obtain a Compact Printed Quadrifilar Helix Antenna. With this design, the axial length of conventional PQHA is reduced by 43% with a dual band behaviour with a good circular polarisation and same radiation making it practical to be implemented on to GPS terminals.

Session:	**Thur-Poster Session A8: Multiband & Wideband 2**
Type:	Poster
Date:	Thursday, April 15, 2010
Time:	14:30 - 16:10
Room:	Foyer 2
Chairs:	O. Quevedo
	C. Reig

Time	Title	Abs No
14:30	**A Wideband Circularly Polarized Rectangular Dielectric Resonator Antenna**	Thur-2

Massie, Gabriel[1]; Caillet, Mathieu[2]; Clénet, Michel[3]; Antar, Yahia M.M.[2]
[1]Canadian Forces, CANADA;
[2]Royal Military College of Canada, CANADA;
[3]DRDC Ottawa, CANADA

A new hybrid dielectric resonator antenna has been investigated to produce circular polarization over a wide frequency band. The fabricated design has shown impedance matching over a 50% bandwidth. The radiation characteristics of the antennas were also characterized. From 1.13 to 1.63 GHz, the achieved maximum gain is over 1.5 dBic and the axial ratio is under 1 dB at boresight. The half-power beamwidth is greater than 75 deg., and the axial ratio beamwidth (AR < 3 dB) is over 90 deg.

| 14:30 | **An Ultra-Wideband Printed Monopole Antenna With The Gain Enhanced Using A Surface-Mounted Short Horn** | Thur-4 |

Ranga, Yogesh[1]; Esselle, Karu[1]; Weily, Andrew[2]; Verma, A. K.[3]
[1]Macquarie University, AUSTRALIA;
[2]CSIRO, ICT Centre, AUSTRALIA;
[3]University of Delhi, INDIA

An ultra-wideband printed monopole antenna, improved by attaching a short two-plate horn to its surface, is reported in this paper. The short horn, which has a slant length of 45 mm and a total physical height of 46.9 mm, significantly increases the gain of the printed monopole antenna at lower frequencies where the gain of the monopole is otherwise low, giving an almost flat gain over a 114 % bandwidth. The new antenna has a measured gain in the range of 4.8 dBi 0.7 dB from 3 GHz to 12 GHz.

| 14:30 | **Wide Band Planar Monopole Antenna with Asymmetric Parasitic Elements** | Thur-6 |

IWASAKI, HISAO[1]; Sugimoto, Shota[2]
[1]SHIBAURA INSTITUTE OF TECHNOLOGY, JAPAN;
[2]Shibaura Institute of Techonogy, JORDAN

This paper introduces the novel wide band planar monopole antenna with asymmetric parasitic elements and describes the simulated and the measured results. The VSWR less than 2 was obtained from 1.8 GHz to 5.9 GHz. The simulated and measured VSWR were agreed very well.

| 14:30 | **Experimental Validation of the UWB ``Eared" Antenna for Impulse Radio Applications** | Thur-12 |

Tanyer-Tigrek, F. Muge; Lager, Ioan; Ligthart, Leonardus
Delft University of Technology, NETHERLANDS

A small sized, CPW-fed "Eared" antenna for Impulse Radio applications is described. The electrical characteristics of the antenna are investigated in frequency and time domains. The antenna has a measured relative impedance bandwidth of 170%. Radiation patterns show stable co-polar and low cross-polar characteristics within the FCC UWB frequency band. Group delay and the fidelity factors of the antenna are investigated for different orientations with good time domain behaviours.

| 14:30 | **Wideband Shorted Backfire Antenna with L-Probe Fed Microstrip Patch** | Thur-14 |

Hazdra, Pavel; Mazánek, Miloš
Czech Technical University in Prague, CZECH REPUBLIC

In this contribution a novel configuration of high-directivity broadband antenna is presented. Its main operational principle is based on the so-called "short backfire" concept, however, instead of conventional dipole, rectangular microstrip patch is used as feeder. Result is a easy-to-build conical-shaped SBF antenna with the bandwidth of 23% and flat gain behavior showing peak of 16 dBi.

| 14:30 | **A Modified Printed Monopole Antenna for Ultra-Wideband Applications** | Thur-16 |

Adnan, Shahid; Abd-Alhameed, Raed; Hraga, Hmeda; Bin-Melha, Mohammad; Elkhazmi, Elmahdi; Jones, Steve
University of Bradford, UNITED KINGDOM

a planer printed monopole antenna for Ultra Wide Bandwidth (UWB) applications is presented and discussed. To obtain the required wide response, the base of the monopole is tapered in five steps to match the width of the feeding line as it emerges from the ground plane. A parametric study is carried out for various antenna parameters using the HFSS software tools.

| 14:30 | **Dual Printed Dipole Design Method** | Thur-18 |

Reig, C[1]; Ávila-Navarro, E[2]; Carrasco, J.A.[2]
[1]Universitat of València, SPAIN;
[2]Universidad Miguel Hernández, SPAIN

A method for designing dual frequency compact printed dipole antennas is presented. The antenna consists of two printed dipoles groups distributed on both sides of the dielectric substrate. Design optimization is carried out by an own FDTD code. As an example, a low-cost dual band antenna for Wi-Fi applications in 2.5GHz-5GHz bands is designed, fabricated and measured. Two operationfrequency bands with a wide bandwidth (>25%) and moderate gain (3.3dBi at 2.5GHz and 7.5dBi at 5GHz) are obtained.

| 14:30 | **Design, Fabrication and Mesureament of a Dual-Band Circularly-Polarized Stacked Microstrip Antenna for Galileo and GPS** | Thur-20 |

Ramirez , M.; Parron, J.
Department of Telecommunication and Systems Engineering, Universitat Autònoma de Barcelona (UAB), SPAIN

This paper deals with the design, fabrication and measurement of a dual-band circularly-polarized stacked microstrip antenna for Galileo (E5a, E5b, E2 and E1 bands) and GPS (L2 band). A feeding network composed of three Wilkinson power combiners is used to generate the required circular polarization.

| 14:30 | **Design of Low Profile Antipodal Vivaldi Antenna for Ultra-Wideband Near-Field Imaging** | Thur-22 |

Zhuge, Xiaodong; Yarovoy, A
Delft University of Technology, NETHERLANDS

In this paper, the design of a low profile antipodal Vivaldi antenna for array-based UWB near-field imaging is presented. The antenna design with dimensions of 45íÁ48.5 mm achieves satisfactory impedance matching and radiation across the frequency band from 2.7 to 35 GHz with more than 170% fractional bandwidth. Both SMA and 2.4 mm connectors are tested with the manufactured antenna in order to confirm its UWB performances.

| 14:30 | **SMALL WIDEBAND ANTENNA FOR GSM AND WLAN APPLICATIONS** | Thur-24 |

Hraga, H[1]; See, C.H[1]; Abd-Alhameed, R.A[1]; Zhou, D[1]; Adnan, S[1]; Elfergani, ITE[1]; Excell, P[2]
[1]University of Bradford, UNITED KINGDOM;
[2]Glyndwr University,, UNITED KINGDOM

A small printed antenna for mobile handset and WLAN applications.

| 14:30 | **Wideband Zero-Mode Circular Patch Antenna** | Thur-26 |

Vazquez-Roy, J. L.[1]; de Inclan-Sanchez, L.[2]; Quevedo-Teruel, 0.[1]; Rajo-Iglesias, E.[1]
[1]Universidad Carlos III de Madrid, SPAIN;
[2]Universidad Autonoma de Madrid, SPAIN

In this paper, a novel wideband zero-mode circular patch antenna is presented. It is shown that by using shorting pins whose position is optimized, not only the concentric conducting post can be removed, but also the matching bandwidth is enhanced, doubling the typical result for the conventional antenna case. Measurements of bandwidth, efficiency and radiation patterns of a manufactured prototype are reported in order to validate the proposal.

| 14:30 | **Archimedean Spiral Antenna for Underground Soil Measurements in Greenland** | Thur-28 |

Gustafson, C; Johansson, A J
Lund University, SWEDEN

In this paper, we present a thin single-arm Archimedean spiral antenna designed to be used in underground soil measurements to characterize the dielectric properties of soil during freezing and thawing processes. The designed antenna works in low permittivity, low-loss frozen soil as well as in high permittivity, high-loss marshy soil and operates over the frequency range 1-3 GHz. The antennas has been successfully used for measurements of soil properties in situ.

| 14:30 | **Low Profile Multiband Antenna for Mobile Communications** | Thur-30 |

Pinho, Pedro[1]; Calhau, Luis[2]; Pinho, Pedro[3]
[1]ISEL / IT, PORTUGAL;
[2]ISEL, PORTUGAL; [3]ISEL/IT, PORTUGAL

In this paper, the design of low profile antennas by using Electromagnetic Band Gap (EBG) structures is introduced. Taking advantage of the fact that they can behave as Perfect Magnetic Conductor (PMC), it is shown that these structures exhibit dual band in-phase reflection at WLAN (Wireless Local Area Network) bands, the 2.4 GHz and 5.2 GHz bands. These structures are applied to PIFA (Planar Inverted-F Antenna) and the results show that it is possible to obtain low profile PIFA's.

| 14:30 | **Analysis & Generation of Statistical Population of Planar UWB Antennas** | Thur-32 |

Yousuf, Muhammad Amir; Roblin, Ch.R
ENSTA-ParisTech, FRANCE

Generation of statistical population is as important as analysis of statistical data. In this paper first, an approach for generating a statistical population of planar UWB antenna is presented, second, a statistical analysis of the generated population is presented.

14:30 **Optimization of UWB Dipole Feeding Circuits** Thur-34

Cerny, Petr
Czech Technical University, CZECH REPUBLIC

The paper presents UWB antennas. As radiating elements, basic shapes (elliptic, rectangular and rhombus dipoles), shapes based on expert designs (rectangular dipole with triangular or elliptical feeding basis) and also fully optimized ones. The microstrip and coplanar lines and balun transformer were used for the dipole feeding. The time domain characteristics (namely the distortion of transmitted impulses and the dispersive characteristic) and the antenna matching are evaluated and discussed.

14:30 **Characteristics of Compact Balanced-fed Folded Dipole Antenna** Thur-36

Hirayama, M. H; Ito, J. I; Watanabe, S. W; Morishita, H. M
National Defense Academy, JAPAN

In our previous paper, in order to make a small size and lower profile antenna for handsets, the built-in folded dipole antenna and U-Shaped folded dipole antenna (UFDA) have been introduced and analyzed. Those antennas can be built in a small volume and placed very close to the rectangular ground plane, because they have a folded structure and high radiation resistance. In this paper, more compact balanced folded dipole antenna based on UFDA is proposed and its characteristics are analyzed.

14:30 **A Multiband Monopole Antenna Using a Double-Tuned Wheeler Matching Network** Thur-38

Antoniades, M.A.; Eleftheriades, G.V.
University of Toronto, CANADA

A double-tuned matching network is proposed, which replaces one of the resonant circuits in a Wheeler matching network with a $\lambda/2$ transmission line in order to achieve broadband and multiband matching performance. The multiband Wheeler matching network is then applied to a circular monopole antenna, and it is demonstrated that a compact, multiband and highly efficient antenna can be achieved.

14:30 **Impact of the Ground Plane Topology on the Performances of a Multiband Quadri-Element Antenna** Thur-40

Palacin, Baptiste[1]; Fonseca, Nelson J. G.[1]; Hebib, Sami[2]; Aubert, Hervé[2]
[1]CNES, FRANCE;
[2]LAAS-CNRS, FRANCE

This paper presents investigations performed on the ground plane topology of a pyramidal multiband quadri-element antenna recently introduced mainly for radio navigation applications. The analyses led to a new topology of ground plane that reduces the overall height of the antenna without affecting the electrical performances of the antenna, mainly input matching and radiation patterns.

Session: **C30P2: COST action RFCSET: Multidisciplinary design for wireless systems - 2**
Type: Convened Session
Date: Thursday, April 15, 2010
Time: 16:40 - 18:20
Room: Room 119
Chairs: A. Georgiadis
             J. Perruisseau-Carrie

Time	Title	Abs No
16:40	**The Wireless Power Supply with the Use of Coupling Surface**	C30P2-1

Kracek, J.; Mazanek, M.
Czech Technical University in Prague, CZECH REPUBLIC

This contribution presents a part of a system for wireless power supply with the use of guided wave in the coupling surface. This system type is suitable for the supply of different devices with small power input in picocells. The main elements of the RF section of the system are slab dielectric waveguide which creates a coupling surface and adaptor to this waveguide. The text especially focuses on this adaptor which ensures the coupling of RF power to and from the slab dielectric waveguide.

17:00	**Antenna RF-System Simulation Tool Including Hardware Artifacts**	C30P2-2

Boman, T[1]; Malmqvist, R[1]; Samuelsson, C[1]; Gustafsson, A[1]; Baggen, R[2]
[1]FOI, SWEDEN;
[2]IMST, GERMANY

We present an antenna RF system simulator and two application examples: a) a conformal electronically scanned multifunction antenna on-board a UAV, and b) a phased array satellite communication car roof antenna. The simulator is a generic tool that can be used to study different applications such as civilian or military radar and communication for example. The focus is to assess the effects tat different hardware architecture and component properties will give at system level.

17:20	**Calibration of Adaptive Antennas in Satellite Navigation Receivers**	C30P2-3

Konovaltsev, A.; Basta, N.; Greda, L.A.; Cuntz, M.; Heckler, M.V.T.; Dreher, A.
German Aerospace Centre (DLR), GERMANY

The focus of the paper is on practical aspects of the array calibration in adaptive antennas used in receivers of Global Satellite Navigation Systems (GNSS). A model for describing the measurements errors occurring in the receiver when using an adaptive antenna is introduced. The effect of different patterns of the array elements is studied in details. A practical implementation of the adaptive antenna receiver with a real-time calibration capability as well as field test results are presented

17:40	**Ultra Wideband Monopole Antenna with Split Ring Resonator for Notching Frequencies**	C30P2-4

Brito, D. B.[1]; Begaud, Xavier[2]; D'Assuncao, A. G.[3]; Fernandes, H. C. C.[3]
[1]Telecom ParisTech, FRANCE;
[2]TELECOM ParisTech, FRANCE;
[3]Universidade Federal do Rio Grande do Norte, BRAZIL

In this paper a new configuration of an Ultra Wideband (UWB) antenna is proposed. The antenna is an optimization of the circular monopole patch antenna with a slot type Split Ring Resonator (SRR) that is inserted in the radiating part. The SRR structure will work as a band stop filter for notching a frequency band between 5 to 6 GHz. A good agreement was observed between the simulated and measured results.

Session:	**C15P2: New perspectives for electromagnetic fields in medicine - 2**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	16:40 - 18:20
Room:	Room 120
Chairs:	T. Isernia
	O. Bucci

Time	Title	Abs No
16:40	**Clinical Diagnostics and Treatment with Electromagnetic Fields**	C15P2-1

Fhager, Andreas; Dobsicek Trefna, H; Zeng, X; Linner, P; Zirath, H; Stake, J; Persson, M
Chalmers University of Technology, SWEDEN

There is a need for novel diagnostic and treatment systems to overcome the limitations with todays modalities. Microwave and THz based system has the potential to become both sensitive and specific in several applications. In this paper we discuss several applications that are currently being developed at the Chalmers University of Technology.

Time	Title	Abs No
17:00	**Novel Ingestible Capsule Antenna Designs for Medical Monitoring and Diagnostics**	C15P2-2

Rajagopalan, H; Rahmat-Samii, Y.
University of California Los Angeles (UCLA), UNITED STATES

This paper presents novel antenna designs for electronic digestible capsules. Firstly, a conformal planar offset meandered dipole capsule antenna for medical diagnostics is presented. The antenna performance is evaluated by studying the impedance, radiation, and return loss characteristics . Secondly, an RFID bio-capsule tag for medical monitoring is presented. The tag performance is evaluated by studying the impedance, radiation pattern and power reflection coefficient characteristics.

Time	Title	Abs No
17:20	**Sub-nanosecond electrical pulses for medical therapies and imaging**	C15P2-3

Kolb, Juergen F.; Xiao, Shu; Camp, J. Thomas; Migliaccio, Mark; Bajracharya, Chandra; Schoenbach, Karl H.
Old Dominion University, UNITED STATES

We have investigated the biological response to sub-nanosecond pulsed electric fields. With the goal of ultimately delivering electric fields with an impulse radiating antenna (IRA), we have developed a 150-ps, 50-kV pulse generator and studied antenna characteristics, when excited by such a pulse. In addition the use of IRAs in the hundred-picosecond temporal range lead us to medical imaging methods with sub-centimeter spatial resolution.

Time	Title	Abs No
17:40	**Rigorous Solutions of Scattering Problems Involving Red Blood Cells**	C15P2-4

Ergul, Ozgur[1]; Arslan-Ergul, Ayca[1]; Gurel, Levent[2]
[1]University of Strathclyde, UNITED KINGDOM;
[2]Bilkent University, TURKEY

We present rigorous solutions of scattering problems involving healthy red blood cells (RBCs) and diseased RBCs with deformed shapes. Scattering cross-section (SCS) values for different RBC shapes and different orientations are obtained accurately and efficiently using a sophisticated simulation environment based on the multilevel fast multipole algorithm. Using SCS values, we determine strict guidelines to distinguish deformed RBCs from from healthy RBCs and to diagnose related diseases.

Time	Title	Abs No
18:00	**Improved Tissue Phantoms for Experimental Validation of Microwave Breast Cancer Detection**	C15P2-5

Porter, E; Fakhoury, J; Oprisor, R; Coates, M; Popovic, M
McGill University, CANADA

This paper presents a complete method for constructing breast tissue models that have realistic physiological and dielectric properties. These models will be useful in validation experiments on microwave imaging for breast cancer detection.

Session:	**C22: Radiowave propagation at low elevation angle**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	16:40 - 18:20
Room:	Room 118
Chairs:	J. Lemorton
	D. Vanhoenacker-Janvier

Time	Title	Abs No
16:40	**Use of the HYCELL Model for Predicting Rain Attenuation on UAS Low Elevation Datalinks** Kourogiorgas, C.[1]; Feral, L.[2]; Fabbro, V.[1]; Jeannin, N.[1]; Lemorton, J.[1] [1]ONERA, FRANCE; [2]Université Paul Sabatier, FRANCE A new approach based on the HYCELL model for predicting rain attenuation on low elevation links is presented. Long-term statistics of rain attenuation are computed for links with elevation angles as low as 0° and for different frequencies at Ku and Ka bands. The results are compared to distributions derived by the ITU-R DBSG3 database for Earth-satellite and terrestrial links and to the Recommendations of ITU-R P.618 and P.530.	C22-1
17:00	**Clear-Air Transmission Impairments at Low Path Elevation Angles** Rogers, David Communications Research Centre Canada, CANADA Low-angle fading behavior is analyzed to surmise preliminarily the likely physical character of this effect.	C22-2
17:20	**Small UAV Radiocommunication Channel Characterization** Romeu, J.[1]; Aguasca, A[2]; Alonso, J.[2]; Blanch, S.[2]; Martins, R.[2] [1]Universitat Politecnica de Catalunya, SPAIN; [2]UPC, SPAIN Small Unmanned Aerial Vehicles (UAV) are finding different applications as platforms to carry observation payloads. The need to establish reliable high data rate channels requires to characterize the radiocommunication channel between the UAV and the ground station. In this communication an experimental set-up and some results for the characterization of a radio channel at 5.8 GHz are presented.	C22-3
17:40	**A Physically Based Methodology for the Evaluation of the Rain Attenuation on Terrestrial Radio Links** Luini, L.; Capsoni, C. Politecnico di Milano, ITALY This contribution presents a new physically based methodology for the prediction of rain attenuation experienced by a microwave terrestrial link. The meteorological environment for the site of interest is reproduced by the MultiEXCELL model and fade levels are calculated by simulating the interaction of a given link geometry with the precipitation field. Eventually, the performance of the proposed methodology is evaluated against the reference data included in the ITU-R DBSG3 database.	C22-4
18:00	**New Method for Estimating Outage Intensity for Various Propagation Path Categories** ITO, T; KITA, N; SUGIYAMA, T Nippon Telegraph and Telephone, JAPAN This paper describes measurement results of fading characteristics in a fixed radio link in the frequency band of 4 to 6 GHz . In order to study the dependency of propagation path categories, the measurements were carried out on various propagation paths in Japan. The measurement results represent the fade duration characteristics for various propagation path categories. Based on the results, we propose a new method for estimating the outage intensity due to multipath fading.	C22-5

Session:	**C27P2: Innovative antenna measurements techniques - 2**
Type:	Convened Session
Date:	Thursday, April 15, 2010
Time:	16:40 - 18:20
Room:	Room 121
Chairs:	C. Rizzo
	M. Sierra Castaner

Time	Title	Abs No
16:40	**OTA Throughput Measurements by using Spatial Fading Emulation technique**	C27P2-1

Scannavini, A.[1]; Foged, L.J.[1]; Abou El Anouar, M.[2]; Gross, N.[3]; Estrada, J.[4]
[1]SATIMO, ITALY;
[2]SATIMO Bretagne, FRANCE;
[3]SATIMO Corporate HQ, FRANCE;
[4]SATIMO USA, UNITED STATES

This paper gives an overview of a technique being investigated in 3GPP and COST2100 for measuring Over the Air (OTA) performances of a multi antenna terminals, and Multi-input Multi-output (MIMO) systems in a controlled environment, such as an anechoic chamber. The Spatial Fading Emulation technique employs the use of an anechoic chamber, a channel emulator, and a mapping of geometry based stochastic channel model (GSCM) by the channel emulator. SATIMO's preliminary testing results are presented.

17:00	**Electro-Optical-Sensor for Near-Field Measurements of Large Antennas**	C27P2-2

Thiele, L.; Geise, R.; Spieker, H.; Schüür, J.; Enders, A.
TU Braunschweig, GERMANY

In this paper a lithiumniobate-based electro-optical field sensor with a minimum sensitivity down to 20 mV/m is presented, which is suitable not only for antenna measurements but also for small devices. The functionality and accuracy of the sensor system is demonstrated with an aperture scan of a large pyramidal horn antenna. Far-field transforms of the measured data show a good agreement with direct far-field measurements at an open area test site.

17:20	**Application of the iterative probe correction technique for compensating the effect of the mechanical alignment errors of probe in spherical near-field antenna measurements**	C27P2-3

Laitinen, Tommi
TKK, FINLAND

This paper shows that the effect of such mechanical alignment errors of probe in spherical near-field antenna measurements, that may vary as a function of the measurement direction, can be compensated for with an iterative probe correction technique. The computational complexity remains the same as that for the traditional first-order probe correction technique.

17:40	**Advances In Cylindrical Mathematical Absorber Reflection Supression**	C27P2-4

Gregson, S.F.; Newell, A.C.; Hindman, G.E.; Carey, M.J.
NSI, UNITED STATES

A post-processing technique named Mathematical Absorber Reflection Suppression (MARS) has been successfully used to reduce range multi-path effects within spherical near-field and far-field antenna measurement systems. A recent adaptation to this technique has been developed for use with cylindrical near-field antenna measurement systems and an ongoing validation campaign has yeilded improvements comparable to those found in the spherical MARS technique.

18:00	**The Volumetric Sources Reconstruction Method and its Applications to Geometry Reconstruction**	C27P2-5

Alvarez Lopez, Yuri; Dominguez Casas, Belen Aranzazu; Garcia Gonzalez, Cebrian; Las-Heras Andres, Fernando
Universidad de Oviedo, SPAIN

An extension of the Sources Reconstruction Method (SRM) is presented in this contribution. The goal is to extend the methods' capabilities not only for antenna diagnostics but also for profile reconstruction. The idea is to retrieve the induced currents on a conductor surface, so that it will have a correspondence to the body's contour. Multiple incidence angles and frequencies are considered so that their combination will improve the method's resolution.

Time	Title	Abs No
16:40	**Differential Phase Shift Characteristics of Normal TEon Modes in an Azimuthally Magnetized Coaxial Ferrite Waveguide**	Thur-53

Georgieva-Grosse, Mariana Nikolova[1]; Georgiev, Georgi Nikolov[2]
[1]GERMANY;
[2]University of Veliko Tirnovo, BULGARIA

The method of successive approximations is applied to reckon the differential phase shift characteristics of the azimuthally magnetized coaxial ferrite waveguide. An analysis is made of the impact of the parameters of geometry on the graphically presented curves for TE_{01} mode. Phase shift might be observed in a restricted from both sides frequency band. When the inner to outer conductor radius ratio grows, the latter expands and moves to the side of higher frequencies.

| 16:40 | **On the Use of an Intelligent Ray Launching for Indoor Scenarios** | Thur-55 |

Lai, Z.[1]; Bessis, N.[1]; De La Roche, G.[1]; Kuonen, P.[2]; Zhang, J.[1]; Clapworthy, G.[1]
[1]University of Bedfordshire, UNITED KINGDOM;
[2]University of Applied Science of Wester Switzerland, SWITZERLAND

This paper extends a discrete ray launching model IRLA (Intelligent Ray Launching Algorithm) to indoor scenarios. A typical office room will be selected to validate this model. The efficiency and suitability of IRLA for indoor scenarios will be investigated and comparison with two referenced indoor models are given. It is promising because it is uniquely efficient on computation of rays, which outperforms most of the propagation models.

| 16:40 | **Urban Indoor Signal Level Characterization in the Medium Wave Band** | Thur-57 |

Fernandez, Igor[1]; De la Vega, David[2]; Angueira, Pablo[2]; Guerra, David[2]; Abaigar, Andoni[2]
[1]University of the Basque Country, SPAIN;
[2]UPV-EHU, SPAIN

This paper presents an analysis of urban indoor signal strength reception in the Medium Wave band. Measurements were carried out in the cities of Bilbao and Vitoria (Spain) at six frequencies: 639 kHz, 990 kHz and 1305 kHz for Bilbao, and 612 kHz, 1197 kHz and 1602 kHz for Vitoria. Building penetration losses have been calculated.

| 16:40 | **Simulation of Propagation through a Frequency Selective Wall at 3GHz** | Thur-59 |

Yang, M; Brown, A.K.
University of Manchester, UNITED KINGDOM

A novel hybrid model is presented to study the radio wave propagation through frequency selective structures (FSS) used to control propagation in an outdoor to indoor building environment. This hybrid model is based on combining ray-tracing with a commercial tool, Computer Simulation Technology (CST) Microwave Studio.

| 16:40 | **Case Study of Fog Attenuation on 830 nm and 1550 nm Free-space Optical Links** | Thur-61 |

Grabner, Martin; Kvicera, Vaclav
Czech Metrology Institute, CZECH REPUBLIC

Propagation of electromagnetic waves through fog is investigated experimentally. Free-space optical communication systems operating with 830 nm and 1550 nm wavelengths are utilized to measure received power fluctuations due to scattering on fog particles. Several fog attenuation events were observed in between January and May of 2009 on experimental paths. Fog attenuation values measured at both wavelengths are compared as well as bit error performance.

| 16:40 | **Man-Made Noise Measuremens in Indoor Locations in Medium Wave Band** | Thur-65 |

Landa, I.; Arrinda, A.; Eizmendi, I.; Velez, M.Mª; Fernandez, I.
University of the Basque Country, SPAIN

This paper presents a study of man-made noise at frequencies below 2 MHz. A lot of radio noise measurements have been taken in the north of Spain. The results will be very useful for broadcasters in order to plan transmitter systems. The results could also complete the data noise values collected by the ITU. This paper also explains the difficulties in the process to obtain accurate results, following the recommendations of the ITU.

16:40   **Experimental Study for Interference Estimation in Microwave band in Coastal-Land Paths**   Thur-67

Sotoyama, T[1]; Kita, N[2]; Sato, A[3]
[1]Panasonic Mobile Communications, JAPAN;
[2]NTT Access Network Service Systems Laboratories, JAPAN;
[3]Tokyo University of Technology, JAPAN

In order to study the interference for frequency sharing in the microwave band, conducting propagation studies in a low altitude atmospheric layer is important. In this paper, a long distance propagation test in a coastal area is performed and the enhancement is evaluated using an existing estimation method. Diurnal characteristics of the interference level are also described. The propagation mechanism is also studied and a method to evaluate the effect of irregular reflection is presented

16:40   **Urban Indoor Noise Level Characterization in the medium Wave Band**   Thur-69

Fernandez, Igor; Angueira, Pablo; Arrinda, Amaia; Ordiales, Juan Luis; Soria, Francisco Luis
University of the Basque Country, SPAIN

Indoor and outdoor noise field strength levels in empty channels in Medium Wave have been statistically analysed in five office buildings sited downtown in Bilbao.

16:40   **Measurement of Loop-Back Interference Channels for Outdoor-to-Indoor Full-Duplex Radio Relays**   Thur-71

Haneda, K.[1]; Kahra, E.[1]; Wyne, S.[2]; Icheln, C.[1]; Vainikainen, P.[1]
[1]Helsinki University of Technology (TKK), FINLAND;
[2]Lund University, SWEDEN

This paper presents a measurement campaign of loop-back interference channels for outdoor-to-indoor communications using a compact relay station. Results revealed that the isolation in multipath environment was 48 dB in the compact relay antenna, and it could be further reduced by placing the outdoor and indoor antennas in a different positions. Combined with an interference canceller, the full-duplex operation of indoor compact relay station was found to be feasible.

16:40   **Comparison of Formulas Estimating Fog Attenuation on Free Space Optics Links**   Thur-73

Fiser, Ondrej[1]; Schejbal, Vladimir[2]
[1]Institute of Atmospheric Physics, CZECH REPUBLIC;
[2]University of Pardubice, CZECH REPUBLIC

This contribution shows two well known methods estimating fog attenuation on free space optics (FSO) links. First one derives relationship between meteorological visibility and FSO link attenuation using the similarity with radio link propagation. The second method is based on light scattering solution in the fog volume after Van de Hulst. We proved that Mie scattering in Mie region corresponds to the situation in fog. Some properties of fog attenuation are shown.

16:40   **Wave Scattering by Plasma Sphere After its Instant Formation**   Thur-75

Remayeva, T.; Nerukh, A.; Sakhnenko, N.
Kharkov National University of RadioElectronics, UKRAINE

Scattering of a plane harmonic wave caused by a plasma sphere after its instant formation is investigated. The exact expressions for the transformed field are obtained as a solution of an initial and boundary value electromagnetic problem for the Maxwell's equations based on the longitudinal and the transverse spherical vector functions.

16:40   **Measurements of Terrestrial Digital TV Signals at Two Cities in South America**   Thur-77

Gonzalez Castellanos, P.[1]; Perez Garcia, N.[2]; Paredes, J.[2]; Uzcategui, J.[2]; Pena, J.[3]; da Silva Mello, L.[4]; Lima de Souza, R.[1]; da Silva Mello, Luiz[5]
[1]Inmetro, BRAZIL;
[2]Universidad de Los Andes, VENEZUELA;
[3]Universidad de Oriente, VENEZUELA;
[4]PUC/Rio, BRAZIL;
[5]Catholic University of Rio de Janeiro, BRAZIL

This paper describes campaigns of measurements of propagation channel characteristics for Terrestrial Digital TV, carried on the metropolitan region of Rio de Janeiro, Brazil and Caracas, Venezuela. Measurements of propagation loss obtained from these experiment are compared with predictions using the ITU-R Recommendation P.1546-3 method. Measured multipath time delay profiles for LOS and NLOS reception are also presented.

16:40   **Estimation of Dielectric Constant of Composite Materials in Buildings Using Reflected Fields and PSO Algorithm**   Thur-79

Vilovic, Ivan[1]; Burum, Niksa[1]; Nadj, Robert[2]
[1]University of Dubrovnik, CROATIA;
[2]University of Zagreb, CROATIA

This paper presents a free-space measurement technique for estimating the complex dielectric constant and loss tangent of the walls in given building. The free-space technique doesn't need material samples and measurement can be made in specific building space. The single layered and multilayered models are included in presented models. The both polarizations are included. The relative dielectric constant is obtained through optimization proces based on PSO algorithm.

16:40 **Analyses of the Polarimetric Data of ALOS of Lake Baikal Natural Territory** **Thur-81**
Leonov, Alexander; Darizhapov, Dashi; Kirbizhekova, Irina
Buryat Scientific Centre SB of RAS, RUSSIAN FEDERATION

Results of the analysis polarimetrical data of Japanese satellite ALOS received in October 2007 on delta of the river Selenga are presented in the report. Classification was carried out by the method of Claude-Potte. Now it is one of the most effective methods of classification of natural and simulated objects using polarimetrical data of synthetic aperture radar.

16:40 **GPR Investigation on Buried Rocks in Martian Subsoil for "WISDOM" Projects: Numerical and Measurement Set-up Results** **Thur-83**
Valerio, Guido[1]; Galli, A.[1]; Barone, P. M.[2]; Lauro, S. E.[2]; Mattei, E.[2]; Pettinelli, E.[2]
[1]Sapienza University of Rome, ITALY; [2]"Roma Tre" University, ITALY

The detection of buried rocks using a GPR system on a rover for Martian missions is here investigated with both an experimental set-up and numerical simulations. The experimental set-up is made of a box filled with a host medium and buried basalts of different shapes and sizes. The numerical simulations, performed with a commercial software, are compared and validated with the measurement results, allowing for a greater flexibility of the analyzed environment and of the measurements devices.

16:40 **Electromagnetic Power Flow Between Opposite Sides of a Lossy Dielectric Sphere Using Spherical Vector Wave Expansion** **Thur-85**
Nour, Baqer; Breinbjerg, Olav
Technical University of Denmark, DENMARK

This article addresses the problem of communication in near field region. The proposed example is the communication between two small antennas, which are modelled as an electric dipole antenna (transmitter) and a small box (receiver), near a sphere that models a head. Spherical vector wave expansion SVWE is used to calculate the response of the model and to investigate propagation of power. Influence of the orientation of the antennas on the propagation is studied.

16:40 **3D Localization Method Based on Ray-Tracing Considering the Presence of Moving People** **Thur-87**
Gomez, J.; Tayebi, A.; Saez de Adana, F.; Gutierrez, O.
University of Alcala, SPAIN

An accurate realistic localization approach for indoor environments based on fingerprinting and ray-tracing techniques is presented in this paper. The method considers fading in indoor environments due to multipath effects and caused by the movement of people or the presence of furniture. The proposed approach considers the effects of human body shadowing to provide a realistic estimation of the mobile station position. Numerical calculations in real indoor scenarios show reasonable results.

16:40 **Confinement and Propagation Relations for Zenneck Surface Waves** **Thur-89**
Sihvola, A.; Qi, J.; Lindell, I.V.
Aalto University, FINLAND

This paper discusses electromagnetic surface waves that can exist in connection with a planar interface between two homogenous and isotropic half spaces, of which at least one is lossy. The idea is to unify and extend the classical Zenneck wave analysis into the region of negative permittivities. Several quantities that characterize the properties of the surface wave are discussed and analyzed.

16:40 **OFDM Interference Detection Using Flexible Subcarrier Channel Estimator** **Thur-91**
Kobayashi, T; Iwakiri, N
Tokyo Denki University, JAPAN

Multiband systems can flexibly create spectral holes to coexist narrowband systems. The multiband system with existing narrowband system must be immediately detected to remove the interference on each system. We develop a flexible subcarrier channel estimator with a narrowband interference detection to easily implement multiband systems. The interfering system parameters, occupation of bandwidth and angle of arrival, can detect before demodulation. The detection error rate are evaluated.

16:40 **Propagation Study and Performance Evaluation of a Fixed Access WiMAX System** **Thur-93**
Moraitis, Nektarios; Skevas, Spyros; Giouzepas, Anastasios; Constantinou, Philip
Institute of Communications and Computer Systems - National Technical University of Athens, GREECE

This paper aims at performing a more detailed coverage and performance analysis of wireless metropolitan area networks based on the IEEE 802.16 standard, which is the basis of WiMAX technology. A coverage study and performance evaluation of fixed access WiMAX system in an urban and suburban environment with the help of a software simulation tool is presented. All the required parameters are given to the program focusing only in suitable propagation models such as COST231-HATA and SUI-C.

16:40 **Effect of Terrain Irregularities and Clutter Distribution on Wave Propagation at 3.5 GHz in Suburban Area** **Thur-95**
Chee, Kin Lien; Kürner, Thomas
Technische Universität Braunschweig, GERMANY

This paper investigates the wave propagation at 3.5 GHz over irregular terrain with clutter information at a suburban area based on the terrain profile derived from a self-tailored 3D digital elevation model (DEM) of Hetzwege in Germany. The simulation results will be verified with measurements determined from a mobile WiMAX system (IEEE 802.16e) deployed in the region.

16:40 **Refractive Index Evaluation of Multi-Walled Carbon Nanotube Arrays**   Thur-97

Katsounaros, Anestis[1]; Rajab, K[1]; Hou, K[2]; Mann, M[2]; Naftaly, M[3]; Crossland, W.A.[2]; Collings, N[2]; Hao, Y[1]
[1]Queen Mary University of London, UNITED KINGDOM;
[2]CAPE Cambridge, UNITED KINGDOM;
[3]National Physical Laboratory, UNITED KINGDOM

Transmission THz time-domain spectroscopy measurements of carbon nanotube arrays are presented. A relatively thin film with vertically aligned multi-walled carbon nanotubes has been prepared and measured using THz-TDS. Experimental results were obtained from 80GHz to 2.5THz, and the sample has been characterized by extracting the relative permittivity of the CNTs. A combination of the Maxwell-Garnett and Drude models within the frequency range provide a good fit to the measured permittivity.

16:40 **Using Game Engines for Wideband Channel Estimation Parameters in Andean Cities**   Thur-99

Navarro, Andres[1]; Guevara, D.[2]
[1]Universidad Icesi, COLOMBIA;
[2]Universidad Francisco de Paula Santander, COLOMBIA

This paper shows the results obtained with a new ray- tracing method using an open source game engine and high performance graphic cards for the estimation of path loss and parameters of wide-band channel with high accuracy, in some specific outdoor urban Andean scenario as is the Cost 2100 Cali reference scenario. We use the algorithms and techniques developed by the game community and graphics hardware accelerators for parameters estimation in time and frequency for wide-band channels

16:40 **Development of an Accurate Tool for Path Loss and Coverage Prediction in Indoor Environments**   Thur-100

Plets, David; Joseph, W.; Vanhecke, K.; Tanghe, E.; Martens, L.
WiCa/UGent - IBBT, BELGIUM

A tool has been developed to predict path loss in indoor environments. The concept of the tool is discussed and its performance is compared with the performance of a ray-tracing tool. The tool is validated with measurements on another floor in the same building and measurements in another building.

Session: **Thur-Poster Session ST2: MM,SMM & THz Antennas**
Type: Poster
Date: Thursday, April 15, 2010
Time: 16:40 - 18:20
Room: Foyer 2
Chairs: W. Whittow
       L. Subrt

Time	Title	Abs No
16:40	**Design of a Dual-Focus Offset Reflector Antenna for a Rotating Mirror Microwave Scanner**	Thur-42

Knott, Peter; von Wahl, N.; Heinen, S.
Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, GERMANY

The Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR is involved in the development of a high-resolution radar system for a tracked vehicle for use in rough terrain. This equipment will allow fire-fighting crews to maneuver even in situations with limited visibility, e.g. in smoke and dust. The present paper outlines the design of a parabolic cylinder reflector antenna for the scanning radar system and presents new simulation and experimental results.

16:40	**A Vialess Vertical Transition at Millimeter Wave Frequencies**	Thur-44

Enayati, amin[1]; Brebels, S.[2]; Vasylchenko, A.[2]; Deraedt, W.[2]; Vandenbosch, G. A. E.[3]
[1]IMEC, KU Leuven, BELGIUM;
[2]IMEC, BELGIUM;
[3]KU Leuven, BELGIUM

A vertical multilayer transition for millimeter wave frequencies is introduced. The transition is implemented in IMEC multi-chip-module technology using high resistive silicon and Benzo-Cyclo-Butene as base materials. As metalized vias in high resistive silicon are difficult to achieve, the transition is designed without using any vias. Simulation and measurement results for a back–to-back CPW-to-microstrip transition prototype show excellent agreement.

16:40	**Benefitting from Spatial Diversity in KA and W Band Deep-Space Communications**	Thur-46

Arapoglou, P.-D. M.; Panagopoulos, Athanasios D.
National Technical University of Athens, GREECE

The advent of sophisticated multiple antenna techniques has renewed the interest in spatial diversity by revolutionizing many aspects of wireless networks. The present paper is a preliminary investigation of possible ways for deep space communication downlinks to benefit from spatial diversity in the new era signified by the migration from X to Ka band and the possible future extension to W band.

16:40	**Post-Wall Slotted Waveguide Array Antennas for a Broadband Communication System in 60GHz**	Thur-48

Yamaguchi, Satoshi; Goto, Jun; Takahashi, Toru; Otsuka, Masataka; Nishino, Tamotsu; Konishi, Yoshihiko
Mitsubishi Electric Corporation, JAPAN

This paper proposes the beam-switching antennas developed for a access point (AP) of a broadband communication system in 60GHz band. The AP is composed of several element antennas which have a high gain and project their beam in a specified direction. The type of element antennas are post-wall slotted waveguide arrays and they have the tilted beam radiation patterns. The effectiveness of the proposed antennas is verified through experiments.

16:40	**Design of Inclined and Displaced Slotted Waveguide Array Antennas with Low Sidelobe Radiation Patterns**	Thur-50

Yamaguchi, Satoshi; Miyashita, Hiroaki; Takahashi, Toru; Nishino, Tamotsu; Konishi, Yoshihiko
Mitsubishi Electric Corporation, JAPAN

Slotted waveguide array antennas are attractive because of their low loss characteristics in high frequencies. In this paper, we propose a design procedure for the inclined and displaced slotted waveguide array antennas and verified its effectiveness through experiments. Furthermore, we applied the Taylor distribution to the antenna aperture to obtain the low sidelobe radiation patterns.

16:40	**High-Efficient Slot-Coupled Superstrate Antenna for 60Ghz Wlan Applications**	Thur-52

Vettikalladi, Hamsakutty; Lafond, Olivier; Himdi, Mohamed; Le Coq, Laurent
Institute of Electronics and Telecommunication of Rennes (IETR), University of Rennes1, Rennes, FRANCE

A high-gain aperture coupled patch antenna with superstrate at 60 GHz is presented. The maximum measured gain is 14.6 dBi with an estimated efficiency of 76%. The measured s11 bandwidth is 6.8%. A 2 x 2 aperture coupled patch antenna array with superstrate is also studied. The corresponding maximum measured gain is 16 dBi with an efficiency of 63%. The measured s11 bandwidth is 6.7%. The radiation patterns are found to be broadside. Hence this antenna is a good candidate for 60 GHz application.

16:40 **Improvement and Validation of Design Tools for MM-Wave Instrument Antennas by Advanced Measurement Techniques** **Thur-54**

Hartmann, Juergen[1]; Steiner, Hans-Juergen[1]; Habersack, Juergen[1]; Paquay, Maurice[2]
[1]Astrium GmbH - Satellites, GERMANY;
[2]ESA/ESTEC, NETHERLANDS

Within this paper, the final results on test setup optimization as well as generation of accurate pattern prediction data can be shown. Firstly, the optimized RF test setup will be described. Secondly, final recommendations on reflector surface data measurements will be given. Finally the comparison of antenna pattern at 501 GHz will be shown for the previous status as well as for the latest status.

16:40 **Optical Approximations for Simulations of Submillimeter Systems** **Thur-56**

Zvanovec, Stanislav; Subrt, Ludek
Czech Technical University in Prague, CZECH REPUBLIC

Propagation aspects of millimeter and submillimeter wave systems can be solved by quasioptical approaches including Gaussian beams. Reflections from rough surfaces nevertheless introduces complex problem. It can be very well solved by an approximation using methods from free space optics with incorporation of corrections of the pure optical approaches. The paper discusses the advantages and drawback of these simulation approaches, based on analyses of electromagnetic wave propagation.

16:40 **A Study of the Attenuation and Rainfall Rate Relationship Between 10-95 GHz in the U.K.** **Thur-58**

Townsend, A J; Watson, R J
University of Bath, UNITED KINGDOM

This paper investigates the relationship between attenuation and rainfall rate in order to determine where a linear relationship exists. This is especially useful in terrestrial links as the linear relationship can be used to determine rainfall rate from attenuation of a link. This is advantageous for finding rainfall rates in areas that are poorly gauged. Six years of disdrometer data from Chilbolton, UK, was used to determine rainfall rate and attenuation.

16:40 **Study of the Excitation of a Silver Nano-Dipole** **Thur-62**

Volski, Vladimir[1]; Vandenbosch, G.A.E.[2]
[1]Katholieke Universiteit Leuven, BELGIUM;
[2]Katholieke Universiteit Leuven, ESAT-TELEMIC, BELGIUM

In this paper different excitations of a silver nano dipole in free space are considered. Its response demonstrates a clear resonance behavior for all excitations. The use of tuning circuits permits to correct slightly the position of the resonance if necessary. The tuning circuits considered are inspired by the RF domain. They include feeding lines with various widths and different T-match connections. The analysis is performed using a full wave solver based on the method of moments.

16:40 **Mm-Wave DRW Antennas Phase Centre Determination** **Thur-64**

Padilla, P[1]; Pousi, P[2]; A, Tamminen[2]; Mallat, J[2]; Ala-Laurinaho, J[2]; Sierra-Castañer, M[3]; Räisänen, A[2]
[1]University of Granada, SPAIN;
[2]Aalto University School of Science and Technology, FINLAND; [3]Technical University of Madrid, SPAIN

This document presents an approach to the phase centre determination of a dielectric rod waveguide (DRW) antenna by means of measurements obtained with a planar measuring system at millimeter wave lengths. Phase centre determination by the least squares fit technique is described in this document for different DRW antennas (silicon and sapphire). Results at different operating frequencies are offered.

16:40 **Millimeter-Wave Microstrip Array Antenna with Matching-Circuit-Integrated Radiating-Elements** **Thur-66**

Sakakibara, Kunio; Sugawa, S.; Kikuma, N.; Hirayama, H.
Nagoya Institute of Technology, JAPAN

Microstrip comb-line antennas are developed in the millimeter-wave band. To improve the return loss characteristics and the design accuracy against the unexpected radiation due to reflection waves in the microstrip feeding line, we propose matching-circuit-integrated radiating-elements for comb-line antennas. Microstrip comb-line antennas are designed in travelling-wave excitation. Their performances are confirmed by experiments.

16:40 **Antenna Measurement System at 300 GHz for the Terasense Project** **Thur-68**

Alfonso, Muñoz-Acevedo; Sierra-Castañer, M.; Besada, J. L.
Technical University of Madrid, SPAIN

The aim of this paper is to introduce the design techniques used to develop the antenna measurement system for the Terasense Project, operating between 75 - 110 GHz and 220 - 325 GHz. Among the different possible configurations, the reflector-based compact range is chosen. The quiet zone is generated by a serrated-edge reflector, fed by a low gain horn. In the paper, we focus on the reflector design. A serrations study is carried out and quiet zone acquisition results are obtained.

16:40 **Active THz Inspection of Water Content in Plants** **Thur-72**

Iriarte, JC.; Etayo, D.; Palacios, I.; Teniente, J.; Ederra, I.; Gonzalo, R.
Public University of Navarra, SPAIN

THz range offers the possibility of measuring water content. This is really useful in wine industry to control plants water levels and also to decrease irrigation costs. Therefore, a THz imaging system has been used to characterised water content in leaves using frequency and time domain methods from 0.14 to 0.22 THz

16:40   **Multilayer and Multidirectional Linearly-Tapered Slot Antenna for 300 GHz Applications**   Thur-74

Jenning, M.; Plettemeier, D.
Dresden University of Technology, GERMANY

Future chip-to-chip interconnections will be freed from the limitation to wires or fixed transmission lines connecting two or more chips. Bandwidth requirements and recent developments in the field of integrated transistors enable the usage of small antennas directly on-chip or in chip packages. Using phased arrays will allow highly flexible interconnections between chips. In this paper a Linearly-tapered slot antenna structure is presented that can be integrated in-package or on-chip.

16:40   **A Novel Low Loss Reflection-Type Phase Shifter in KU-Band**   Thur-76

Lambard, T.[1]; Lafond, O.[2]; Himdi, M.[2]; Jeuland, H.[1]; Bolioli, S.[1]
[1]ONERA, FRANCE;
[2]IETR - University of Rennes 1, FRANCE

In this paper, we present a new reflection-type analog phase shifter using varactor diodes and a branch-line coupler. This technology lowers the cost, simplifies the manufacturing and the phase shift control technique. Furthermore, varactor diodes need moderate bias voltage and permit a very low current consumption. The originality of this paper is to present a new reflection-type phase shifter structure, with good performances and working up to 30 GHz.

16:40   **CPW-Fed Slot Bow-Tie Antenna at 90 GHz for a MM-Wave Detector Matrix**   Thur-78

Tavakol, Vahid[1]; Qi, Feng[1]; Ocket, Ilja[2]; Schreurs, Dominique[1]; Nauwleaers, Bart[1]
[1]K.U.Leuven, BELGIUM;
[2]IMEC, BELGIUM

In this work we investigate a slot bow-tie antenna fabricated using wet-etching technique on a 5mil laminate having a low dielectric constant (ε_r=2.2). The planer antenna is aiming to operate, linearly polarized, in the range of 85-95 GHz. The return-loss measurements show acceptable agreement with FEM simulations. The simulated radiation patterns and Co/Cross polar patterns are also presented.

16:40   **Fade Duration Statistics of Millimetre Wavelength Terrestrial Line-of-Sight Links**   Thur-80

Cheffena, M[1]; Tjelta, T[2]; Breivik, T[2]
[1]University Graduate Center-UNIK, NORWAY;
[2]Telenor R&I, NORWAY

The paper presents several years of measured fade duration for four terrestrial line-of-sight links at 42.1 and 83.5 GHz in the Oslo-region, Norway. The measured durations are compared with models. Relatively good agreement is found for long durations. Considering also short durations, a model based on a double lognormal distribution was found to give a good fit to the measured fade duration data. Statistical results of the number of fades with durations longer than 10 s are also presented.

16:40   **Simple Models for the Analysis of Waveguiding Systems at the Terahertz Band Using Classical Microwave Approaches**   Thur-82

Leal-Sevillano, C. A[1]; Ruiz-Cruz, J. A.[2]; Montejo-Garai, J. R.[1]; Rebollar, J. M.[1]
[1]Universidad Politécnica de Madrid, SPAIN;
[2]Universidad Autonoma de Madrid, SPAIN

In this contribution the analysis of different waveguides systems in the terahertz band is presented. The analysis is based on a hybrid mode formulation and the Drude model for the dielectric permittivity of the Metallica conductor. A comparison between the exact results obtained with this last formulation and those using classical microwave approaches is done in order to determine the validity range of the approximations in both the propagation constant and the electromagnetic field pattern.

16:40   **Statistical Channel Model for 60 GHz WLAN Systems in Conference Room Environment**   Thur-86

Maslennikov, R.[1]; Maltsev, A.[2]; Sevastyanov, A.[2]; Lomayev, A.[2]; Khoryaev, A.[2]
[1]N.I. Lobachevsky State University of Nizhny Novgorod, RUSSIAN FEDERATION;
[2]Intel Corporation, RUSSIAN FEDERATION

A methodology of statistical channel modeling for 60 GHz WLAN systems is proposed that takes into account the most important properties of the indoor 60 GHz propagation channel: large propagation loss and necessity to use steerable directional antennas, quasi-optical propagation nature, clustering of the channel, and significant impact of the polarization characteristics. The application of the methodology is demonstrated by development of a channel model for the conference room environment.

Session:	**C10P1: Analysis and synthesis of large conformal arrays on complex structures - 1**
Type:	Convened Session
Date:	Friday, April 16, 2010
Time:	08:30 - 10:30
Room:	Room 119
Chairs:	P. Pathak
	Z. Sipus

Time	Title	Abs No
08:30	**Holographic Antennas: Principle of Operation and Design guidelines**	C10P1-1

M., Albani[1]; Bandinelli, M.[2]; Caminita, F.[1]; De Vita, P.[3]; Freni, A.[2]; Maci, S.[1]; Mazzinghi, A.[2]; Minatti, G.[1]; Sabbadini, M.[4]
[1]University of Siena, ITALY;
[2]University of Florence, ITALY;
[3]Ingegneria dei Sistemi, ITALY;
[4]European Space Agency, NETHERLANDS

In this paper, a systematic procedure to design a surface wave excited holographic antenna is proposed. First, an equivalent anisotropic surface impedance is defined by a combination of a desired aperture field and the average electric current distribution of the incident surface wave. This combination is then included as a constrain in an alternate projections process that is allowed for synthesizing an aperture field for a given mask of antenna directivity. Once each point of the antenna surface is characterized by a suitable impedance tensor, the latter is synthesized by a FFS-kind patch structure with variable dimension and geometry.

08:50	**A Comparison of Two Different Ray Based Methods for Analyzing Large Convex Conformal Antenna Arrays**	C10P1-2

Pathak, P.[1]; Janpugdee, P.[2]; Burkholder, R.J.[1]
[1]Ohio State University, UNITED STATES;
[2]Temasek Lab, National University of Singapore, SINGAPORE

A uniform geometrical theory of diffraction ray based approach is employed in two different ways to describe the radiation by large, flush mounted antenna arrays that are conformal to a larger complex metallic platform. The array aperture surface field distribution is obtained numerically by solving only the local array problem excluding the remaining part of the platform outside the neighborhood of the array. Two ray methods are presented for tracking the fields in the presence of the platform.

09:10	**Analysis of Conformal Arrays Using Spectral Domain Approach – Comparison of Different Asymptotic Extraction Methods**	C10P1-3

Bosiljevac, M.; Skokic, S.; Sipus, Z.
University of Zagreb, CROATIA

The motivation of this paper is to compare different asymptotic approaches when combined with the spectral domain method in the analysis of conformal arrays. The goal is to find the best approach that can significantly reduce the calculation time, but also retain the analysis accuracy. Four different approaches are compared: extraction based on the large-order form of Hankel functions, exponential approximation of Green's functions, homogeneous-space equivalent model, and impedance surface model

09:30	**Modeling EMC/EMI Effects of Antenna Arrays on Large Platform using Multi-Solver Domain Decomposition Method**	C10P1-4

Wang, X.; Peng, Z.; Stephanson, M. B.; Lee, J.-F.
the Ohio State University, UNITED STATES

A successful application of multi-region multi-solver domain decomposition method (MS-DDM) is presented in evaluating mutual coupling among antennas mounted on platform at 2GHz frequency. The fundamental strategy is to decompose the domain into many sub-regions based on their properties and apply different solvers. The sub-regions is not necessarily disjointed. The major advantage of MS-DDM is that it provides a framework which existing solvers can be integrated into with very minor modification

09:50	**Improved Efficiency of Spatial Mixed-Potential Green's Function Computation for Coated Cylinders**	C10P1-5

Galvis Salzburg, C.[1]; Bertuch, Thomas[1]; Vecchi, Giuseppe[2]
[1]Fraunhofer FHR, GERMANY;
[2]Politecnico di Torino, ITALY

Expressions for the spectral domain electric mixed-potential Green's function for a coated cylinder are derived in terms of the spectral dyadic Green's function for the electric field. Their properties are exploited in the transformation to the space domain. Recently, the computations have been significantly accelerated by a spectral domain interpolation and Filon integration. Issues of software implementation, numerical stability, and accuracy are discussed. Numerical results are presented.

Session:	**C19: Finite difference models for radio covergae prediction**
Type:	Convened Session
Date:	Friday, April 16, 2010
Time:	08:30 - 10:30
Room:	Room 120
Chairs:	G. de la Roche
	A. Valcarce

Time	Title	Abs No
08:30	**Indoor Service Coverage Predictions: How Good is Good Enough?**	C19-1

Wagen, J.-F.
EIA-FR, SWITZERLAND

Indoor radio planning tools are of increasing interests. The PixelFlow approach discussed here can easily simulate radio wave propagation. PixelFlow offers many advantages: a computation speed independent of the number of antennas and a robustness against inaccurate floor plans. However since there is no metric to quantify the accuracy and robustness of coverage prediction model, the radio engineers must interpret the results presented here.

08:50	**Comparison and Application of FDTD and Ray Optical Method for Indoor Wave Propagation Modeling**	C19-2

Nagy, Lajos
BME, HUNGARY

Growing interest in providing and improving radio coverage for mobile phones and wireless LANs inside buildings has recently emerged. Although the three dimensional FDTD method has shown great promise, the calculation time is very environment dependent and exceeds the calculation time of ray tracing or ray launching in most cases. In this article, we focus on the theoretical estimation and comparison of FDTD and ray methods in aspects of the algorithmic complexity

09:10	**Indoor Channel Characterization: FDTD Simulations and Measurement**	C19-3

Ramirez, L.[1]; Carvalho, A.[2]; Trintinalia, L.[2]; Hasselmann, F.[1]; Silva Mello, L.[1]
[1]Centro de Estudos em Telecomunicações (CETUC), BRAZIL;
[2]Escola Politécnica, Universidade de São Paulo, BRAZIL

Application of FDTD (with companion UPML) to the coverage analysis and (wide band) channel characterization of actual indoor scenarios is explored and results compared with measured data pertaining to an office space at the University of São Paulo (USP), Brazil.

09:30	**Subject-Specific Analysis of the On-Body Radio Propagation Channel Adopting a Parallel FDTD Code**	C19-4

Sani, A[1]; Hao, Y[1]; Zhao, Y[1]; Lee, S-L[2]; Yang, G-Z[2]
[1]Queen Mary University of London, UNITED KINGDOM;
[2]Imperial College, London, UNITED KINGDOM

The paper presents a subject-specific radio propagation study in wireless body area networks using a simulation tool based on the parallel finite-difference time-domain technique. The impact of different digital phantoms in the on-body radio channel was studied at the frequency of 2.4 GHz, and results demonstrate that the characteristics of the on-body radio channel are subject-specific and are associated with human genders, height, and body mass index.

09:50	**Analysis of Propagation Effects in LANs and WANs by FDTD and Ray Tracing Techniques**	C19-5

Pennock, S.R.; Watson, R
University of Bath, UNITED KINGDOM

Ray tracing and FDTD analysis techniques are used to evaluate signal transmission between transmitter and receiver, allowing small scale and large scale effects to be included. A simple technique for enhancing indoor/outdoor propagation is investigated and shows promise. The influence of rain induced wet ground is investigated, showing that significant changes in reflection properties result. Linking ray tracing with FDTD through the Power Delay Profile is investigated using the MUSIC algorithm.

10:10	**On Simulating Propagation for OFDM/MIMO Systems with the MR-FDPF Model**	C19-6

Gorce, Jean-Marie[1]; Villemaud, Guillaume[2]; Flipo, Paul[1]
[1]INRIA / INSA Lyon, FRANCE;
[2]INSA Lyon, FRANCE

Radio propagation tools are needed for wireless network optimization. The MR-FDPF approach earlier proposed uses a multi-resolution pre-processing in the frequency domain. However, the current challenge for radio propagation tools not relies on providing signal power levels but beyond on providing a realistic prediction of the system performance. A system level simulator should comply with OFDM and MIMO features. This paper investigates the appropriateness of the MR-FDPF approach for such task.

Time	Title	Abs No
08:30	**Software Framework for integration of Method of Moments Kernels with Direct or Iterative Fast Solvers**	C23P1-1

Rius, J.M.[1]; Herrero, J.A.[2]; Tamayo, J.M.[2]; Heldring, A.[2]; Ubeda, E.[2]; Parron, J.[3]; Lopez-Penya, S.[4]; Polimeridis, A.G.[4]; Mosig, J.R.[4]; Espinosa, H.[5]; Boag, A.[5]
[1]Universitat Politècnica de Catalunya, SPAIN;
[2]Universitat Politecnica de Catalunya, SPAIN;
[3]Universitat Autonoma de Barcelona, SPAIN;
[4]Ecole Polytechnique Federale de Lausanne, SWITZERLAND;
[5]Tel Aviv University, ISRAEL

This paper presents the idea to develop a software framework in order to allow the integration of efficient UPC fast solvers with the method of moments kernels of other groups. This work should lead to a future open-source software project to integrate modules developed by different University groups expert either in accurate computation of Integral Equations Green's functions or in developing Fast Solvers for efficient solution of the resulting linear system.

| 08:50 | **Generalized Shannon Basis Functions for Curved Surfaces** | C23P1-2 |

Casaletti, M.[1]; Maci, S.[1]; Vecchi, G.[2]
[1]University of Siena, ITALY;
[2]Politecnico di Torino, ITALY

This paper presents a new complete entire-domain basis functions set for the current induced on a smooth curved portion of a scatterer surface. The set is obtained generalizing to the case of curved surfaces the Generalized Shannon Basis functions introduced in [3]. The basic idea is presented here together with preliminary numerical results.

| 09:10 | **Time Domain Integral Equation Modeling Based On Ordinary Differential Equation Solution Methods** | C23P1-3 |

Weile, D.S.; Wang, X.; Lin, Y.Q.
University of Delaware, UNITED STATES

A new set of methods for solving the time domain integral equations of electromagnetic theory is introduced. The new approach couples a Galerkin spatial discretization with temporal integrations based on ordinary differential equation techniques. The new method can easily model dispersion, gives rise to high-order convergence, and results in a method that is absolutely stable for any time step.

| 09:30 | **Analysis of the Scattering Field of Wind turbine Using Rigorous and Asymptotic Techniques** | C23P1-4 |

González, I[1]; Lozano, L[1]; Gómez, J[1]; Tayebi, A[1]; Etayo, I.[2]; Catedra, M.F.[1]
[1]Alcalá University, SPAIN;
[2]Acciona, SPAIN

This work presents the scattered field analysis of a wind turbine using asymptotic and rigorous techniques for the electromagnetic analysis of complex structures. Several simulations considering different configurations have been performed to compare results obtained by the electromagnetic techniques, as a previous stage to study the influence in the telecommunication systems of wind farms. The results obtained with the codes and the CPU-time and computer memory required are shown.

| 09:50 | **A Universal Dipole-Moment-Based Approach for Formulating MoM-Type Problems Without the Use of Green's Functions** | C23P1-5 |

Mittra, Raj[1]; Panayappan, Kadappan[1]; Pelletti, Chiara[2]; Monorchio, Agostino[2]
[1]EMC Lab, Penn State University, UNITED STATES;
[2]Microwave and Radiation Laboratory, University of Pisa, ITALY

The paper presents a new dipole-moment-based approach for formulating MoM-type problems. The method is universal in nature and it applies equally well to PEC and dielectric objects. The dipole moment (DM) formulation neither suffers from the singularity problem associated with the Green's functions, nor does it experience any difficulties at low frequencies, as do the conventional MoM formulations.

Session:	**A26P1: UWB antennas 1**
Type:	Antennas Session
Date:	Friday, April 16, 2010
Time:	08:30 - 10:30
Room:	Room 122-123
Chairs:	S. Nikolaou
	G. Valerio

Time	Title	Abs No
08:30	**Design and Analysis of MIMO Antennas for UWB Communications**	A26P1-1

NAJAM, Ali Imran; Duroc, Y.; Tedjini, S.
Grenoble INP, FRANCE

Two MIMO antennas for UWB communications are designed and analyzed in this paper. Both systems comprised of two identical circular disc monopoles operate in the frequency range of 3.0-12 GHz and provide good diversity. To analyze their performance for UWB operation, the impedance matching and radiation characteristics have been investigated. For MIMO operation, mutual coupling and correlation have been examined. The presented results are based on both simulations and measurements.

08:50	**Rapid Surrogate-Based Optimization of UWB Planar Antennas**	A26P1-2

Koziel, Slawomir; Ogurtsov, Stanislav
Reykjavik University, ICELAND

Computationally efficient design optimization methodology for ultra-wideband antennas is proposed. It exploits space mapping with the surrogate model built using kriging interpolation of the coarse-discretization EM simulation data. Robustness of the proposed approach is demonstrated through the design of two UWB planar antennas. In both cases, an optimized design is obtained at the computational cost corresponding to a few full-wave EM simulations of the antenna structures under consideration.

09:10	**Small-area Solar Antenna for Low-Power UWB Transceivers**	A26P1-3

Danesh, M.; Long, J. R.; Simeoni, M.
Delft University of Technology, NETHERLANDS

A 2 x 2.65 cm2 solar monopole antenna was designed and tested for both DC and RF performances within the 3-10 GHz UWB frequency band. The amorphous silicon solar cell delivers up to 15 mW, suitable for autonomous low-power wireless transceivers. The radiation patterns and gain are comparable with a copper-only antenna for frequencies less than 5 GHz. Beyond 5 GHz, changes in the solar antenna radiation patterns are caused by the solar cell physical characteristics and DC output connections.

09:30	**The Shark Antenna : a Miniature Antenna for Transient Ultra Wide Band Applications in the Frequency Band 800MHz - 8GHz**	A26P1-4

Desrumaux, L.[1]; Lalande, M.[1]; Andrieu, J.[1]; Bertrand, V.[2]; Jecko, B.[1]
[1]XLIM/OSA, FRANCE;
[2]CISTEME, FRANCE

This paper is dedicated to an original miniature antenna for transient Ultra Wide Band applications : the Shark antenna. This antenna is well matched from 800MHz up to 8GHz, has a sectoral transient radiation pattern, has a high transient front to back ratio, and is dedicated to be used in an array with an N generators / N antennas architecture. This paper presents the design and the characteristics of this antenna.

09:50	**UWB Antenna Element for a Full-Polarmetric Antenna Array**	A26P1-5

Yarovoy, A[1]; Haider, N.[1]; Yang, B[1]; Tran, D[2]
[1]Delft University of Technology, NETHERLANDS;
[2]IRCTR, NETHERLANDS

Two Ku-band antenna elements to be used in full-polarimetric UWB arrays are introduced. Both antenna elements consist of four linearly polarized UWB radiators. It is demonstrated that both elements have over 100% fractional bandwidth, good impedance matching, linear phase (almost constant group delay) and uni-directional patterns.

10:10	**UWB Receiving Photonic Antenna for Radio-over-Fiber Systems**	A26P1-6

Yashchyshyn, Yevhen[1]; Chizh, Alexander[2]; Malyshev, Sergei[2]; Modelski, Jozef[1]
[1]Warsaw University of Technology, POLAND;
[2]Stepanov Institute of Physics, BELARUS

This paper presents an experimental study of the UWB receiving photonic antenna, which consists of pigtailed fiber-optic laser diode module integrated directly with the Vivaldi radiator.

Session:	**C17P1: Research projects in satellite applications - 1**
Type:	Convened Session
Date:	Friday, April 16, 2010
Time:	08:30 - 10:30
Room:	Room 125
Chairs:	M. Geissler
	S. Voight

Time	Title	Abs No
08:30	**The Planck mission**	C17P1-1

Martin Polegre, A; Tauber, J.; Crone, G.; Paßvogel, T.
ESA-ESTEC, NETHERLANDS

This paper describes the main characteristics of Planck, the latest medium-sized mission launched by ESA as part of its science programme. An overview of the telescope and cryogenic system is given.

08:50	**A View on the Planck LFI Optics**	C17P1-2

Sandri, M.; Villa, F.; Mandolesi, N.
INAF/IASF-BO, ITALY

This document presents the optical performances of the Low Frequency Instrument on-board the Planck satellite, which is making observations of the cosmic microwave background with unprecedented accuracy. It reviews the study that has led to the flight design of the feed horns, their characteristics, arrangement, and orientation in the focal plane to perform polarisation measurements of the CMB.

09:10	**Planck-HFI optical design and pre-flight performances**	C17P1-3

Maffei, B.[1]; Noviello, F.[2]; Savini, G.[3]; Murphy, J.A.[4]; Lamarre, J-M.[5]; Ade, P.A.R.[6]; Bouchet, F.R.[2]; Brossard, J.[2]; Catalano, A.[5]; Colgan, R.[4]; Gispert, R.[2]; Gleeson, E.[4]; Haynes, C.V.[1]; Jones, W.C.[7]; Lange, A.E.[8]; Longval, Y.[2]; McAuley, I.[4]; Nørgaard-Nielsen, H.U.[9]; Pajot, F.[2]; Peacocke, T.[4]; Pisano, G.[1]; Puget, J-L.[2]; Ristorcelli, I.[10]; Sudiwala, R.[11]; Tauber, J.[12]; Wylde, R.J.[13]; Yurchenko, V.[4]
[1]The University of Manchester, UNITED KINGDOM;
[2]CNRS & Université Paris, FRANCE;
[3]UCL, UNITED KINGDOM;
[4]NUI Maynooth, IRELAND;
[5]CNRS, FRANCE;
[6]Cardiff university, UNITED KINGDOM;
[7]Princeton University, UNITED STATES;
[8]Caltech/JPL, UNITED STATES;
[9]Danish National Space Center, DENMARK;
[10]CNRS Université, FRANCE;   [11]Cardiff University, UNITED KINGDOM;
[12]European Space Agency, NETHERLANDS; [13]School of Physics and Astronomy, UNITED KINGDOM

We present the optical design of the High Frequency Instrument (HFI) together with the optical performances measured during the ground calibration campaigns. We report on the evolution of the knowledge of the pre-launch HFI beam patterns when coupled to the telescope, and on their significance for the HFI data analysis procedure.

09:30	**Prediction of the In-flight Radiation Patterns of the Planck Telescope**	C17P1-4

Martin Polegre, A.[1]; Nielsen, P.H.[2]; Tauber, J.[1]; Doyle, D.[3]; Dubruel, D[4]; Martin, P.[5]; Daddato, R.[1]; Cozzani, A.[1]; Kirschner, V.[1]; Crone, G.[1]; Peacocke, T.[6]; Norgaard-Nielsen, H.U.[7]; Maffei, B.[8]; Murphy, A.[6]; Sandri, M.[9]; Villa, F.[9]; Crone, G.[3]
[1]ESA-ESTEC, NETHERLANDS;
[2]TICRA, DENMARK;
[3]European Space Agency, NETHERLANDS;
[4]Thales Alenia Space France, FRANCE;
[5]Thales Alenia Space, FRANCE;
[6]NUIM, IRELAND;
[7]Danish National Space Center, DENMARK;
[8]University of Manchester, UNITED KINGDOM;
[9]INAF-IASF, ITALY

This paper summarises the work done over the last few years on the prediction of the RF performance of the Planck telescope, which was done initially to support the design phase, and later to assess compliance to specifications and to infer the in-flight performance of the telescope once in its operational orbit.

09:50	**In-Flight Retrieval of Reflector Anomalies for the Planck Space Telescope**	C17P1-5

Jensen, F[1]; Nielsen, P.H.[1]; Tauber, J.[2]; Martin-Polegre, A.[2]
[1]TICRA, DENMARK;
[2]ESTEC, NETHERLANDS

Accurate in-orbit measurements are requested for the patterns of the Planck Space Telescope at frequencies from 30 to 857 GHz. Physical Optics simulations are described in which reflector distortions are optimized so that the radiation patterns of the antenna fits noise contaminated amplitude measurements of Jupiter. The reflector geometry retrieved from measurements by 5 to 10 detectors may precisely predict patterns, for low frequency detectors to levels far below the noise in the measurements

Session:	**A27: Numerical Techniques**
Type:	Antennas Session
Date:	Friday, April 16, 2010
Time:	08:30 - 10:30
Room:	Room 127
Chairs:	N. Chavannes
	F. Vico

Time	Title	Abs No
08:30	**A Self-Consistent FDTD Model of Plasma Antennas**	A27-1

Vecchioni, Eleonora; Cerri, Graziano; Russo, Paola
Università Politecnica delle Marche, ITALY

A plasma antenna represents a technology that relies on plasma elements rather than in metallic wires or surfaces: its feasibility is provided by plasma conductivity. The pump signal and gas discharge parameters have to be chosen to optimize plasma antenna design and realization and to obtain the desired antenna properties A self-consistent numerical model of a cylindrical plasma antenna have been developed for a realistic description of its behaviour and characteristics.

08:50	**Challenges and Solutions for the Modeling of Linear and Nonlinear Dispersion Effects with FDTD**	A27-2

Schild, Stefan[1]; Chavannes, N[2]; Kuster, N[1]
[1]Foundation for Research on Information Technologies in Society, Zurich, Switzerland, SWITZERLAND;
[2]Schmid & Partner Engineering AG, Zurich, Switzerland, SWITZERLAND

The presented approach can treat any combination of the linear Drude, Debye and Lorentz models and the nonlinear Kerr- and Raman-effects and it is possible to predict stability limits for any combination thereof. For validation, the algorithm has been implemented in both Matlab code and the full-featured EM FDTD simulation platform SEMCAD X. It has been applied to generic benchmark problems and used to verify existing results.

09:10	**Mini Cell Metallo Dielectric Antenna Based on Extraordinary Transmission Principle**	A27-3

Francisco, Falcone[1]; Illescas, J.[2]; Estevez, A.[2]; Marcotegui, A.[2]; Beruete, M.[3]
[1]UPNA, SPAIN;
[2]Tafco Metawireless, SPAIN;
[3]Universidad Publica de Navarra, SPAIN

In this paper, a planar antenna for application in 3G and 3.5G mini cell application is presented. The antenna is based on the use of Extraordinary Transmission principle commonly used in IR and THz regime downscaled to the microwave frequency region. Full Wave FDTD simulations with in-house codes as well as measurement results are presented, showing good agreement. The resulting antenna offers competitive parameters with a size reduction when compared to similar commercial models

09:30	**Efficient Analysis of Slotted SIW**	A27-4

Arnieri, Emilio; Amendola, Giandomenico; Boccia, Luigi
Università della Calabria, ITALY

A full-wave analysis of substrate integrated waveguide structures with radiating slots is presented. The field is computed by considering the dyadic Green's function of a parallel-plate waveguide and considering the scattering from the ensemble of conducting posts. The analysis of radiating slots have been carried out by the MOM . The proposed method is efficient and gives results in excellent agreement with the most common simulations tools.

09:50	**Exact Path Deformation Technique for Computing the RCS of 2D Rational Bezier Curves**	A27-5

Ferrando-Bataller, Miguel; Alfonso-Alos, Esperanza; Antonino-Daviu, Eva; Vico-Bondía, Felipe
UPV, SPAIN

A Fast Physical Optics technique is presented for computing the RCS of 2D geometries described in terms of Rational Bezier curves. The algorithm is based on the path deformation technique. The exact integration path is computed analytically, therefore, the highly oscillatory PO integral is transformed into a slowly varying integral with exact accuracy.

Session: **A28: Mobile Antennas**
Type: Antennas Session
Date: Friday, April 16, 2010
Time: 08:30 - 10:30
Room: Room 128
Chairs: S. Blanc
                A. Sibille

Time	Title	Abs No
08:30	**Control System for Compensation of Antenna Mistuning and Absorption Caused by the User's Index Finger** Berg, M.; Salonen, E. CWC, University of Oulu, FINLAND	A28-1

In this paper, an antenna arrangement and a control system that decreases the losses caused by the user of the mobile terminal, is presented. Performance of the system is evaluated with the presence of user hand and index finger. Experimental results prove that two switchable antenna elements are able to increase the total efficiency up to 2.5 dB at 900 MHz.

| 08:50 | **A Novel Paradigm for High Isolation in Mulitple Antenna Systems With User's Influence**
Pelosi, Mauro[1]; Knudsen, M. B.[2]; Pedersen, G. F.[1]
[1]Aalborg University, DENMARK;
[2]Infineon Technologies, DENMARK | A28-2 |

A novel paradigm is proposed for small antenna design, exploiting the high isolation potential of narrow-band antennas. Several PIFA antennas operating in different UMTS bands are investigated, showing also the influence of different hand phantoms trough FDTD simulations. It is confirmed that the way a mobile phone is held is very important in determining the amount of total loss and antenna isolation. Narrow-band antennas are more robust against mutual coupling, having a better isolation.

| 09:10 | **Analysis of the Shorting Pin Effects on an Inverted-F Antenna Using an Equivalent Model for Impedance Matching**
Lee, Woosung; Ko, Manjung; Kim, Jaeheung; Yoon, Young Joong
Yonsei University, KOREA, REPUBLIC OF | A28-3 |

The effect of the shorting pin on a IFA was analyzed using a equivalent model to realize the best impedance matching condition in this paper. As a result, it was verified that the input impedance can be controlled without changing the radiating arm, which enables to realize the best impedance matching condition at a desired frequency.

| 09:30 | **Impacts of Human Body on Built-in GPS Antennas for Mobile Terminal in Multipath Environment**
Ur Rehman, Masood[1]; Gao, Yue[1]; Chen, Xiaodong[1]; Parini, Clive[1]; Ying, Zhinong[2]
[1]Queen Mary University of London, UNITED KINGDOM;
[2]Sony Ericsson Communications AB, SWEDEN | A28-4 |

GPS mobile terminal antennas experience multipath effects as the environmental objects in the vicinity cause the incident radio waves to reflect, diffract and scatter. Also, most of the mobile terminal GPS antennas operate in the proximity of the human body that further degrades the antenna operation. This paper investigats the effects of the multipath environment and the humna body on the GPS mobile terminla antennas using statistical model replicating real working scenarios.

| 09:50 | **Study of Miniaturized Circular Patch Diversity Antenna for Mobile Terminals**
Gao, Y; Falade, O.; Rehman, M.; Wang, S.; Chen , X.; Parini, C.
Queen Mary University of London, UNITED KINGDOM | A28-5 |

The demand on portable and user-friendly wireless communication devices has geared up accordingly which necessitates optimal miniaturised built-in antenna for mobile terminals. This paper presents a design of a miniaturized circular microstrip L-probe wideband patch antenna for achieving diversity operation at mobile terminals. The design is optimised to cover the UMTS, LTE and WLAN. A prototype is fabricated, and its s-parameters and radiation paters are measured to verify the design.

| 10:10 | **Virtual Prototyping and Optimization of Mobile Phone Antennas with Genetic Algorithms**
Chen, Xi Lin[1]; Ofli, Erdem[2]; Chavannes, Nicolas[2]; Kuster, Niels[1]
[1]Foundation for Research on Information Technologies in Society, SWITZERLAND;
[2]Schmid and Partners Engineering AG, SWITZERLAND | A28-6 |

In this article, the virtual prototyping of mobile phone antennas is demonstrated with a FDTD-based electromagnetic simulation platform powered with GPU hardware acceleration. Through network parallelization and Generic Algorithms, antenna optimizations can be performed concurrently on multiple workstations. The simulation time required for an optimization task is reduced proportionally by the number of workstations utilized.

Session:	**A29: Reconfigurable arrays**	
Type:	Antennas Session	
Date:	Friday, April 16, 2010	
Time:	08:30 - 10:30	
Room:	Room 129	
Chairs:	S.V. Hum	
	J. Balcells	

Time	Title	Abs No
08:30	**A Method to Control Phased Array Antenna for Rain Fading Mitigation of 21-GHz Band Broadcasting Satellite**	A29-1

Nakazawa, S; Nagasaka, M; Tanaka, S; Shogen, K
Japan Broadcasting Corporation, JAPAN

We have been studying rain fading mitigation techniques in order to compensate large amount of rain attenuation in the 21-GHz band . In this paper, A method to control the radiation pattern dynamically in accordance with the movement of the rain area assuming array-fed reflector antenna was showed. Then we compared the outage areas using dynamically controlled radiation pattern formed by the array-fed reflector antenna with that using static radiation pattern formed by shaped reflector antenna.

Time	Title	Abs No
08:50	**Design and Characterization of a 6x6 Planar Reconfigurable Transmitarray**	A29-2

Lau, J.Y.; Hum, S.V.
University of Toronto, CANADA

This paper presents the design and experimental characterization of a planar 6x6 fully reconfigurable transmitarray at 5.7 GHz. The array design and two-dimensional beamforming results are presented. This design is low-profile, low-cost, and easy to fabricate, making it very attractive for applications where high-gain electronic beam-scanning is needed.

Time	Title	Abs No
09:10	**Design of Steerable Concentric Rings Array Using Rotation Properties and Evolutionary Optimization**	A29-3

REYNA, A
UNIVERSITY OF TAMAULIPAS, MEXICO

This paper deals with the design of steerable concentric rings array for low side lobe level using evolutionary optimization. This design of steerable concentric rings arrays considers the optimization of the amplitude and phase excitations across the antenna elements by using genetic algorithms and particle swarm optimization. Some results obtained by simulation for a steerable concentric rings array are presented.

Time	Title	Abs No
09:30	**Multifunctional Digitally Controlled Array Antenna**	A29-4

Nesteruk, Sergey
Odessa National Academy of Telecommunications n.a. A.S. Popov, UKRAINE

The results of theoretical research of flat conformal array antenna are presented in the report. A modified spiral radiator is offered as an element of such array antenna. Procedures of signal processing aimed at the suppression of side radiation level in array antenna pattern and realization of radiated field polarization control are also developed in the work.

Time	Title	Abs No
09:50	**X-Band Transmit-Arrays with Linear and Circular Polarization**	A29-5

KAOUACH, HAMZA[1]; DUSSOPT, Laurent[1]; SAULEAU, R[2]; KOLECK, T[3]
[1]CEA LETI MINATEC, FRANCE;
[2]Université de rennes1, FRANCE;
[3]CNES, FRANCE

This article presents the design and characterization of new planar transmit-arrays at 10 GHz with 1-bit and 2-bit phase quantization and specific unit-cell designs in each case. The 1-bit and 2-bit arrays operate in linear and circular polarization, respectively. The measured directivity/gain values equal 26.2/23.2 dBi for the 1-bit design, and 27.8/24.8 dBi for the 2-bit design. Beam-steering characteristics up to Â±30Â° are achieved by tilting the focal source

Time	Title	Abs No
08:30	**Element Correlation of MIMO Antennas on Small Terminals**	C12P1-1

Martens, Robert; Manteuffel, Dirk
Christian-Albrechts-Universität of Kiel, GERMANY

This paper aims at investigating some significant integration aspects involved in daily practical mobile terminal design and their impact on the correlation coefficient of multiple antenna elements. While the antenna elements itself are kept as simple as possible the influence of its location on the terminal platform is investigated systematically. The investigations show, that the influence of the integration is significant.

08:50	**Design and Measurement Considerations for Implantable Antennas for Telemetry Applications**	C12P1-2

Merli, F.; Skrivervik, A. K.
LEMA-EPFL, SWITZERLAND

This work investigates the measurement of electrically small implantable antennas at the component level, avoiding complex and costly system tests. Several radiators have been analyzed, via numerical simulations and measurements, showing the importance of the feeding coaxial cable. Simple solution to the problem is proposed. The physical understanding of the phenomena related to the feeding cable provides also useful design considerations.

09:10	**Non-Foster Networks for Improvement of Radiation Efficiency and Effective Diversity Gain of a Multi-Port Antenna**	C12P1-3

Karlsson, Kristian; Carlsson, Jan
SP Technical Research Institue of Sweden, SWEDEN

The use of non-Foster components in a wideband matching network connected to a multi-port antenna is studied. The aim is to synthesize the frequency response of the optimized network with real circuit components. As the required reactance slope is negative, the possibility to use non-Foster components is investigated.

09:30	**Lower Bounds for Radiation Q of Very Small Antennas of Arbitrary Topology**	C12P1-4

Vandenbosch, Guy; Volski, V.
Katholieke Universiteit Leuven, BELGIUM

A simple technique is presented to derive lower bounds for the radiation Q of electrically small devices. The new technique is applicable to any topology. It takes into account possible currents actually flowing on the device. Moreover, it allows to prove several well-known minimum radiation Q's for basic topologies.

09:50	**Multi-Antenna Systems For Clamshell Mobile Phones**	C12P1-5

Addaci, R; Chebihi, A; Diallo, A; Luxey, C; Le Thuc, P; Staraj, R
LEAT-CNRS, FRANCE

In this paper, we present a parameter study of the port-to-port isolation of two UMTS Planar Inverted-F Antennas (PIFAs) versus the length and the width of the ground plane where they are placed. From those results, an efficient multi-PIFA system suitable for a clamshell type UMTS mobile phone is designed, fabricated and measured.

Time	Title	Abs No
08:30	**Negative Index Subwavelength Arrays Operating at 0.5 THz**	M06-1

Lheurette, Eric[1]; Garet, F[2]; Croenne, C[3]; Carbonell, J[4]; Coutaz, J-L[2]; Lippens, D[3]
[1]IEMN, FRANCE;
[2]IMEP-LAHC, Université de Savoie, FRANCE;
[3]IEMN, Université de Lille 1, FRANCE;
[4]Universidad Polytecnica de Valencia, SPAIN

We report on a double negative metamaterial operating at 0.5 THz. Following the characterisation via TeraHertz Time Domain Spectroscopy, (THz-TDS), dispersion parameters are retrieved using a Fresnel inversion technique. A left handed-band is evidenced around 480 GHz corresponding to a -3dB level of transmission. Finally, we give some simulation results of the negative refraction trough a prism-like structure while the experimental verification is under progress.

| 08:50 | **Near-Field Amplitude-Only Measurement System to Validate Performance of mm-Wave Antennas** | M06-2 |

Deshpande, Manohar[1]; Zhaonan, Z[2]; Star, David[2]; Racette, Paul[2]; Hersey , Ken[2]; Marx, Cathy[2]; Cornelis, Dutoit[2]; Mahnad , Ali[2]; Deshpande, Manohar[1]
[1]NASA Goddard Space Flight Center, UNITED STATES;
[2]NASA GSFC, UNITED STATES

Abstract: This paper presents design and experimental validation of radiation performance of torroidal shaped mm wave reflector antenna to be used in NASA's SIRICE mission. A near field amplitude-only measurement set up is described for experimental validation of radiation performance of mm wave torroidal shaped reflector antenna. A global optimization procedure, Particle Swarm Optimization (PSO) is described to estimate phase front of the measured near field .

| 09:10 | **Probe Based Radiation Pattern Measurements for Highly Integrated Millimeter-Wave Antennas** | M06-3 |

Beer, S.; Zwick, T.
Universitaet Karlsruhe, GERMANY

This paper presents the existing measurement solutions for integrated millimeter-wave antennas as well as the novel measurement assembly at the authors' institute. This setup allows probe based radiation pattern, gain and return loss measurements of antennas in the frequency range between 50 and 110 GHz.

| 09:30 | **Quasi Optical Circulator X-Band Scale Model Utilizing a Circular Polarization Frequency Selective Surface** | M06-4 |

Fusco, Vincent[1]; Euler, M[2]
[1]Queens University Belfast, UNITED KINGDOM;
[2]QUB, UNITED KINGDOM

A prototype X-band scale model for a quasi optical 3-port circulator utilizing a double-layer circularly polarizing frequency selective surface is proposed. The operating principles and measured characteristics of the device are discussed. A prototype device operating at 9.9 GHz is built and validated experimentally.

| 09:50 | **Wideband Millimetre Wave End-Fire Antenna and Array for Wireless Short-Range Applications** | M06-5 |

Lamminen, A.; Saily, J.
VTT Technical Research Centre of Finland, FINLAND

A wideband 60 GHz end-fire antenna element and a 1x4 array suitable especially for mobile devices have been developed. For the single antenna, the measured gain is 3.1...7.1 dBi between 55-64 GHz. For the array, the measured gain is 7.0...9.5 dBi between 55-64 GHz. The antennas are manufactured on LTCC ceramic process and can be integrated with a radio module or flip-chip mounted on a mobile device circuit board. The sizes of antennas are only 3 mm x 4 mm x 0.27 mm and 12 mm x 5.5 mm x 0.27 mm.

Session: **A30P1: Reflectarray 1**
Type: Antennas Session
Date: Friday, April 16, 2010
Time: 08:30 - 10:30
Room: Room 133-134
Chairs: R. Gillard
M. Barba

Time	Title	Abs No
08:30	**"Pharmacist Cross" Phase-Shifting Cell Loaded with MEMS Switches for Reconfigurable Reflectarrays** Salti, H.[1]; Fourn, E.[1]; Gillard, R.[1]; Girard, E.[2]; Legay, H.[2] [1]IETR, FRANCE; [2]Thales Alenia Space, FRANCE	A30P1-1

This paper proposes a new MEMS based reconfigurable reflectarray cell. It is based on the "pharmacist cross topology". The number and position of MEMS switches in this cell are optimized in order to have a 360° phase range with a uniform distribution at the central frequency. This cell is then used as key element in a test-case reflectarray in order to assess its capabilities regarding bandwidth and MEMS capacitances uncertainty.

Time	Title	Abs No
08:50	**Analysis of a Reconfigurable Reflectarray Cell Comprising a Multitude of MEMS Control Elements** Perruisseau-Carrier, J.[1]; Girard, E.[2]; Legay, H.[2] [1]Centre Tecnologic de Telecomunicacions de Catalunya (CTTC), SPAIN; [2]Thalès Alenia Space, FRANCE	A30P1-2

This paper discusses the analysis of reflectarray cells comprising MEMS control elements. The method employed allows a fast and accurate analysis of the cell, quasi independently of the number of MEMS. It also allows computing useful design parameters such as the power dissipated in each MEMS. Based on this method, we present the analysis of a cell embedding a multitude of MEMS control elements, demonstrating for e.g. the intimate link between phase dispersion and loss.

Time	Title	Abs No
09:10	**Analysis of Parabolic Reflectarray in Dual-Reflector Configuration** Tienda, C.[1]; Arrebola, M.[2]; Encinar, J.A.[3]; Toso, G.[1] [1]ESA (ESTEC), NETHERLANDS; [2]Universidad de Oviedo, SPAIN; [3]Universidad Politécnica de Madrid, SPAIN	A30P1-3

A modular technique is presented in this paper for the analysis of a dual-reflectarray antenna configuration comprising a parabolic reflectarray as main reflector. The technique has been applied to analyse a single offset parabolic reflectarray designed previously to produce a South American coverage. The co-polar and cross-polar radiation patterns are shown, showing that the contoured beam is in close agreement with the predictions previously report

Time	Title	Abs No
09:30	**Design of a Wideband Single Layer Sub-reflectarray for Space Applications** Chaharmir, MR.[1]; Shaker, J.[1]; Legay, H.[2]; Bresciani, D.[2] [1]Communications Research Centre (CRC), CANADA; [2]Thales-Alenia Space, FRANCE	A30P1-4

A single-layer reflectarray operating as sub-reflector of a dual-reflector configuration was designed for shaped beam application at Ku-band. An optimization method was utilized in the design of the reflectarray to achieve a broad bandwidth of 11 GHz – 14.5 GHz. Double cross loop elements were used as reflectarray elements. The calculated radiation patterns at the centre and extreme frequencies meet the required specifications closely.

Time	Title	Abs No
09:50	**Electronically Switchable-Beam Reflectarray Antenna** Carrasco, E.; Barba, M.; Encinar, J. UNIVERSIDAD POLITECNICA DE MADRID, SPAIN	A30P1-5

The design of a two-beam electronically switchable reflectarray based on patches aperture-coupled to delay lines is presented. The antenna switches the beam from –5 deg. to +5 deg. in the switching plane. The phase-shift control is performed using a SPST switch implemented with a series PIN diode. The number of diodes, as well as their biasing lines has been reduced to a half by using the concept of gathered elements. The final breadboard mask for the phase-shifter layer is also shown.

Time	Title	Abs No
10:10	**Reconfigurable Active Reflector Based on High Impedance Surface** Ratajczak, Philippe[1]; Baracco, J.M.[2]; Brachat, P.[1]; Fargeas, J.M.[1] [1]Orange Labs, FRANCE; [2]Mardel, FRANCE	A30P1-6

In this paper, the manufacturing and testing of a prototype concluding the development of a waveguide fed active antenna using an active High Impedance Surface (HIS) as main reflector are reported. The capability of such an antenna to generate various types of radiation beam (focalised, scanned**...**) has been demonstrated.

Session: **C10P2: Analysis and synthesis of large conformal arrays on complex structures - 2**
Type: Convened Session
Date: Friday, April 16, 2010
Time: 11:00 - 13:00
Room: Room 119
Chairs: P. Pathak
Z. Sipus

Time	Title	Abs No

11:00   **Influence of the Finite Conductivity on RLSA Antenna Design**   C10P2-1

Albani, M.[1]; Mazzinghi, A.[2]; Freni, A.[2]
[1]University of Siena, ITALY;
[2]University of Florence, ITALY

We consider the effect of the finite conductivity on the design of a radial line slot array (RLSA). Such an effect can be not negligible at high frequencies, especially when low cost metallization techniques are adopted. We extend the analytical evaluation of the dyadic admittance Green's function to the case of a low, arbitrary impedance surface, and we use it within a Method of Moment (MoM) for RLSA. The results have been tested those by commercial codes for different conductivity values.

11:20   **Green's Function Approach for Interfacing UTD with FEM for a Conformal Array Antenna on a Large** Platform   C10P2-2

Burkholder, Robert; Kim, Youngchel; Pathak, Prabhakar H.; Lee, Jin-Fa
Ohio State University, UNITED STATES

A hybrid interface method is presented for analyzing complex array antennas mounted on a large platform. The antenna is characterized using the finite element method, and the radiation from the antenna is computed in the presence of the platform using the uniform geometrical theory of diffraction (UTD). This approach may be applied to computing the radiation pattern of the antenna, the coupling to other antennas on the same platform, or the scattering from the platform back into the antenna.

11:40   **Experimental Investigation of a Smoothly Curved Antenna Array on a UAV-Nose Mock-up**   C10P2-3

Pettersson, L.; Gunnarsson, R.; Lundén, O.; Leijon, S.; Gustafsson, A.
Swedish Defence Research Agency, SWEDEN

The experimental evaluation of a conformal, smoothly curved, microstrip array mounted on a structure representing the nose section of a small UAV is reported and discussed. The array consists of 35×7 single-polarized probe fed Ku-band patch elements for 16−18 GHz. Embedded element patterns as well as their mean values and standard deviations are presented. A comparison with a previously studied faceted conformal array which used identical elements, is also made.

12:00   **Efficient Design of Finite Conformal Antenna Arrays Using VSIE Formulation and P-FFT Method.**   C10P2-4

Xiao, K.[1]; Li, L. W.[2]; Zhao, W. J.[2]; Chai, S.-L.[1]; Mao, J.-J.[1]
[1]National University of Defense Technology, CHINA;
[2]National University of Singapore, SINGAPORE

A rigorous and effective analysis of finite conformal microstrip antenna array of arbitrary shape is presented using volume-surface integral equation (VSIE) formulation and Precorrected-fast fourier transform method (P-FFT) method where combined conducting and dielectric materials are considered. Three typical conformal arrays including cylindrical, spherical and conical arrays with thin dielectric sheets are considered. Microstrip-line and probe feed methods are used to excite the arrays.

Time	Title	Abs No
11:00	**Evaluating the Singular Integrals Arising in MPIE Formulations with a Double-Exponential Algorithm**	C23P2-1

Polimeridis, Athanasios G.; Mosig, Juan R.
LEMA-EPFL, SWITZERLAND

Novel generalized Cartesian product rules for the computation of weakly singular integrals, arising in the mixed potential integral equation formulations are presented in this paper. The key feature of the proposed integration schemes lies in the incorporation of the double exponential quadrature rule, originally developed by Takahasi and Mori in the mid-seventies for the integration of functions with singularities at the endpoints of the associated integration interval.

| 11:20 | **Orthogonal Basis Functions for the Discretization of the Magnetic-field Integral Equation in the Low Frequency Regime** | C23P2-2 |

Ubeda, Eduard; Tamayo, Jose M; Rius, Juan M
Technical University of Catalonia, SPAIN

We compare the RCS accuracy of the Method of Moments discretization of the Magnetic-field Integral Equation with two types of orthogonal facet-oriented basis functions: (i) a recently proposed zero-order set and (ii) a novel first-order set. We show their performance when compared with the discretization in Method of Moments of the Electric-field and the Magnetic-field Integral equations with low-order div-conforming sets and for different meshings (triangular, quadrilateral and combined).

| 11:40 | **EDX- Companion Tools and other 2nd year developments** | C23P2-3 |

Sabbadini, Marco[1]; Frandsen, P.E.[2]; Ghilardi, M.[3]; Vandenbosch, G.A.E[4]
[1]ESA-ESTEC, NETHERLANDS;
[2]TICRA, DENMARK;
[3]ITLink, ITALY;
[4]Katholieke Universiteit Leuven, BELGIUM

This paper presents the status of the Electromagnetic Data eXchange (EDX). The EDX is a core activity under the Working Group on Software of the European Association on Antennas and Propagation (EurAAP). Recent new developments and free software tools are discussed and a new Data Dictionary language for electromagnetic dictionaries is introduced.

| 12:00 | **New results from the SoftLAB benchmark of antenna software** | C23P2-4 |

Rolland, Anthony[1]; Gillard, Raphaël[2]; Sauleau, Ronan[1]; Eberhard, Jens[3]; Rius, Juan M.[4]; Cappellin, Cecilia[5]; Vandenbosch, Guy[6]
[1]IETR, University of Rennes 1, FRANCE;
[2]Institut d'Electronique et de Télécommunications de Rennes (IETR), FRANCE;
[3]CST, GERMANY;
[4]UPC, SPAIN;
[5]TICRA, DENMARK;
[6]KUL, BELGIUM

This paper gives an overview of the antenna software benchmarking activity that took place within the Software Group of the EurAAP association in 2009. A particular focus is brought to one of the proposed test case that consists of a non conventional horn antenna.

Session:	**A26P2: UWB antennas 2**
Type:	Antennas Session
Date:	Friday, April 16, 2010
Time:	11:00 - 13:00
Room:	Room 122-123
Chairs:	J. Costa
	G. Valerio

Time	Title	Abs No
11:00	**A 433 MHz – 22 GHz Reconfigurable Dielectric Loaded Biconical Antenna**	A26P2-1

Ott, Arndt; Eibert, T. F.
Technische Universitaet Muenchen, GERMANY

A reconfigurable ultra-wideband (UWB) biconical antenna is presented. It exhibits a bandwidth of 433 MHz-22 GHz due to a specially shaped dielectric placed between the two cones. Different flanges can be connected to the antenna to increase the frequency range. The radiation pattern has a constant main direction and changes its shape only slightly over the entire frequency range. Furthermore the antenna offers an excellent transient behavior.

11:20	**A New Multifunctional UWB Planar Antenna Based on Printed Dipoles in Rhombic Configuration**	A26P2-2

Mazzocchi, Simona[1]; Valerio, G.[1]; Zucca, M.[2]; Ciattaglia, M.[2]; De Luca, A.[2]; Galli, A.[1]
[1]Sapienza University of Rome, ITALY;
[2]Selex Sistemi Integrati, ITALY

In this paper a new simple and low-cost radiating element is presented, based on a multilayered planar configuration with printed dipoles arranged in a rhombic shape. The main objective is to reach UWB performance in the C-X bands, with good matching and fairly regular radiation patterns in different frequency regions. The feeding and radiating features of the antenna element are extensively analyzed and also optimized as concerns the matching features by means of different numerical procedures.

11:40	**Investigation of a Crossed Exponentially Tapered Slot Printed Antenna for UWB Ranging**	A26P2-3

R. Costa, J.[1]; R. Medeiros, C.[2]; A. Fernandes, C.[2]
[1]Instituto Telecomunicacoes - ISCTE, PORTUGAL;
[2]Instituto Telecomunicacoes - IST, PORTUGAL

This paper presents a compact printed antenna for UWB ranging over the 3.1-10.6 GHz band. The radiation pattern and polarization are very stable over the entire band. Preliminary line-of-sight (LOS) ranging measurements are performed and range information is extracted from the pulse signal time delay. The antenna link performance is measured, presenting very low pulse distortion effects. Early results demonstrate accurate position estimation from measurements performed in different scenarios.

12:00	**New Method for Design implementation of Vivaldi Antennas to Improve its UWB Behavior**	A26P2-4

Javashvili, Otar[1]; Andersson, Daniel[2]
[1]Radarbolaget AB, GEORGIA;
[2]Radarbolaget AB, SWEDEN

The project was done as a Master's thesis at University of Gavle with colaboration of the Radio Center Gavle and Radarbolaget AB. Otar Javashvili

12:20	**Statistical Models of Wideband and UWB Omnidirectional Antennas Based on Parametric Modeling.**	A26P2-5

ROBLIN, Christophe; YOUSUF, Muhammad Amir
ENSTA, FRANCE

The need for antenna models, devoted to various simulation tools (e.g. ray tracing, radio linklevel, etc.) is more and more topical. This is especially true for UWB systems, because of higher complexity of antenna representation. The great diversity of the situations (radiators, close environment, fabrication dispersion, etc.) suggests a statistical approach of the problem. A statistical analysis of the radiation of a population of omni antennas based on a parametric modelling is proposed her.

12:40	**Switched UWB to Narrowband Planar Monopole Antenna**	A26P2-6

Ghanem, F.[1]; Kelly, J.[2]; Hall, P.S.[2]
[1]University of Sheffield, Department of Electronic & Electrical Engineering, Mappin Street, Sheffield, UNITED KINGDOM;
[2]School of Electronic, Electrical & Computer Eng., University of Birmingham, Edgbaston, Birmingham, B, UNITED KINGDOM

Reconfigurable antennas will be required for future mobile systems. This paper presents a multi-switched standard antenna. The antenna is based around a planar monopole and it is fed via a single stage parallel-coupled line filter. By using 4 microwave switches, within the resonator, it is possible to switch between wide and narrowband operation. With the aid of a further 6 switches, it is possible to vary the narrowband operating frequency.

Time	Title	Abs No
11:00	**Lightweight Intersatellitelink Antenna (LISAMS) operating at Ka-Band**	C17P2-1

Nathrath, N.[1]; Truemper, M.[1]; Purschke, R.[2]; Harder, J.[2]; Wolf, H.[3]
[1]NTP - Netzwerk Technischer Partner, GERMANY;
[2]TU München, GERMANY;
[3]Astrium GmbH, GERMANY

Since 2008 the lightweight intersatellitelink antenna ($LISA_{MS}$) has been developed for establishing communication between low flying satellites (e.g. earth observation satellites) and geostationary relay satellites. For this development a detailed electrical design has been simulated to predict performance parameters. The paper describes the detailed component design and the comparison of the simulated values with measurements from manufactured breadboard antenna model.

11:20	**Perspectives for Mobile Satellite Communications in Ka-Band (MOSAKA)**	C17P2-2

Hein, Matthias[1]; Bayer, H[1]; Krauss, A[1]; Stephan, R[1]; Volmer, C[1]; Heuberger, A[2]; Eberlein, E[2]; Keip, C[2]; Mehnert, M.[2]; Mitschele-Thiel, A[1]; Driess, P[1]; Volkert, T[1]
[1]Ilmenau University of Technology, GERMANY;
[2]Fraunhofer IIS, GERMANY

The German Heinrich Hertz mission signalises the growing interest in nomadic and mobile Ka-band satellite communications. The project MoSaKa adresses the ground segment required for such missions, in terms of bidirectional non-stationary communication links in a heterogeneous emergency network. Issues like terminal antennas, communication links and protocols, and a specific measurement testbed are addressed by an interdisciplinary consortium of electronic engineers and computer scientists.

11:40	**The German Heinrich Hertz Satellite Mission**	C17P2-3

Voigt, Siegfried
DLR, GERMANY

This contribution gives an overview of the German satellite communication mission, called Heinrich Hertz Satellite Mission. The main project goal is a technology verification and qualification of various innovative technologies over an operation time of 15 years in the geostationary orbit. Amongst others this mission will re-establish the satellite and payload prime know-how for German space companies. The verification payload and the antenna developments are focused on Ka-Band.

12:00	**Active Antenna Arrays at Ka-Band: Status and Outlook of the SANTANA Project**	C17P2-4

Holzwarth, Sybille[1]; Jacob, Arne[2]; Dreher, Achim[3]; Hunscher, Christian[4]; Fischer, Horst[1]; Stark, Alexander[5]; Rohrdantz, Benjamin[2]; Geise, Alexander[2]; Kuhlmann, Karsten[2]; Gieron, Roman[1]; Litschke, Oliver[1]; Lohmann, Dirk[1]; Simon, Winfried[1]; Buchner, Peter[1]; Heckler, Marcos[3]; Greda, Lukasz[3]
[1]IMST GmbH, GERMANY;
[2]TU Hamburg-Harburg, GERMANY;
[3]DLR, GERMANY;
[4]Astrium GmbH, GERMANY;
[5]Tu Hamburg-Harburg, GERMANY

This paper gives an overview on different research activities on electronically steerable antennas at Ka-band within the framework of the SANTANA project. In addition, it gives an outlook on future objectives, namely the perspective of testing SANTANA technologies with the projected German research satellite "Heinrich Hertz".

12:20	**A Multibeam Antenna for Data Relays for the German Communications Satellite Heinrich-Hertz**	C17P2-5

Greda, L. A.[1]; Knuepfer, B.[1]; Knogl, J. S.[2]; Heckler, M. V. T.[1]; Bischl, H.[1]; Dreher, A.[1]
[1]German Aerospace Center (DLR), GERMANY;
[2]Technische Universität München (TUM), GERMANY

This paper presents a concept of a novel Ka-band receiving multibeam antenna that can be used for high-rate data relays between a GEO satellite and several LEO satellites. The antenna is a payload candidate for the German communications satellite Heinrich-Hertz that is intended to be launched in 2014. First numerical results assessing the radiation characteristics and performance of the proposed antenna are given.

Session:	**A31: New materials**
Type:	Antennas Session
Date:	Friday, April 16, 2010
Time:	11:00 - 13:00
Room:	Room 127
Chairs:	F.J. Ferrer
	K. Mahdjoubi

Time	Title	Abs No
11:00	**Attenuation of Magnetoplasma in Semiconductor Periodic and Quasi-Periodic Layered Waveguides**	A31-1

Olkhovskiy, Y.[1]; Shramkova, O.[2]
[1]Kharkiv National Pedagogical University, UKRAINE;
[2]Institute of Radiophysics and Electronics of the NAS of Ukraine, UKRAINE

A study is made of the TM-wave propagation in periodic and quasiperiodic layered waveguide composed of alternating layers of semiconductor and dielectric in a magnetic field. The dispersion dependencies for a finite periodic and quasiperiodic media are obtained. The effect of the dissipation processes on the wave dispersion is considered. The dependence of the minimum phase velocity on the collision frequency, the magnetic field strength and the thicknesses of the layers is studied.

Time	Title	Abs No
11:20	**Epoxy Bonded Ferrimagnetic Compounds as Patch Antenna's Substrate**	A31-2

Zervos, Theodore[1]; Alexandridis, A.A.[1]; Lazarakis, F.[1]; Stamopoulos, D.[2]; Pissas, M.[2]; Dangakis, K.[1]
[1]Institute of Informatics & Telecommunications, National Centre for Scientific Research "Demokritos", GREECE;
[2]Institute of Materials Science, National Centre for Scientific Research "Demokritos", GREECE

The use of an epoxy bonded ferrimagnetic compound, Yttrium Iron Garnet (YIG), as a substrate of a patch antenna in Ku band is studied. We investigate its influence on the antenna's polarization properties under the application of an external magnetic field. It is proved that the axial ratio and also the sense and the tilt of the antenna polarization ellipse are influenced since they change in respect to the direction and the magnitude of an externally applied magnetic field.

Time	Title	Abs No
11:40	**Ferrimagnetic Composites in Building Material for Electromagnetic Wave Absorption Wireless Communication Systems**	A31-3

Pretorius, Johann; Maharaj, B.T.
University of Pretoria, SOUTH AFRICA

Magnetic material is mixed with plaster cement to form a composite magnetic building material for electromagnetic wave (EMW) attenuation in indoor wireless communication systems. Samples were prepared as tiles and placed in the propagation path of the EMW between two broadband horn antennas. The attenuation capability of the samples was determined as the relative path loss between the antennas. Attenuation of the EMW of 8-12 dB were measured.

Time	Title	Abs No
12:00	**Performance Enhancement of Salisbury Screen Absorber using A Resistively Loaded High Impedance Ground Plane**	A31-4

Che Seman, Fauziahanim; Cahill, Robert; Fusco, Vincent
Queens University Belfast, UNITED KINGDOM

In this paper we use numerical predictions to show that a Salisbury screen absorber backed by a high impedance ground plane can be designed to give a -10 dB reflectivity bandwidth which exceeds 100% when operated at angles of incidence up to 40º. A major advantage of this design methodology is that the enhanced bandwidth performance and insensitivity to angle of incidence is obtained without the need to increase the physical thickness of the structure.

Time	Title	Abs No
12:20	**Plasma Capillary Application to Switchable and Tunable EBG Coupler**	A31-5

Varault, Stefan[1]; Bolioli, Sylvain[1]; Sokoloff, Jerome[2]
[1]ONERA, FRANCE;
[2]LAPLACE-CNRS, FRANCE

We present in this study the application of a plasma capillary used as a point defect between two waveguides. By varying the intensity at the capillary electrodes, the resonance frequency of the point defect can be tuned in order to couple energy at the desired frequency.

Time	Title	Abs No
12:40	**Printed Antennas over Lossy Magneto-Dielectric Substrates**	A31-6

NIAMIEN, Constant; COLLARDEY, Sylvain; MAHDJOUBI, Kouroch
Institue of Electronic and Telecommunication of Rennes, FRANCE

Printed antennas over lossy truncated magneto-dielectric materials are investigated using the cavity model. Some useful design formulas have been proposed for calculating the patch antenna radiation efficiency and bandwidth. It has been shown that the patch performances are better when the magneto-dielectric substrate is chosen such that the permeability is greater than the permittivity.

Session:	**A33: EBG**
Type:	Antennas Session
Date:	Friday, April 16, 2010
Time:	11:00 - 13:00
Room:	Room 129
Chairs:	J.M. Gonzalez-Arbesú
	H.M. Lee

Time	Title	Abs No

11:00 **A High-impedance Surface Based Antenna - Lose the Antenna** A33-1
Luukkonen, O.[1]; Karilainen, A. O.[2]; Vehmas, J.[2]; Simovski, C.[2]; Tretyakov, S. A.[2]
[1]University of Pennsylvania, UNITED STATES;
[2]Aalto University, School of Science and Technology, FINLAND

In this paper a high-impedance surface based antenna is designed by using only the high-impedance surface structure itself. No horizontal dipole antenna, commonly used in such antenna structures, is used at all. By utilizing two characteristic resonance modes of the surface structure, namely the plasmonic resonance and the structural high-impedance surface resonance mode, two separate resonance bands are formed.

11:20 **Analysis of Abilities to Achieve Overlapped Radiating Apertures Using Multi-Feed EBG Strucutre** A33-2
Loaded by Passive Filters
Chreim, H.[1]; Chantalat, R.[1]; Thevenot, M.[1]; Naeem, U.[1]; Bila, S.[1]; Verdeyme, S.[1]; Monediere, T.[1]; Dumon, P.[2]; Diez, H.[2]; Palacin, B.[2]; Pacaud, D.[3]; Cailloce, Y.[3]; Caille, G.[3]
[1]XLIM- UMR 6172, FRANCE;
[2]CNES, FRANCE;
[3]Thales Alenia Space, FRANCE

This paper presents an analysis of different multi-feed EBG solutions, in order to choose the best one which provides overlapped apertures and promises good functioning as a reflector focal array. The coupling, generally existing in these types of antennas, must be managed constructively. That is why, suited filtering functions should load the antenna in order to isolate feeds and reconstruct the radiation.

11:40 **Design of a Multi-Feed EBG Antenna as a Reflector Focal Array for KA-Band Space Applications** A33-3
Chreim, H.[1]; Chantalat, R.[1]; Arnaud, E.[1]; Thevenot, M.[1]; Naeem, U.[1]; Bila, S.[1]; Verdeyme, S.[1]; Monediere, T.[1]; Dumon, P.[2]; Palacin, B.[2]; Diez, H.[2]; Pacaud, D.[3]; Cailloce, Y.[3]; Caille, G.[3]; De Maagt, P.[4]
[1]XLIM- UMR 6172, FRANCE;
[2]CNES, FRANCE;
[3]Thales Alenia Space, FRANCE;
[4]European Space Agency, NETHERLANDS

This paper is dedicated to the design of a multi-feed matched EBG antenna, providing overlapped beams, as a reflector focal array for Ka-band space applications. The architecture must ensure the coverage of Europe through 40 spots "Agora mission proposed by CNES" with a 4x reuse scheme (2 linear polarizations and 2 frequency channels). A whole system (antenna+filters) is studied and its performances are exposed. Finally, a reflector is illuminated in order to characterize the coverage.

12:00 **Dual-Band Surface Wave Supression Using Isolated Soft Surface Structures** A33-4
Cho, T. J.; Lee, H. M.
Kyonggi Univ., KOREA, REPUBLIC OF

To suppress the surface waves in dielectric substrate at dual-band, novel soft surface structures are proposed. By removing the ground plane edges of the patch and forming soft surfaces within the bare substrate, the front-to-back ratio of a patch antenna significantly improved. By using the proposed soft surface structure, backward radiation powers of a microstrip patch antenna show - 18 dB at 1.95 GHz and - 24 dB at 2.14 GHz, respectively.

12:20 **Miniaturised Frequency Selective Surface** A33-5
Ford, K. L.[1]; Liu, H[2]; Langley, R. J.[2]
[1]University of Sheffield, UNITED KINGDOM;
[2]university of sheffield, UNITED KINGDOM

This paper presents a method for designing a Frequency Selective Surface (FSS) using a miniaturised unit cell based on a simple lumped circuit analogue. The paper presents the theory underpinning the technique with a single polarisation method, followed by a dual polarised design.

12:40 **Parametric study of a unit cell with elliptical patch for periodic structures with variable number of** A33-6
grounding vias
Matekovits, L.[1]; De Sabata, A.[2]; Orefice, M.[1]
[1]Politecnico di Torino, ITALY;
[2]Politehnica University of Timisoara, ROMANIA

Numerical investigation of the effect on the DD of a different number of off-axis positioned grounding vias for an elliptic patch in periodic arrangement is presented. Various aspect ratios for the mushroom-like structure have been considered. For an easy scalability the position of the vias has been moved according to the variation of the geometry. The degenerate geometry of circular shape guarantees the maximum width of the band-gap which decreases with the increase of the number of vias.

Time	Title	Abs No
11:00	**A New Miniaturized Antenna for ISM 433MHz Band**	C12P2-1

Lach, C.[1]; Rudant, L.[1]; Delaveaud, C.[1]; Azoulay, A.[2]
[1]CEA LETI, FRANCE;
[2]Supelec, FRANCE

A new miniaturized antenna for 433MHz frequency band is introduced for sensor networks. The antenna is a magnetic monopole loaded with a capacitor, which can significantly decrease the resonant frequency of the structure. It is designed to operate in the ISM 433MHz band on a small PCB (103mm*55mm) and has at least 3MHz bandwidth. Moreover, its radiation efficiency is suitable for the possible applications and its pattern is omnidirectionnal.

| 11:20 | **Electrically Small Loop Antenna Surrounded by a "Shell"of Concentric Split Loops** | C12P2-2 |

Polivka, M.; Holub, A.
Czech Technical University, CZECH REPUBLIC

Electrically small antenna formed by planar loop with a "shell" of three concentric split loops with the relative outer size ka = 0.40 has been designed with complex input impedance Zin ~ 22 + j195 ohm to be used as UHF RFID tag antenna. The "shell" of concentric loops increases the total current path length so that it reaches the length about 1.08 ë0 at 869 MHz. The measured radiation and antenna efficiency is thus improved and reaches the value about 51 and 33 %, respectively.

| 11:40 | **Dielectric Loaded Ultra Wideband Monopole Antenna Integrated in a Universal Serial Bus Device** | C12P2-3 |

Pires, Nuno[1]; Letizia, M.[2]; Maisenbacher, A.[3]; Moreira, A.[1]
[1]Instituto de Telecomunicacoes, Instituto Superior Tecnico, PORTUGAL;
[2]Laboratory of Electromagnetics and Acoustics, Ecole Polytechnique Federale de Lausanne, SWITZERLAND;
[3]ads-tec GmbH, GERMANY

A planar Ultra Wideband (UWB) monopole antenna designed to operate inside a Universal Serial Bus (USB) dongle is reported. Dielectric loading with inexpensive substrates was used. The antenna was tested inside the USB dongle and this case effect was studied. Measurements of S_{11} with the antenna connected to a laptop have shown small effects on the antenna performance.

| 12:00 | **Compact Spiral Loaded Printed Monopole Antenna** | C12P2-4 |

Bao, X. L; Ammann, Max
Dublin Institute of Technology, IRELAND

A novel miniaturized printed monopole structure is proposed. The antenna comprises a printed monopole strip which is loaded by a spiral located on the rearside connected by a via. The inductive loading provided by the spiral enables considerable miniaturization of antenna. A parametric study of key dimensional parameters and groundplane are discussed.

| 12:20 | **Optimum Design of a Scavenging Antenna System** | C12P2-5 |

Serrano, Raquel; Aguasca, A; Romeu, J; Jofre, L
UPC, SPAIN

This paper presents some guidelines for the design procedure of an optimum scavenging antenna system. Based on these guidelines, a scavenging antenna has been fabricated and characterized, achieving very good results in comparison to the traditional designs.

Time	Title	Abs No
11:00	**A Flip Test Procedure for Positioning System Errors and Antenna Phase Center Determinations**	M07-1

LE COQ, Laurent; LAFOND, Olivier; HIMDI, Mohamed
IETR - University of Rennes 1, FRANCE

The pattern phase centre is determined using measurements in a specific cut plane. This parameter is totally defined by a lateral and a longitudinal distance which are specified in the measured cutting plane. These lengths determinations can be corrupted by two elements: misalignment of the antenna under test and positioning systems errors. To solve the whole problem, a procedure based on flip tests is applied. Experimental results are performed in both Ka- and V-band.

| 11:20 | **Active Optical Sensor for Electromagnetic Field Measurements in Time and Frequency Domains** | M07-2 |

Kuehn, Sven[1]; Kuster, N.[2]; Bomholt, F.[3]; Chavannes, N.[4]
[1]ETH Zurich, SWITZERLAND;
[2]IT'IS Foundation, ETH Zurich, SWITZERLAND;
[3]SPEAG, SWITZERLAND;
[4]IT'IS Foundation, SWITZERLAND

We present a miniature fiber-optic magnetic field sensor that is capable of detecting the amplitude and phase of the measured field in the frequency range from 0.1-6GHz. It is also capable of capturing the full time domain signal information of modern communication signals. The sensor is based on a versatile optical platform to which various antenna types and amplifier stages may be connected. The millimeter size and full electrical isolation allow field measurements with minimal disturbance.

| 11:40 | **Comparison of RMS Delay Spread and Decay Time Measured in Reverberation Chamber** | M07-3 |

Chen, X.; Kildal, P.-S.
Chalmers University of Technology, SWEDEN

The relation between RMS delay spread and decay time in reverberation chamber (RC) is derived and verified by measurements. Due to their proportionality we propose decay time to be an alternative parameter for channel characterization in RC instead of RMS delay spread because it is easier to compute from measured S-parameters.

| 12:00 | **Frequency-Dependent Effects of Platform and Wall Antenna Stirring on Measurement Uncertainty in Reverberation Chamber** | M07-4 |

Chen, X.; Kildal, P.-S.
Chalmers University of Technology, SWEDEN

Both platform and wall antennas stirring are known to reduce uncertainty when measuring wireless devices in reverberation chamber (RC). There is a maximum limit on the number of independent platform positions, surpassing which there will be no more improvement in accuracy. The present paper introduces such a limitation on the number of platform positions in a recently published new uncertainty model for the RC.

| 12:20 | **Near-Field Mapping of Passive Intermodulation in Printed Circuits** | M07-5 |

Shitvov, Alexey; Schuchinsky, Alexander; Zelenchuk, Dmitry
Queen's University of Belfast, UNITED KINGDOM

This paper presents an experimental technique of the near-field probing of passive intermodulation (PIM) products distribution on microstrip transmission lines. An effective normalization of the probe readings at the intermodulation frequency is proposed and validated by experiment. The main properties of the distributed PIM generation in microstrip lines are deduced from the experimental results.

| 12:40 | **The Reverberating Chamber as Emulator of Radar Ground Clutter Doppler Spectra** | M07-6 |

Sorrentino, Antonio; Ferrara, G.; Migliaccio, M.
Università Parthenope, ITALY

The emulation of real scenarios is a topic of considerable interest in determining the performance of target detection against ground clutter. This paper introduces a new employment of the Reverberating Chamber as emulator of radar ground clutter Doppler spectra. Experiments accomplished at the Università di Napoli Parthenope show how by properly modulating the stirrer velocity used for measurements, real scenarios such as vegetation under several wind speed conditions, can be emulated in RC.

Session:	**A30P2: Reflectarray 2**
Type:	Antennas Session
Date:	Friday, April 16, 2010
Time:	11:00 - 13:00
Room:	Room 133-134
Chairs:	J.A. Encinar
	N.V. Shuley

Time	Title	Abs No
11:00	**Preliminary Design of Foldable Reconfigurable Reflectarray for Ku-Band Satellite Communication**	A30P2-1

EL GHANNUDI, HAMZA[1]; Vincenti Gatti, Roberto[1]; Tomassoni, Cristiano[2]; Sorrentino, Roberto[2]
[1]RF MICROTECH, ITALY;
[2]Uviversity of Perugia, Dept. of Electronic and Information Engineering, ITALY

This paper presents the recent activities carried out in the framework of the ESA Project RESKUE (Transportable REflectarray Antenna for Satellite KU-band Emergency Communications). Aim of this project is to assess the feasibility of a new generation foldable and transportable antenna for bi-directional satellite communications at Ku-band. An Electronically reconfigurable reflectarray architecture is proposed for an easy stowing, deployment and portability.

| 11:20 | **A Dual-Band Reflectarray Antenna for Emergency Infomobility Service Systems** | A30P2-2 |

Pirinoli, Paola; Cong, P.T.; Mussetta, M.; Dassano, G.; Orefice, M.
Politecnico di Torino, ITALY

In this paper an innovative dual-band printed reflectarray is introduced. The structure is dual-layer and uses a new kind of enhanced bandwidth re-radiating element. In order to validate the basic concepts of this planar reflector a scaled prototype has been designed: the numerical results of the optimization prove the feasibility of the proposed configuration.

| 11:40 | **Characterization of Microstrip Reflectarray Square Ring Elements by means of an Artificial Neural Network** | A21P2-3 |

Mussetta, M.[1]; Pirinoli, P.[1]; Cong, P.T.[1]; Orefice, M.[1]; Zich, R.E.[2]
[1]Politecnico di Torino, ITALY;
[2]Politecnico di Milano, ITALY

An Artificial Neural Network (ANN) is introduced in order to speed up the optimized design procedure of a printed Reflectarray. The ANN is used to model the reflecting behaviour of patch radiator as a function of its geometric parameters, the angle of incidence and the frequency. When used in the RA design process, the reflection coefficient approximated with the ANN produces results that are very close to those obtained with that directly evaluated, proving the accuracy of the ANN.

| 12:00 | **Design of Hollow Patch Microstrip Reflectarray Antenna at Ka-band using Waveguide Simulator** | A30P2-4 |

Hajian, Mostafa[1]; Dickhof, J.H.[2]; Trampuz, C.[3]; Ligthart, L. P.[4]
[1]Technical University Delft, NETHERLANDS;
[2]FEL-TNO, NETHERLANDS;
[3]TU Delft, NETHERLANDS;
[4]IRCTR, Tu Delft, NETHERLANDS

A new phasing technique, patch with a slot of variable width and length developed at IRCTR for reflectarray antennas is proposed. A theoretical study was first carried out, then measurements were performed on some prototypes which showed good agreement with simulations. The hollow patch phasing has the advantage of avoiding non-uniform spacing between the elements. A number of array to orient the main beam to a certain direction is built and their radiation patterns have been measured.

| 12:20 | **Dual-Polarization Reflectarray Elements for Ku-Band TX/RX Portable Terminal Antenna** | A30P2-5 |

Carrasco, E.[1]; Encinar, J.[1]; Barba, M.[1]; Vincenti, R.[2]; Sorrentino, R.[2]
[1]UNIVERSIDAD POLITECNICA DE MADRID, SPAIN;
[2]RF Microtech, ITALY

Different dual-linear polarization elements for reflectarrays are proposed with the aim of achieving more than 360 degrees of phase delay for both polarisations, with low cross-polarisation levels, enough room for adding control devices and a linear phase response in the two bands, one from 10.70 GHz to 12.75 GHz (Rx) and the other from 14.00 GHz to 14.50 GHz (Tx). The elements are based on two stacked patches aperture-coupled to delay lines, in order to provide a good response in both bands.

| 12:40 | **Microstrip Reflectarray Formed By Double Elliptical Ring Elements** | A30P2-6 |

Li, Y.[1]; Bialkowski, M. E.[1]; Sayidmarie, K. H.[2]; Shuley, N. V.[1]
[1]School of ITEE, University of Queensland, AUSTRALIA;
[2]College of Electronic Engineering, University of Mosul, IRAQ

A small microstrip reflectarray constituted by a conical feed and 81 variable-size double elliptical rings printed on a single substrate is presented.