AES 2016 Malaga - Spain

The 4th Advanced Electromagnetics Symposium

Program

July 26 – 28, 2016
Malaga, Spain

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Edited by

Said Zouhdi | Paris-Sud University, France
Eva Rajo-Iglesias | University Carlos III of Madrid, Spain
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CONTENTS

AES 2016 ORGANIZATION 1

SPONSORS AND SUPPORTERS 3

PLENARY SPEAKERS 5

AES 2016 VENUE 6

GUIDELINES FOR PRESENTERS 8

TECHNICAL PROGRAM 9

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PLENARY SPEAKERS

Ismo V. Lindell

Aalto University, Finland

Coordinate-Free Classifications of Electromagnetic Media

Ismo V. Lindell is a Professor Emeritus in the Department of Radio Science and Engineering, in the School of Electrical Engineering at the Aalto University, Finland. He has authored or coauthored more than 270 refereed scientific papers and 11 books, for example, Multiforms, Dyadics and Electromagnetic Media (Wiley, 2015), Methods for Electromagnetic Field Analysis (IEEE Press, 2002), Electromagnetic Waves in Chiral and Bi-Isotropic Media (Artech House, 1994), Differential Forms in Electromagnetics (IEEE Press, 2004). Dr. Lindell received the IEEE S.A. Schelkunoff price (1987), the IEE Maxwell Premium (1997 and 1998) and the URSI van der Pol gold medal (2005).

Koji Yamada

National Institute of Advanced Industrial Science and Technology (AIST), Japan

Back-end Si photonics for high-performance photonic systems

Koji Yamada received his B.E., M.E. and Ph.D. degrees in nuclear engineering from Kyushu University, Japan, in 1986, 1988 and 2003, respectively. Currently, he is a group leader of Silicon Photonics Group in National Institute of Advanced Industrial Science and Technology (AIST), Japan. From 1988 to 2015, in NTT laboratories, he was engaged in studies on accelerator physics/engineering for synchrotron light sources and studies on silicon-based photonic platform. Since joining AIST in 2015, he continues studying silicon-based photonic platform. He is a member of IEEE, the Institute of Electronics, Information and Communication Engineers (IEICE), the Japan Society of Applied Physics, the Atomic Energy Society of Japan and the Particle Accelerator Society of Japan.

AES 2016 VENUE

AES 2016 will be held at the **Palacio de Congresos y Exposiciones de la Costa del Sol** (Torremolinos Congress Center), 3 Calle Mexico, 29620 **Torremolinos**, Spain, from **25 to 28 July 2016**.

GETTING TO VENUE

Address

Palacio de Congresos y Exposiciones de la Costa del Sol, 3 Calle Mexico, 29620 **Torremolinos**, Spain.

Getting to Torremolinos from Malaga Airport

Torremolinos is around 8km away from Malaga international airport. You can go from the airport to the city center by taxi, by train or by bus.

By Taxi

The airport has a well-signposted taxi rank outside the arrivals area of Terminal T3. Make sure that the taxi driver has started the taximeter at the beginning of the journey (minimum fare). We recommend requesting a receipt for any complaint or claim. The cost of a taxi from the airport into Torremolinos City Centre will cost between €15-20 depending on your time of travel.

By Train

The new suburban train station in the new Terminal T3 building links the airport with Torremolinos city centre and other cities like Benalmadena and Fuengirola in one direction, and it links Malaga city center in the other direction.

The new train station is situated underground and accessed via escalators. It is well signposted and can be reached via the square outside arrivals or outside departures. Before the station entry barriers you will see several self-service tickets machines on your right where you can buy your tickets.

The first train to Torremolinos leaves the airport at 05 :32, leaving every 20-30 minutes until the last train at 23.42. Line : C1. Estimated travel time : 10 minutes. The single fare for this journey is €1.80.

By Bus

You will find the bus stop straight in front of you outside the arrivals area of Terminal T3 on the side of the road where there are a couple of shelters with seats.

You will also see a ticket office in the left hand corner of the arrivals forecourt where you should purchase your tickets for the journey. Line : Torremolinos-Benalmadena-Airport. Estimated travel time : 30

minutes. The single fare for this journey is €3.80.

Getting to Torremolinos from Malaga train station

There are two train stations in the centre of Malaga : Maria Zambrano and Centro Alameda. Maria Zambrano station provides high-speed (AVE) and long-distance links to many Spanish cities like Barcelona, Cordoba, Madrid, Santiago de Compostela, Seville..., as well as local and regional routes.

You can take Line C1 from any of the two stations to reach Torremolinos. Estimated travel time : 20 minutes. The single fare for this journey is âĆň1.80. You can check the timetables on the website of the national rail company RENFE (http ://www.renfe.com/viajeros/cercanias/malaga/).

Getting to Torremolinos from Malaga bus station

Malaga bus station is located at the street "Paseo de los Tilos" very near Maria Zambrano train station. So it will be very easy to take a bus or a train from this station. You can take bus line Malaga-Torremolinos. Estimated travel time : 20 minutes. The single fare for this journey is €1.42.

GUIDELINES FOR PRESENTERS

ORAL PRESENTATIONS

Each session room is equipped with a stationary computer connected to a LCD projector. Presenters must load their presentation files in advance onto the session computer. Technician personnel will be available to assist you.

Scheduled time slots for presentation are 15 mn for regular, 20 mn for invited presentations, 30 mn for keynote talks and 40 mn plenary talks, including questions and discussions. Presenters are required to report to their session room and to their session Chair at least 15 minutes prior to the start of their session.

The session chair must be present in the session room at least 15 minutes before the start of the session and must strictly observe the starting time and time limit of each paper.

POSTER PRESENTATIONS

Presenters are requested to stand by their posters during their session. One panel, A0 size (118.9 x 84.1 cm), in vertical orientation, will be available for each poster (there are no specific templates for posters). Pins or thumbtacks are provided to mount your posters on the board. All presenters are required to mount their papers one hour before the session and remove them at the end of their sessions.

GENERAL INFORMATION

Venue

Palacio de Congresos y Exposiciones de la Costa del Sol (Torremolinos Congress Center)
3 Calle Mexico, 29620 **Torremolinos**, Spain

Registration Desk

Monday 25 July (16 :30 – 18 :30) : Reception of the Congress Center
26 July – 28 July (08 :00 – 17 :00) : Reception of the Congress Center

Banquet

Date : Wednesday, 27 July
Time : 19 :30 – 23 :30
Venue : Malaga

Best Poster Award Ceremony

Date : Wednesday, 27 July (to be announced at the Symposium Banquet)
Time : 19 :30 – 23 :00
Venue : Malaga

TECHNICAL PROGRAM

Monday 25th July, 2016

Registration

Reception of the Congress Center

16:30 - 18:30

Tuesday 26th July, 2016

Registration

Reception of the Congress Center

08:00 - 17:00

09:00 - 09:40 — Alhaurin

Session 1A1

SP6. Homogenization and effective medium theories

Organized by: Ying Wu

Chaired by: Ying Wu

09:00 : Invited talk
Boundary optical stress in metamaterial and effective-medium systems
Shubo Wang, C. T. Chan
The Hong Kong University of Science and Technology (Hong Kong)

Using a generic microscopic model, we show that the boundary stress induced by an electromagnetic plane wave in a negative-refractive-index metamaterial depends not only on the macroscopic effective permittivity and permeability but also on the microscopic lattice symmetry of the polarizable units that constitute the metamaterial. The lattice effect is attributed to electrostriction and magnetostriction which can be accounted for by the Helmholtz stress tensor within the context of effective medium theory.

09:20 : Invited talk
High-frequency homogenization for layered hyperbolic metamaterials
Arkadii Krokhin[1], Jesus Arriaga[2], Lyudmila N. Gumen[3], Vladimir P. Drachev[1]
[1] *University of North Texas (USA),* [2] *Universidad Autonoma de Puebla (Mexico),* [3] *Universidad Popular Autonoma del Estado de Puebla (Mexico)*

We propose an analytical approach for calculation of the dielectric tensor of metal-dielectric superlattice. The obtained formulas are valid at high frequencies near the points of topological transition from an elliptic to hyperbolic regime. We take into account the evanescent character of the plasmonic mode and oscillatory behavior of the waveguide modes. Our results show good correspondence to the exact solution of the dispersion equation and significant deviation from the widely used quasi-static formulas, which ignore spatial field inhomogeneity.

09:00 - 10:15 — Coin

Session 1A2

GEN1. Electromagnetic Theory

Chaired by: Enrique Marquez Segura

09:00 : Analysis of Electromagnetic Scattering at a Radially Inhomogeneous Dielectric Sphere Using the Hybrid Projection Method
Alina R. Gabdullina[1], Olga N. Smolnikova[2], Sergei P. Skobelev[3]
[1] *Moscow Institute of Physics and Technology (Russia),* [2] *Moscow Aviation Institute (Russia),* [3] *Public Joint-Stock Company Radiofizika (Russia)*

A modification of the hybrid projection method is proposed for analysis of wave scattering at a radially inhomogeneous dielectric sphere. The approach is based on projection matching of the fields on the boundaries of spherical regions, on projection of the Maxwell equations on the transverse vector functions, and on application of the one-dimensional finite element method to the obtained ordinary differential equations for reduction of the latter to algebraic systems with three-diagonal matrices.

09:15 : Influence of Time Retarded Solutions of Electromagnetic Fields on Transmission Line RLGC Modeling
Peng Ye[1], Brandon Gore[2], Paul Huray[3]
[1] *Oracle Corporation (USA),* [2] *Intel Corporation (USA),* [3] *University of South Carolina (USA)*

RLGC modeling is one of the most common techniques to characterize the behavior of a transmission line. Segmented network elements are cascaded to model transmission lines of arbitrary length. RLGC values are extracted using numerical simulation methods, and the resulting RLGC values are usually found to be frequency-dependent. This paper introduces an analytical approach to extract the RLGC values of transmission line, and also explains a factor that contributes to the frequency-dependent RLGC values.

09:30 : Electromagnetic and material contributions to stress, energy, and momentum in metamaterials
Brandon A. Kemp[1], Cheyenne J. Sheppard[2]
[1] *Arkansas State University (USA),* [2] *Arkansas State University (USA)*

We demonstrate modeling of the field-kinetic and material response subsystem for various media and extend the models to dispersive negative index metamaterials. It is shown that neither the Minkowski or Abraham models are universally correct, as demonstrated to describe metamaterials under both the field-kinetic and wave SEM models for various applications such as negative refraction, perfect lensing, and invisibility cloaking.

09:45 : Electromagnetic Nuclear Physics
Bernard Schaeffer
(France)

An attractive strong force was assumed by Chadwick to equilibrate the Coulomb repulsion. Bieler had almost solved the problem magnetically, also attractive, instead of being repulsive. It needs only to reuse the Rutherford formula where the repulsive electric -2 exponent is replaced, at high kinetic energies, by the also repulsive magnetic -6 exponent. The nuclear binding energy is the attraction between a proton electric charge and a not so neutral neutron equilibrated statically by their magnetic repulsion.

10:00 : Polarization effects on 3D imaging from scattering measurements
Christelle Eyraud, Jean-Michel Geffrin, Amelie Litman, Herve Tortel
Aix-Marseille University (France)

This paper deals with the polarization aspect in microwave imaging for 3D targets. The vectorial information contained in the scattering matrix is often under-exploited in inverse scattering problems. In this work, a study on the influence of the polarization state on the reconstructed maps by inverse procedures will be presented. Reconstructions performed from measurements in different polarization cases will be compared and discussed.

09:00 - 09:50 — Blanca

Session 1A3

GEN15. Field Characterization and Measurement

Chaired by: Herve Tortel

09:00 : Microwave Interferometry Based Open-ended Coaxial Technique for High Sensitivity Liquid Sensing
Hind Bakli[1], Kamel Haddadi[2], Tuami Lasri[3]
[1] *Departement des Sciences et Technologie (Algeria),* [2] *Institut d'Electronique de Microelectronique et de Nanotechnologie (France),* [3] *Institut d'Electronique de Microelectronique et de Nanotechnologie (France)*

This paper desctibes a modified open-ended coaxial technique for liquid media microwave characterization. The method proposed associates a conventionnal vector network analyser, a microwave open-ended probe and a broadband matching network based on microwave interferometry. This latter is used to match the probe impedance to the 50 Ohm impedance vector network analyser. The characterization of aqueous solutions of different sodium chloride concentrations is experimentally demonstrated using the technique proposed.

09:15 : Comparison of Software and Hardware Time Gating Techniques on the Measurements of Low RCS Targets in a Bistatic Configuration
Hassan Saleh, Jean-Michel Geffrin, Herve Tortel
Aix-Marseille Universite (France)

A hard-gating setup was added to the measurement facility of the CCRM to enhance measurement accuracy. This setup was used to measure targets with dimensions of the order of the wavelength and the results were compared to soft-gated measurement and to numerical simulations. To our knowledge, this is the first time a hardware and software gating comparison is made with low scattering targets in a bistatic configuration.

09:30 : Invited talk
Wideband Electromagnetic Nearfield Imaging Using Compressed Sensing
I. Elshafiey, Md. Anowar Hossain
King Saud University (Saudi Arabia)

Nearfield electromagnetic imaging (EMI) provides an attractive and simple medical imaging tool to reconstruct maps of tissue properties. This research aims at dealing with resolution limitations of EMI, by implementing wideband multichannel system for energy excitation and adopting compressed sensing approach in image reconstruction. Simulation is conducted assuming a head model with tumor anomalies. Inversion techniques based on orthogonal matching pursuit OMP are developed. Results reveal the potential of the system in detecting tissue properties inside the human head.

Coffee Break and Exhibit Inspection

10:00 - 10:30

10:30 - 12:40 — Alhaurin

Session 1A4

SP6. Homogenization and effective medium theories

Organized by: Ying Wu

Chaired by: Ying Wu

10:30 : Invited talk
Superluminal propagation of Dirac-cone modes in photonic crystal slabs
Kazuaki Sakoda
National Institute for Materials Science (Japan)

Apparent superluminal propagation characterized by a divergent group velocity is shown for the Dirac-cone modes in photonic crystal slabs by deriving their dispersion relation in the presence of diffraction loss. An analytical expression connecting the energy velocity to the group velocity is presented. It is shown that the former remains smaller than the speed of light even when the latter diverges.

10:50 : Invited talk
Dynamic Homogenization of Metamaterials: Nonlocal Effects and Additional Constitutive Parameters
Marie-Fraise Ponge, Olivier Poncelet, Daniel Torrent
Universite de Bordeaux (France)

We present a dynamical homogenization method for acoustic and elastic metamaterials based on periodic arrangements of inclusions. The method allows for the calculation of the frequency-dependent effective para-

meters. It is shown that they are also spatially dispersive (nonlocal). Additionally, new constitutive parameters, which can also be accurately computed in the framework of the present theory, are found in the homogenization process. Several propagation regimes concerning these nonlocal effects are studied and some examples are given.

11:10 : Invited talk
Homogenization scheme for metamaterials in scalar waves
Min Yang, Guancong Ma, Ying Wu, Zhiyu Yang, Ping Sheng
Hong Kong University of Science and Technology (Hong Kong)

We present a homogenization scheme for metamaterials based on reproducing the lowest orders of scatterings from a finite volume of metamaterials. With the aid of metamaterials' eigenstates, the effective parameters can be obtained by matching the surface responses of a metamaterial's unit cell with a piece of homogenized material. Three examples validate this scheme with almost exact agreement to numerical simulations and experiments.

11:30 : Nonlocal effective medium theory for photonic crystals and metamaterials
Jie Luo, Yun Lai
Soochow University (China)

We propose a nonlocal effective medium theory for photonic crystals and metamaterials by matching of the dispersions and impedances of eigen-fields. Such nonlocal effective medium theory is capable of homogenizing periodic structures beyond the long wavelength limit. The conditions of the validity of the theory is also clarified. Moreover, with the nonlocal effective medium theory, we propose photonic crystals with omnidirectional impedance matching and the ability of formation of aberration-free virtual image, which we denote as ultra-transparent photonic crystals.

11:45 : Invited talk
Effective medium theory for coated particles and magnetic metamaterials
Shiyang Liu[1], Jialin Zhou[2], Xinning Yu[2], Huajin Chen[3], Zhifang Lin[3]
[1] *Zhejiang Normal University (Canada),* [2] *Zhejiang Normal University (China),* [3] *Fudan University (China)*

An effective medium theory (EMT) based on coherent potential approximation for magnetic metamaterials (MMs) as well as coated particles are presented. The EMT can be used to design MMs with particular electromagnetic properties such as nonreciprocal magnetic surface plasmon, thermally tunable index materials, and anisotropic zero index materials. Nonreciprocal Goos-Hanchen effect and tunable unidirectional electromagnetic wave propagation are demonstrated.

12:05 : Higher order terms and origin dependence in metamaterial homogenization
Christopher Dirdal, Hans Olaf Hagenvik, Johannes Skaar
Norwegian University of Science and Technology (Norway)

Surprising features of metamaterial homogenization are presented. The electric quadrupole and higher order terms in the expansion of macroscopic polarization can be significant. Origin dependence in the effective parameters can be used to adjust them towards e.g. making the effective parameters more local. These features are discussed in relation to the two classical Agranovich and Ginzburg and Russakoff-Jackson formulations, and the correspondence between them is made.

12:20 : Invited talk
An integral equation method for the homogenization of periodic inhomogeneous media with complex microstructure
William James Parnell, Duncan Joyce, Raphael Assier, I. David Abrahams
University of Manchester (United Kingdom)

A new method to determine the effective properties of periodic composites is proposed, based on the integral equation form of the governing equations. For ease of illustration the scheme is presented here in the context of the two-dimensional potential problem, e.g. we determine the effective conductivity of a unidirectional fibre-reinforced composite. New, explicit formulae for effective properties are derived that are valid at arbitrary volume fraction, for general lattice configurations and for a wide range of fibre cross-sections.

10:30 - 12:15 — Coin

Session 1A5

SP12. Diffraction Grating theories as applied to nanophotonics, plasmonics and metamaterials

Organized by: Kofi Edee

Chaired by: Kofi Edee

10:30 : Invited talk
Rigorous and extremely fast electromagnetic methods for diffraction problems
Wolfgang Alexander Iff[1], Thomas Kampfe[2], Yves Jourlin[2], Alexandre V. Tishchenko[2]
[1] *Lyon University (France),* [2] *University of Lyon (France)*

There is a growing demand for and lack of ultrafast, memory sparing but rigorous light scattering calculation techniques at large planar 2D diffracting objects. Examples include diffraction in OPC and in real-time scatterometry. Our approach to these requirements is the Generalized Source Method (GSM) formulated in Fourier space and its ongoing improvement. In this conference contribution, we report on recent success by switching from CPU to GPU computations and by application of the scattering-vector (S-vector) algorithm.

10:50 : Invited talk
Efficient statistical analysis of plasmonic devices response with a stochastic collocation method
Kofi Edee, Pierre Bonnet
Clermont Universite (France)

We present an efficient numerical tool allowing to analysis the electromagnetic response of plasmonic guiding devices when some geometrical parameters of theses structures are considered as random variables characterized by a given statistical distribution low. The deterministic responses i.e. the transmitivity and the reflectivity of the devices are successfully calculated with the modal method based on a subsectionnal Gegenbauer basis functions. Then statistical moments of these observables are computed thanks to a stochastic collocation method.

11:10 : Invited talk
Full-wave approach for modeling cylindrical microresonators with aperiodic Fourier modal method
Haitao Liu, Ying Li, Hongwei Jia, Fang Bo, Guoquan Zhang, Jingjun Xu
Nankai University (China)

A full-wave approach for solving the whispering-gallery modes (WGMs) of cylindrical microresonators based on the aperiodic Fourier modal method (a-fMM) is proposed. The approach allows efficient and accurate calculations of the resonant wavelength, the quality factor, and the field of the WGMs of rotationally-symmetric resonators. The validity and the efficiency of the method are confirmed by the numerical results with microdisk and microring resonators as examples in comparison with other approaches.

11:30 : Leaky Modes and Plasmonics - The Impact of Layered Structures
Steven Brueck, Seung Chang Lee
University of New Mexico (USA)

Plasmonic structures are of great interest particularly for infrared detectors where strong enhancements 100x have been reported as compared with bare detectors. Detectors are complex layered structures including absorption, contact and possibly other layers. This layer structure can impact the plasmonic effects and give rise to leaky modes that couple energy to propagating modes in the substrate reducing the surface plasmon detectivity.

11:45 : Hypersingularity of transverse electric field at sharp edges: a case study of the simplest lamellar grating problem
Lifeng Li
Tsinghua University (China)

A lamellar grating model is set up to study hypersingularity of transverse electric field component at a sharp edge formed with lossless dielectric and metallic media. The model is the simplest possible and it allows

asymptotic expression of the final system of linear equations of an infinite number of unknowns. A detailed study of this expression may shed light on understanding numerical divergence due to hypersingularity.

12:00 : Derivation of the radiation pattern of a spheroidal particle with the Aperiodic Fourier Modal Method
Mira Abboud[1], Hassan Saleh[2], Julien Charon[3], Kofi Edee[1], Jean-Michel Geffrin[2], Jean-Francois Cornet[1], Jeremi Dauchet[1], Gerard Granet[1]
[1] *Universite Clermont Auvergne (France),* [2] *Aix Marseille University (France),* [3] *Universite Federale de Toulouse Midi-Pyrenes (France)*

A novel approach based on the Aperiodic Fourier Modal Method is presented tocompute the radiative properties of a spheroidal particle. A parametric study in which we varythe different parameters specific to the method is performed. The computed radiation patterns show good agreement with experimental data made at Fresnel Institute and with the results of the T-Matrix method.

10:30 - 12:20 — Blanca

Session 1A6

SP3. Recent Advances in Antenna Technology

Organized by: Khalid Z. Rajab

Chaired by: Khalid Z. Rajab

10:30 : Invited talk
Non-Foster Matched Reconfigurable Antenna in UHF band
Deepak S. Nagarkoti, Yang Hao, Khalid Z. Rajab
Queen Mary University of London (United Kingdom)

This paper discusses the RTD (resonant tunneling diode) based non-Foster matching with a tunable passive inductor to achieve reconfigurable, multiband and broadband performance of an ESA (electrically small antenna). A capacitive ESA exhibits high capacitance and very low radiation resistance. An RTD based capacitive negative impedance circuit is required to cancel the antenna capacitance and a tunable inductor based non-Foster based transformer circuit is used to reconfigure the operational bandwidth from 250 MHz to 2.5 GHz range.

10:50 : Simple Design Method for Dielectric-Filled Low-Sidelobe Slotted Waveguide Antennas
Mohammed Al-Husseini[1], Hilal M. El-Misilmani[2], Karim Y. Kabalan[2], Ali El-Hajj[2], Elias Nassar[3]
[1] *Lebanese Center for Studies and Research (Lebanon),* [2] *American University of Beirut (Lebanon),* [3] *Notre Dame University (Lebanon)*

A simple method for the design of dielectric-filled slotted waveguide antennas with low sidelobes is presented. Existing methods mostly deal with vacuum or air-filled SWAs and use numerical techniques or available design graphs to compute the different slots' characteristics. This presented method is based on identical slots and uses closed-form equations to compute their uniform length, longitudinal locations, and offsets from the center line. Examples are given to show the correctness of the presented method.

11:05 : Study of the Complementary Strip-Slot with Circular Geometry
Yordanis Alonso-Roque, Elena Abdo-Sanchez, Carlos Camacho-Penalosa
Universidad de Malaga (Spain)

In this contribution the study of the complementary strip-slot with circular geometry is presented. Electromagnetic simulations of the S-Parameters and radiation characteristics were carried out. A matching bandwidth of more than 175 percent was obtained, which is explained by the circuit modeling using a lattice network. The circular strip-slot has a broadside and bidirectional radiation pattern appropriate for series-fed arrays.

11:20 : Simple Design Procedure for 2D SWAs with Specified Sidelobe Levels and Inclined Coupling Slots

Hilal M. El Misilmani[1], **Mohammed Al-Husseini**[2], **Karim Y. Kabalan**[1]
[1] *American University of Beirut (Lebanon),* [2] *Lebanese Center for Studies and Research (Lebanon)*

A simple procedure for the design of two-dimensional SWA array systems with desired sidelobe level ratio (SLR) is presented. The described procedure finds the slots length, width, locations and displacements from the centerline, for each branch waveguide. For a specified number of branch waveguides, the method also finds the rotation angle of each of the coupling slots. To explain the controllable SLR, two 2D SWA array systems designed for an SLR higher than 20 dB are illustrated and compared.

11:35 : Low-Cost Transmit and Receive Reflectarray Antenna for Satellite Communications in Ka-Band
Eduardo Martinez-de-Rioja[1], **Jose A. Encinar**[2], **Rafael Florencio**[3], **Rafael R. Boix**[3]
[1] *Technical University of Madrid (Spain),* [2] *Technical University of Madrid (Spain),* [3] *University of Seville (Spain)*

This contribution describes the design of a printed reflectarray to generate a focused beam in dual polarization at 19.7 GHz and also at 29.5 GHz, which are downlink and uplink frequencies for Satcom terminal antennas in Ka-band. The proposed reflectarray allows dual-frequency and dual-polarization operation, as well as simple and low-cost manufacturing. The simulated radiation patterns for a 20-cm reflectarray show a gain better than 30 dBi in both bands, with low levels for cross-polar radiation and side lobes.

11:50 : New Ultra Wide Band antenna design with innovative materials
Houda Nadir[1], **R. Negrier**[2], **N. Essaidi**[2], **E. Martinod**[2], **N. Feix**[2], **V. Bertrand**[3], **S. Rossignol**[2], **M. Lalande**[2]
[1] *XLIM (France),* [2] *University of Limoges (France),* [3] *CISTEME (France)*

The limitation of the antenna dimensions is critical for radar applications, especially at low frequencies. We demonstrate the use of an appropriate dielectric material is an efficient way to optimize antenna behavior and to reduce its dimensions. The behavior of an antenna filled with resin intended for Ground Penetrating Radar is validated using the experimental results. We propose to develop a new dielectric material based on different test mixtures to significantly improve the material properties.

12:05 : Interesting Combinations of Phase and Group Velocities in the Transmission Line Negative Delay Metamaterials Explained by the Forward-Transmission-Matrix (FTM) Method
Omar Siddiqui
Taibah University (Saudi Arabia)

A Negative delay metamaterial (NDMM) consists of a left-handed transmission line structure periodically loaded with a parallel RLC resonator. In this paper we analyze the NDMMs by employing the Forward-Transmission-Matrix (FTM) technique. It has been shown that the NDMMs demonstrate several interesting combinations of phase and group velocities. In time domain, the propagation behavior is shown by Gaussian pulse propagation simulations.

Lunch and Exhibit Inspection

12:30 - 13:30

Session 1P1

Poster session I

13:30 - 14:15

P1: Diffraction by a lossless dielectric wedge on a ground plane: time domain formulas
Marcello Frongillo[1], **Gianluca Gennarelli**[2], **Giovanni Riccio**[1]
[1] *University of Salerno (Italy),* [2] *I.R.E.A.-C.N.R. (Italy)*

Easy to handle expressions are proposed for evaluating the time domain diffraction coefficients associated to plane waves impacting a structure consisting of a tapered lossless dielectric wedge on a perfectly conducting surface. They are determined by applying the inverse Laplace transform to the Uniform Asymptotic Physical Optics diffraction coefficients in the frequency domain. No closed form solutions exist for the considered time domain problem.

P2: Physico-Chemical study of the Electrically Degraded Silicone

Nacera Rouha, Djenkel Kaissa, Kettir Khallil
Universite A. MIRA de Bejaia (Algeria)

We investigate the electrical aging phenomenon of Silicone coated insulators. Accelerated testing under alternating 50 Hz homogeneous electrical field, were conducted on both polluted and clean silicone. The permittivity and the loss index are measured before and after aging produced by a series of surfacic breakdown. Then the samples were chemically analyzed using a SEM, an FTIR and an XRD. Phases modification of the insulating material were observed, resulting in the alteration of its dielectric properties.

P3: In situ permittivity measurements using stand-alone end effect probe

Francois Demontoux, Gilles Ruffie, Fabrice Bonnaudin
Bordeaux University (France)

Numerous applications using microwave frequency behavior of materials (remote sensing, non-destructive analysis) are strongly dependent on the material permittivity. Thus, permittivity is a key parameter to develop algorithms for the retrieval of materials properties from remote sensing data. Permittivity measurements are generally carried out in laboratory because in-situ measurements are more difficult to obtain. This study deals with the development at IMS laboratory of an in situ dielectric measurement system based on a stand-alone end effect probe.

P4: Bio-inspired inversion method for the retrieval of the frequency-dependent permittivities of natural multilayer materials

Demetrio Macias[1], Diana C. Skigin[2], Marina E. Inchaussandague[2], Alexandre Vial[3]
[1] *Universite de Technologie de Troyes (France),* [2] *Universidad de Buenos Aires (Argentina),* [3] *Universite de technologie de Troyes (France)*

In this contribution we enhance the capabilities of our bio-inspired inversion method to retrieve the dielectric frequency-dependent permittivity of the layers that compose a biological structure. For this, we incorporate a statistical processing stage to reliably establish confidence intervals and uncertainties related to the retrieved parameters. Also, we employ a dispersion model to realistically describe the optical properties of materials involved. Ultimately, we evaluate, through some examples, the robustness of the inversion scheme in the presence of noise.

P5: Sintering temperature and iso-valent dopant effects on microstructural and dielectric properties of La0.01(Ba1-xCax)0.99Ti0.9975O3 ceramic

Lhoussain Kadira[1], Abdelilah Elmesbahi[2], Salaheddine Sayouri[3]
[1] *CRMEF (Morocco),* [2] *FST (Morocco),* [3] *Faculty of Science Dhar Mahraz (Morocco)*

Ca-doped Lanthanum barium titanate La0.01Ba0.99Ti0.9975O3 ceramics powders were prepared by sol-gel process . Sintering of pressed powders was performed at 1150 C, 1250 C and 1300 C for 4 hours. Microstructure morphology was analyzed using Scanning Electron Microscopy (SEM), and the grain size of the samples was estimated. Dielectric measurements were carried out with an impedance-analyzer in the temperature range from room temperature (RT) to 250 C, and for frequencies ranging from 100Hz to 1MHz.

P6: Toxic Effects of X-Rays and Frequency Heterodyning

Sara Liyuba Vesely, Sibilla Renata Dolci
ITB-CNR (Italy)

The toxicity of X-rays remained hidden during the short period of time in which this method of analysis established itself both in medicine, where it extended diagnostic capabilities, and in physics, where it unlocked the possibility to extend investigations of the structure of matter from microscopy down to the atomic scale. Enhanced X-ray generation may allow to link up electromagnetic received signals in that frequency range with hazards from X-ray exposure.

P7: Analyzing the properties of quantized electromagnetic waves in time-varying media

Jeong Ryeol Choi
Daegu Health College (Korea)

The field quantization in time-varying media is fulfilled via complex classical solutions in this research. The characteristics of the quantized electromagnetic fields are analyzed in detail through the results of such quantization scheme.

P8: Electromagnetic Field Visualization with Jefimenko's Equations

Brandon Gore[1], **Peng Ye**[2], **Paul Huray**[3]
[1] *Intel Corporation (USA),* [2] *Oracle Corporation (USA),* [3] *University of South Carolina (USA)*

Jefimenko's Equations are one set of the analytical equations that can be used to solve electromagnetic fields. Jefimenko's Equations address the time retardation of electromagnetic fields due to the finite propagation velocity. This paper presents intermediate results of the authors' study of electromagnetic fields and their propagation using Jefimenko's equations. This study also shows a visual view of how electromagnetic fields near a simple transmission line propagate at 10GHz and 100GHz.

P9: Identification of the electromagnetic scattering by dynamic sea surfaces with a stochastic differential equation model

Arnaud Coatanhay, Alexandre Baussard
ENSTA-Bretagne (France)

This paper presents a Nonlinear Stochastic Differential Equation System (NLSDES) that can be used to model the electromagnetic scattering by time-varying sea surfaces. More precisely, we show how to identify the parameters of this generic stochastic model with the numerical simulations computed for different sea states.

P10: Competition between the antiferomagnetic phase and the superconducting state in undoped BaFe2-xNixAs2 (RF measurements)

Abdellatif Abbassi[1], **M. Saint-Paul**[2], **C. Guttin**[2], **M. R. Britel**[1], **Rachid Dkiouak**[1], **Zhao-Sheng Wan**[2], **Huinqian Luo**[3], **Xingye Lu**[3]
[1] *Universite Abdelmalek Essaidi (Morocco),* [2] *Universite Grenoble Alpes (France),* [3] *Chinese Academy of Sciences (China)*

Strong anomalies are observed along antiferromagnetic phase before reaching the superconducting state. The succession of variations in these two phases, confirms their competition.Drude type conductivity yields reactance X and resistance R differ from each other.The increase of the real conductivity in the superconducting state is attributed to a rapid decrease of the quasiparticle scattering time. This result give evidence of the coexistence and competition of the superconductivity and antiferromagnetism in the underdoped iron superconductors.

P11: Inverse Scattering in a Multipath Environment

Antonio Cuccaro, Raffaele Solimene
Seconda Universita degli Studi di Napoli (Italy)

Inverse scattering problem is addressed in a multipath environment. In particular,here the multipath is due to known extra point-like scatterers deployed between the sceneunder investigation and the source/measurement domains. By adopting as imaging procedurethe BACK-PROJECTION scheme, it is shown as the performance achievable change with the passive elements compared to the free-space.

P12: A scheme to homogenize anisotropic metamaterials with elliptical inclusions

Xiujuan Zhang[1], **Ying Wu**[2]
[1] *King Abdullah University of Science and Technology (Saudi Arabia),* [2] *King Abdullah University of Science and Engineering (Saudi Arabia)*

We report a scheme, based on coherent potential approximation, to homogenize a type of metamaterial with elliptical inclusions beyond the long-wavelength limit. It offers an analytic solution to the anisotropic effective medium parameters. The theory serves as a tool in the design of new metamaterials. Here we present two examples, one can control energy flux arbitrarily and the other can perfectly absorb oblique incidence coherent waves.

P13: Two-stage reconstruction of complex dielectric permittivity and magnetic permeability for biomedical microwave imaging employing magnetic contrast agents

Cameron Kaye, Ian Jeffrey, Joe Lovetri
University of Manitoba (Canada)

An implementation of the Contrast Source Inversion algorithm employing the discontinuous Galerkin method has been modified to produce quantitative 2D images of both the dielectric permittivity and magnetic permeability of synthetic contrast-enhanced breast models. These numerical models contain breast tumours embedded with simulated accumulations of magnetic nanoparticles (MNP). A brief description of a two-stage methodology for contrast-enhanced microwave imaging along with an example reconstruction of synthetic

data is provided.

P14: Comparison between different decorrelation techniques in vital sign detection
Angela Dell'Aversano, Andrea Natale, Raffaele Solimene
Second University of Naples (Italy)

The problem of detecting the breath activities of a human subject located beyond a wall is addressed. A CW signal is used to probe the scene and MUSIC algorithm is exploited to detect frequency doppler modulation introduced by the chest movements. For this particular measurement configuration, the correlation matrix result rank deficient. In order to restore the rank, three decorrelation techniques are compared on numerical and experimental data.

P15: Optical investigations of the quality and optical processes of photonic and plasmonic nanostructures
Roman Antos[1], Martin Veis[1], Lukas Beran[1], Karel Palka[2], Jan Mistrik[2], Petr Janicek[2], Miroslav Vlcek[2]
[1] *Institute of Physics Charles University of Prague (Czech Republic),* [2] *University of Pardubice (Czech Republic)*

Optical scatterometry based on spectroscopic ellipsometry and other measurement techniques together with optical simualtions are used to analyze the quality of various nanostructure patterns and to study the optical behavior of selected photonic and plasmonic devices.

P16: Frequency and magnetic field dependence of the skin depth in Fe- and Co-rich soft magnetic microwires
Arkady Zhukov[1], Mihail Ipatov[2], Ahmed Talaat[2], Valentina Zhukova[2]
[1] *Universidad del Pais Vasco (Spain),* [2] *UPV/EHU (Spain)*

We studied giant magnetoimpedance (GMI) effect in magnetically soft amorphous Fe and Co-rich microwires in the extended frequency range. From obtained experimentally dependences of GMI ratio on magnetic field and different frequencies we estimated the penetration depth and its dependence on applied magnetic field and frequency.

P17: Emergence of classicality from initial quantum world for dissipative optical waves
Jeong Ryeol Choi
Daegu Health College (Korea)

For light waves propagating in dissipative media, the emergence of classical characteristics from the initial quantum world is investigated. Two classicality measures of the system, which are the measure of the degree of (relative) classical correlation and that of the degree of quantum decoherence, are analyzed. We also investigated absolute classical correlations for the light in dissipative media.

P18: Accuracy of Norton Approximation Formulas for the Radiation of an Electric Current Element over a Homogeneous Ground
Julien Vincent[1], Pierre Borderies[2], Vincent Gobin[2], Martin Lelong[2], Jean-Rene Poirier[2]
[1] *Universite de Toulouse (France),* [2] *Universite Clermont II (France)*

In this paper the problem of the radiation of an electric current element above a homogeneous infinite flat ground is solved with an adaptive algorithm to compute the numerical integration. This method ensures to obtain the correct values of all components of the electromagnetic field with a controlled accuracy. These values, computed in different scenes, are considered as references to analyse the approximation error in the propagation theory of Norton.

P19: Broadband TE10 to TE20 Mode Transformer for X Band
Davide Passi, Alberto Leggieri, Rocco Citroni, Franco Di Paolo
University of Rome Tor Vergata (Italy)

This paper deals with a broadband TE10 to TE20 mode transformer in a WR90 rectangular waveguide with more than 35 dB suppression of the fundamental mode and only 0.4 dB of maximum transformation loss. It employes two fin lines with appropriate configuration in order to obtain a broadband mode transformation.

P20: Theoretical analysis of ferromagnetic bilayer structures for realization of stop bands in spin wave transmission spectrum
Jose Roberto Fragoso, Daniel Matatagui, Oleg Kolokoltsev

Universidad Nacional Autonoma de Mexico (Mexico)

A novel mechanism for obtaining the band-stop zones in a microwave frequency region based on a bilayer ferromagnetic structure was theoretically evaluated by the magnetostatic approximation, for magnetostatic surface waves (MSSW) propagating along two-layer thin-film structure. The analysis has revealed spatial evolution and periodical redistribution of MSSW energy in the waveguide system. Energy exchange periodicity was used for suppression of MSSW propagation within a narrow microwave frequency regions.

P21: Automatic finite element Tool for the Error Estimation of the Probe trajectory in Eddy Current NDT of Steam Generator Tubes
Laurent Santandrea
Group of Electrical Engineering-Paris (GEEPS-CNRS) (France)

Finite Element Method (FEM) are one of the most popular approach for the simulation of Eddy Current (EC) Non-Destructive Testing problems. Modeling tool can provide information for design and characterization of EC probes. Particularly, they prove useful to evaluate the influence of the probe mispositioning on the measurement. In this work, we propose an automatic finite element tool DOLMEN dedicated to this kind of problem. Simulation of the effect the trajectory of a non axial ferrite core probe during the inspection of a steam generator tube with a diameter variation is presented using the Dolmen code.

P22: Performance Evaluation of Conventional and Planar Feeds in Resonant Cavity Antennas
Arslan kiyani, Raheel M. Hashmi, Karu P. Esselle
Macquarie University (Australia)

A simple and planar feeding approach is evaluated for use in wideband Resonant Cavity Antennas (RCAs). Boresight directivity performance of the planar (aperture-coupled dual slot) and a conventional feeding technique (waveguide-fed slot) are investigated by placing each under an unprinted all-dielectric single-layer superstrate with transverse permittivity in lateral dimensions.

P23: Bounds on Eddy Current Losses Estimate for Soft Magnetic Composites
Xiaotao Ren, Romain Corcolle, Laurent Daniel
GeePs-CentraleSupelec (France)

Upper and lower bounds for eddy current losses in Soft Magnetic Composites (SMC) treated as a periodic pattern of circular fibers inside a matrix are analytically deduced. The model is validated using numerical simulations. The bounds are found to apply to 3D SMC with spherical inclusions.

14:15 - 15:35 — Alhaurin

Session 1A7

SP13. Reliability and failures in electronic devices

Organized by: Farid Temcamani and Hichame Maanane

Chaired by: Farid Temcamani and Hichame Maanane

14:15 : Invited talk
Reliability study of mechatronic power components using spectral photon emission microscopy
Niemat Moultif, Eric Joubert, Olivier Latry
University of Rouen (France)

In this paper, we present one of the most important failure analysis tools that permits the localizing and the identification of the failure mechanisms. It is a new spectral photon emission system, enabling to localize the failure and quickly get the photon emission spectra that characterize the failure with high resolution. A diffraction grating is used as a spectrometer in the system. Application results on mechatronic power devices such as HEMT AlGaN/GAN and SiC MOSFETs are reported.

14:35 : Invited talk
Thermal Management of GaN Electronics

James Pomeroy, Martin Kuball
University of Bristol (United Kingdom)

Gallium nitride based transistors are a disruptive technology in high-power RF and power conversion applications. Maintaining device temperatures within a safe operating area is critically important to ensure reliable long term operation, although this becomes ever more challenging as increasing power densities are required. We review recent developments in thermal management, from understanding where heat is generated during different modes of transistor operation (DC versus RF), to near junction thermal management strategies, including high thermal conductivity diamond substrates.

14:55 : Invited talk
Overview on Zener diode pulsed EOS characterization
Feiyi Zhu [1], Francois Fouquet[1], Blaise Ravelo[1], Bernadette Domenges[2], Moncef Kadi[3]
[1] *IRSEEM/ESIGELEC (France),* [2] *Lamips/CNRS - Presto Engineering (France),* [3] *ESIGELEC/IRSEEM (France)*

The electrical overstress (EOS) is assumed as one of misinterpreted electrical phenomena susceptible to degrade electronic components. This paper deals with the failure analysis of a Zener diode under EOS. The experimentation enabling to investigate the tested component EOS signature with typically ms-duration square wave voltage pulse is described. Based on the transient responses of the stressed diode, the predictive model reproducing the degradation mechanism is presented.

15:15 : Invited talk
Measuring and Improving Reliability in Today's Consumer Electronics Industry
Martin Shaw
MD reliability solutions (United Kingdom)

Understanding and predicting Reliability in the fast moving consumer electronics industry is becoming more and more difficult, while pressure is increasing to maintain low warranty failure costs while developing new products in very short design cycles. The old approach of concentrating purely on Parts Count / Stress, Design Reliability and Design Margin simply do not protect the manufacturer from possible excessive warranty costs. Increased focus on Early Life Reliability testing and assessment is now more critical than ever.

14:15 - 16:15 — Coin

Session 1A8

SP15. Computational Techniques for Plasmonics, metamaterial and Graphene

Organized by: Salah Obayya and Mohamed Swillam

Chaired by: Salah Obayya and Mohamed Swillam

14:15 : Invited talk
A Surface Integral Equation Solver for Transient Analysis of Graphene Devices
Yifei Shi[1], Ping Li[2], Ismail Enes Uysal[1], Huseyin Arda Ulku[2], Hakan Bagci[1]
[1] *King Abdullah University of Science and Technology (Saudi Arabia),* [2] *King Abdullah University of Science and Technology (Saudi Arabia)*

A surface integral equation solver for analyzing transient electromagnetic wave interactions on composite graphene-based devices is described. The time domain resistive boundary condition (TD-RBC) and the Poggio-Miller-Chang-Harrington-Wu-Tsai (TD-PMCHWT) integral equation, which are enforced on the surfaces of the graphene and dielectric substrates, respectively, are discretized using the well-known marching-on-in-time (MOT) scheme. The expressions of the time domain resistivity and conductivity of the graphene sheet are obtained analytically from the intra-band contribution formulated in frequency domain.

14:35 : Invited talk
Time Domain Modelling of Parity-Time Symmetric Structure with Dispersive Gain/Loss
Sendy Phang, Ana Vukovic, Stephen Creagh, Gabriele Gradoni, Phillip Sewell, Trevor Mark Benson

University of Nottingham (United Kingdom)

A time-domain method based on the Transmission-Line Modelling (TLM) method is developed with an homogeneously broadened dispersion gain/loss material profile. It is used to model Parity-Time (PT) symmetric structures such as Bragg gratings and coupled cylindrical resonators. Different applications of interest, such as a memory device and a laser in a loss-dominated structure, are studied. Results show that if the disperison of gain/loss is considered then PT-symmetry can only be acheived at a single frequency.

14:55 : Invited talk
Efficient Wideband Adjoint Sensitivity Analysis of Dispersive Structures using FDTD
Mohamed Bakr[1], Yu Zhang[1], Osman Ahmed[2]
[1] *McMaster University (Canada),* [2] *Lear Corporation (USA)*

We review in this paper efficient approaches for wideband sensitivity analysis of dispersive electromagnetic structures using FDTD. We show that to estimate the sensitivities of the desired response over the band of interest relative to all material and geometrical parameters, only one extra adjoint simulation is needed. This can be contrasted with the 2n extra simulations required to estimate the gradient using the accurate central finite difference (CFD) approaches, where n is the number of parameters.

15:15 : Sensitivity analysis for photonic crystal microcavities
Zhen Hu[1], Ya Yan Lu[2]
[1] *Hohai University (China),* [2] *City University of Hong Kong (Hong Kong)*

We develop an efficient sensitivity analysis technique to analyze two-dimensional (2D) photonic crystal (PhC) microcavities. By using the Dirichlet-to-Neumann (DtN) map method, the resonant frequencies of the PhC microcavities could be written as an implicit function of the design parameters. Then the partial derivatives of the resonant frequencies with respect to the design parameters could be calculated. Based on this technique, we can predict the resonant frequencies and the peak frequencies of the transmission spectra.

15:30 : Pseudospectral modal method for analyzing bent waveguides
Dawei Song, Ya Yan Lu
Nanjing University of Aeronautics and Astronautics (China)

The pseudospectral modal method (PSMM) is mode expansion method based onsolving the one-dimensional modes numerically using the Chebyshev pseudospectral method. Itwas originally developed for analyzing diffraction gratings, later reformulated as a waveguidemode solver. The method is capable of producing very accurate solutions. In this paper, thePSMM is further extended as a mode solver for bent waveguides.

15:45 : Novel Design of High Directivity Hybrid Yagi-Uda Antenna
AbdelRahman Ghanim[1], Mohamed Hussein[1], Mohamed Farhat[2], O. Hameed[3], Ashraf Yahia[1], Salah Obayya[3]
[1] *Ain Shams University (Egypt),* [2] *Mansoura University (Egypt),* [3] *Zewail City of Science and Technology (Egypt)*

In this paper, a novel design of broadband optical antenna with high directivity is introduced and analyzed using finite integration method (FIT). The proposed design consists of cylindrical nanoantenna with silver core surrounded by silicon cladding. The different geometrical parameters have been tuned to maximize the directivity. The proposed design offers high directivity of 14.8 which exceeds those of silicon nanospheres counterparts of directivity 12 with enhancement of 23 percent at wavelength of 500 nm.

16:00 : Novel Wide Band Smoothed Finite Element Time Domain Analysis of Resonant modes in Photonic Bandgap Cavities
Khaled S. R. Atia, Ahmed M. Heikal, Salah S. Obayya Koshelev
Zewail City of Science and Technology (Egypt)

This paper aims to develop novel smoothed finite element method (SFEM) for the analysis of photonic bandgap cavities though the application of the imaginary time beam propagation technique. The imaginary time beam propagation formula is also extended to include wide-band optical pulses. A 5x5 photonic bandgap cavity is simulated to test the performance of the proposed method.

14:15 - 15:35 — Blanca

Session 1A9

SP11. Silicon photonic devices and integration

Organized by: Linjie Zhou

Chaired by: Linjie Zhou

14:15 : Invited talk

Demonstration of integrated optical matrix-vector multiplier based on two-dimensional silicon micro-ring resonator array

Lei Zhang, Hao Jia, Jianfeng Ding, Lin Yang
Chinese Academy of Sciences (China)

We report the proposal and demonstration of an integrated optical matrix-vector multiplier. We introduce the principle and show the advantages compared with its free-space counterpart. We present the latest experimental results and evaluate the limit of performance.

14:35 : Invited talk

Fano resonance photonic crystal Si membrane photonics

Weidong Zhou[1], Deyin Zhao[1], Hongjun Yang[1], Zhenqiang Ma[2], Mattias Hammar[3]
[1] *University of Texas at Arlington (USA),* [2] *University of Wisconsin-Madison (USA),* [3] *KTH-Royal Institute of Technology (Sweden)*

We review surface-normal Fano resonance photonic crystal membrane photonic devices based on heterogeneously integrated crystalline semiconductor nanomembranes on both Silicon and flexible substrates. Devices to be reviewed include two types of photonic crystal surface emitting membrane lasers on silicon substrates, close to unity absorption from monolayer graphene based on critically coupled photonic crystal cavities, and multi-band multi-color imaging arrays.

14:55 : Invited talk

Chirp-free silicon ring optical modulator with a dual-ring push-pull coupler

Xiaomeng Sun[1], Linjie Zhou[2], Lars Zimmermann[1], Klaus Petermann[1]
[1] *Technische Universitat Berlin (Germany),* [2] *Shanghai Jiao Tong University (China)*

We present a novel design of chirp-free silicon ring optical modulator. A parallel dual-ring coupler structure is introduced to control the coupling between the silicon ring resonator and the input bus waveguide. The push-pull drive of the coupler can suppress the frequency chirp of the modulated signal.

15:15 : Invited talk

Novel Application and Design for Silicon Photonic Devices

Xiaoping Liu, Minghui Lu, Yanfeng Chen
Nanjing University (China)

After decades of development, silicon photonic platform is becoming one of the most influential platforms for exploring novel concepts of photonic applications and device designs. In this talk, we will fist present an investigation of parity-time symmetry Bloch oscillations (BO) on a silicon photonic lattice and present an object oriented device design for various integrated photonic devices. In particular, we show that novel, high performance ultra-compact waveguide crossing and mode converter are possible.

Coffee Break and Exhibit Inspection

16:00 - 16:30

16:30 - 17:20 — Alhaurin

Session 1A10

SP13. Reliability and failures in electronic devices

Organized by: Farid Temcamani and Hichame Maanane

Chaired by: Farid Temcamani and Hichame Maanane

16:30 : Invited talk
GaN heterostructures for next generation of highly robust RF power electronics: from growth design to devices
E. Dogmus, A. Linge, M. Zegaoui, Farid Medjdoub
IEMN (France)

We report on a novel ultrathin high polarization AlN/GaN heterostructure for millimeter-wave applications that allows achieving unique combination of high performance and high robustness. A key feature has been the implementation of a thick in-situ SiN cap layer. A full description from growth design to major electrical data with respect to device reliability will be provided in the presentation.

16:50 : Reliability and Failure Analysis of UHF-RFID Tags for Harsh Environments Applications
Sanae Taoufik[1], Ahmed El Oualkadi[1], Pascal Dherbecourt[2], Farid Temcamani[3], Bruno Delacressonniere[3]
[1]Abdelmalek Essaadi University (Morocco), [2]University of Rouen (France), [3]National School of Electronics and its Applications (France)

In this work we have chosen to study the high temperature effect on the performance of passive UHF-RFID system. Therefore, a measurement bench was developed, and a thermal storage testing at various extreme temperatures (140 C, 160 C and 180 C) were made.

17:05 : Simulation of Upset of Electronic Systems from Intentional Electromagnetic Interference
R. L. Gardner
Consultant (USA)

Upset of electronic systems systems is a failure in the function of the system due to a tailored illumination of the system. Upset is difficult to simulate because it involves a complex interaction of the circuits and systems at threat current and voltage levels that are similar to the operating levels and frequencies of the electronics controlling the systems. This paper will demonstrate simulation of a number of interesting responses and system failure modes caused by tailored illumination. The simulations begin with a study of a number of interesting nonlinear, potentially chaotic circuits and their response to stimuli and concludes with a simulation of a mechanical system controlled by an electronic circuit.

17:20 - 18:30 — Alhaurin

Session 1A11

SP9. Photonics, Optics and Laser Technology

Organized by: Erik S. Lotfi

Chaired by: Erik S. Lotfi

17:20 : Invited talk
Novel platform for Optical Modulation Using Silicon Photonics
Mohamed Swillam
The American University of Cairo (Egypt)

We propose novel platform for integrated sensing and modulations using silicon nanowires. The nanowires can be easily fabricated using metal assisted chemical etching (MACE). The dimensions of these nanowires can be easily controlled using the time and temperature of the etching process.

17:40 : Analysis of Optical Properties of Nanowires Using Surface Integral Equations and the Multilevel Fast Multipole Algorithm
Akif Yilmaz, Bariscan Karaosmanoglu, Ozgur Ergul
Middle East Technical University (Turkey)

We present fast and accurate analysis of nanowires at optical frequencies. Plasmonic properties are investigated via the Lorentz-Drude model, where the metals are considered as penetrable bodies with negative permittivity values. Surface integral equations are used to formulate scattering and transmission problems, while strongly negative permittivity values bring computational challenges. MLFMA is employed for accelerating numerical solutions, where quickly decaying interactions are dropped for improving the efficiency. Numerical examples are presented to demonstrate the capabilities of the developed implementation.

17:55 : Optical Attenuators with Translational Risley Prisms
Virgil-Florin Duma
Aurel Vlaicu University of Arad (Romania)

We study the three possible configurations of optical attenuators with translational Risley prisms. Their relevant parameters are obtained and compared: minimum transmission coefficient, attenuation range and interval, and sensitivity. The variant with two identical, symmetrically moving prisms is demonstrated to be the best one. Its designing calculus is developed and the parameters which provide the highest parameters are determined.

18:10 : Invited talk
Plasma technology for industrial wastewater treatment and hydrogen production
Erik S. Lotfi
Qatar University (Qatar)

This study aims to review the previous research work taken towards this technology for the treatment of wastewater and hydrogen production that could guide for creating a new system that combines the two applications for the reduction of the consumed energy. The study will undertake all the related previous work in order to discuss the feasibility of the new proposed system for its application in the industrial scale.

16:30 - 16:50 — Coin

Session 1A12

SP11. Silicon photonic devices and integration

Organized by: Linjie Zhou

Chaired by: Linjie Zhou

16:30 : Invited talk
Low-voltage monolithic silicon optical modulators for high-capacity optical-fiber communications
Kensuke Ogawa
Fujikura Ltd. (Japan)

The paper describes monolithic silicon modulators having high-efficiency vertical PN-junction rib-waveguide phase shifters in the light of energy-efficient small-footprint modulators for high-capacity optical fiber communications. Characteristics of intensity modulation and phase modulation using the monolithic silicon modulators are reviewed.

17:05 - 19:05 — Coin

Session 1A13

SP5. Absoprtion and emission of electromagnetic radiation in 2D layered materials

Organized by: Mohamed Boutchich and Bruno Gallas

Chaired by: Mohamed Boutchich and Bruno Gallas

17:05 : Invited talk
Growth and applications of 2D materials in electron emitters and renewable energy
Daniel H. C. Chua
National University of Singapore (Singapore)

Pulsed laser deposition has been widely known for its ability to deposit high quality carbon films and is used to deposit graphene at relatively low temperatures of 700 C. One application of this is in the fabrication of electron emitters. In addition, other 2D materials such as MoS2 has been successfully demonstrated for applications in Li-air and other batteries.

17:25 : Invited talk
Spatio-temporal observation of photogenerated electron dynamics in twisted graphene
Keiki Fukumoto[1], M. Boutchich[2], H. Arezki[2], K. Sakurai[3], K. Onda[3], S. Koshihara[3]
[1] *High Energy Accelerator Research Organization (Japan),* [2] *University Paris-Sud (France),* [3] *Tokyo Institute of Technology (Japan)*

Graphene is one of the most studied 2D materials. However, the ultrafast carrier dynamics influenced by the crystallographic structures is not well studied, because of the instrumental limitations. Locally different twisting angle between graphene layers was detected by Raman spectro-microscopy. Photogenerated carrier lifetimes in these selected regions were estimated by time-resolved photoemission electron microscopy with 100 nm spatial and 100 fs temporal resolutions. We concluded that the interaction between layers and to the substrate influence the optoelectronic properties.

17:45 : Invited talk
Nanoscale Terahertz Sensing and Imaging with Graphene and Arrayed Carbon Nanotubes
Yukio Kawano
Tokyo Institute of Technology (Japan)

My talk will explain novel terahertz sensing and imaging technologies based on graphene and carbon nanotube devices, and their applications to materials and devices characterization.

18:05 : Invited talk
Strongly Coupled Graphene-Metamaterial Hybrids
Isaac Luxmoore[1], Peter Liu[2], Sergey Mikhailov[3], Nadya Savostiyanova[3], Federico Valmorra[2], Penglei Li[1], Jerome Faist[2], Geoff Nash[1]
[1] *University of Exeter (United Kingdom),* [2] *ETH Zurich (Switzerland),* [3] *University of Augsburg (Germany)*

We introduce hybrid metamaterials consisting of split ring resonators and a graphene nanoribbon array and demonstrate their use for both modulation and integrated detection of electromagnetic radiation.

18:25 : Invited talk
Coherent absorption of N00N states
Thomas Roger[1], S. Restuccia[2], A. Lyons[1], D. Giovannini[2], J. Romero[2], J. Jeffers[3], M. Padgett[2], D. Faccio[1]
[1] *Heriot-Watt University (United Kingdom),* [2] *University of Glasgow (United Kingdom),* [3] *University of Strathclyde (United Kingdom)*

We experimentally investigate N00N state coherent absorption in a multilayer graphene film and show that coherent absorption may be used to selectively choose whether the sample undergoes one-photon or two-photon absorption.

18:45 : Invited talk
Generation and detection of light in 2D materials and heterostructures

Thomas Mueller
Vienna University of Technology (Austria)

Two-dimensional (2D) materials are currently receiving a lot of attention for applications in optoelectronics. In this talk, I will review our research activities on electrically driven light emission and photodetection in 2D materials and van der Waals heterostructures. In particular, I will present studies of electroluminescence from MoS2 and WSe2 monolayers and their heterojunctions. Further, I will discuss photoconductivity studies of 2D semiconductors, in which we find strong photoconductive gain.

16:30 - 17:50 — Blanca

Session 1A14

SP16. Recent Advances in Optical Micro-cavities

Organized by: Wenjie Wan and Harald Schwefel

Chaired by: Wenjie Wan and Harald Schwefel

16:30 : Invited talk
Phase matched SHG in an on-chip crystalline microresonator
Jintian Lin[1], Yingxin Xu[2], Zhiwei Fang[1], Min Wang[1], Wei Fang[2], Y. Cheng[3]
[1] *SIOM (China),* [2] *Zhejiang University (China),* [3] *Shanghai Institute of Optics and Fine Mechanics (China)*

We demonstrate phase matched SHG in an on-chip lithium niobate (LN) microresonator fabricated by femtosecond laser direct writing followed by focused ion beam milling. We achieve a normalized conversion efficiency of 1.1x10-3/mW in the LN microdisk with a diameter of 100 micron.

16:50 : Invited talk
Electro-opical modulator with 0.1 percent quantum efficiency
Alfredo R. Rueda Sanchez[1], Florian Sedlmeir[1], Harald G. L. Schwefel[2]
[1] *University Erlangen-Nuernberg (Germany),* [2] *University of Otago (New Zealand)*

Conversion of microwave qubits into the optical regime is one of the next big steps in quantum information technology. It provides the link between electronic quantum devices via low-loss optical telecommunication networks. We present a novel system for coherent frequency upconversion of weak microwave signals to the telecom band based on the electro-optical effect using a high quality crystalline WGM-resonator coupled to a 3D microwave cavity, achieving high photon conversion efficiency of 0.1 percent with MHz bandwidth at room temperature.

17:10 : Invited talk
Electrically tunable silicon dual-ring assisted Mach-Zehnder interferometer switches
Linjie Zhou, Liangjun Lu, Shuoyi Zhao, Jianping Chen
Shanghai JiaoTong University (China)

We report our recent progress on 16X16 optical switches based on dual-ring assisted Mach-Zehnder interferometers. TiN microheaters and p-i-n diodes are integrated in microring resonators for thermo-optic phase correction and electro-optic switching, respectively. Optical signal can be routed from an input port to any output port with low power consumption.

17:30 : Invited talk
High-Q Micro/Nanoresonators for Nonlinear/Quantum Photonics and Sensing
Qiang Lin
University of Rochester (USA)

In this talk, we will discuss our recent progress in developing high-quality micro/nanoresonators on material platforms such as silicon, silicon carbide, and lithium niobate, whose outstanding material properties exhibit great potential for broad photonic applications. We will focus on our recent efforts in applying them for nonlinear and quantum photonics, and for sensing applications.

17:50 - 18:50 — Blanca

Session 1A15

SP10. Recent progresses for EMC applications: numerical and experimental tools

Organized by: Sébastien Lalléchère and Jérôme Rossignol

Chaired by: Sébastien Lalléchère and Jérôme Rossignol

17:50 : Invited talk

Optimization of EMC shielding procedures by means of statistical re-sampling: from mean trends to reliability assessments

Sebastien Lallechere[1], Chaouki Kasmi[2], Jose Lopes-Esteves[2], Sebastien Girard[1], Pierre Bonnet[1], Francoise Paladian[1]

[1] *Universite Blaise Pascal (France),* [2] *ANSSI, Wireless Security Lab (France)*

This proposal aims to demonstrate the benefit that could be expected from re-sampling methods for electromagnetic compatibility (EMC) test cases subject to random variations. Based upon Monte Carlo simulations, the use of bootstrap-like approaches will provide optimized confidence levels for stochastic assessments. Based upon statistical assumptions, the optimization process is validated and quantified in view of electromagnetic field-to-wire coupling inside EMC enclosure.

18:10 : Invited talk

Kapton-based 1x2 passive antenna array physical parameters sensitivity analysis

Y. G. Rabobason, Blaise Ravelo, N. Benjelloun

IRSEEM-ESIGELEC (France)

This paper describes a multivariable sensitivity analysis of the Kapton-based flexible antenna. The analysis is focused on the 1x2 antenna array using Tee-power divider. The reflection loss variation versus the substrate and the microstrip antenna physical parameters varied randomly with +/-5 percent standard deviation under 20 trials is performed with Monte Carlo (MC) analysis. The performed MC trials quantify the combined effects due to the antenna length and width associated with the Kapton substrate relative permittivity.

18:30 : Invited talk

Microwave microscopy: Effect of material deposition on the distributions of E/H-fields in the vicinity of electronic circuits

Jerome Rossignol[1], Didier Stuerga[1], Guillaume Bailly[1], Valentin Colin[1], Jordan Dufresne[1], Sebastien Lallechere[1], Sebastien Girard[2]

[1] *UBFC (France),* [2] *UBP (France)*

This proposal is devoted to a collaborative approach dealing with microwave microscopy experiments. The application is dedicated to electromagnetic field cartography above circuits and the influence of nanometric material layer deposition on the circuits. The first application is associated to microstrip circuits. The results are in agreement with the simulated fields. The second application is focused on the effects of a dielectric layer deposited on the circuit and its impact in terms of electric modes propagation and shielding effectiveness.

Wednesday 27th July, 2016

08:00 - 09:20 — Nerja

Session 2A1

SP12. Diffraction Grating theories as applied to nanophotonics, plasmonics and metamaterials

Organized by: Kofi Edee

Chaired by: Kofi Edee

08:00 : Invited talk
Modal analysis of V-groove plasmonic waveguides
Gerard Granet
Universite Clermont II (France)

An original modal method is derived for the analysis of V-groove plasmonic wave-guides. The problem is formulated with Maxwell's equations written under the covariant form and matched coordinates. The numerical solution is obtained by using the method of moments and sub-domain basis funtions.

08:20 : Invited talk
Casimir Interaction between a sphere and a grating
Mauro Antezza[1], Riccardo Messina[1], Paulo Maia Neto[2], Brahim Guizal[1]
[1] *Universite de Montpellier (France),* [2] *Universidade Federal do Rio de Janeiro (Brazil)*

We derive the explicit expression for the Casimir energy between a sphere and a 1D grating under thermal equilibrium, in terms of the sphere and grating reflection matrices, and valid for arbitrary materials, sphere radius, and grating geometric parameters.

08:40 : Invited talk
On the stability of modal methods when dealing with lamellar structures with extreme filling ratios
Brahim Guizal[1], Maha Ben Rhouma[2], Kofi Edee[3]
[1] *Universite de Montpellier (France),* [2] *Universite de Tunis El Manar (Tunisia),* [3] *Universite Blaise Pascal (France)*

Behind the appellation Modal Methods, for gratings, there is a variety of methods sharing in common the development of the fields in basis functions that are either Fourier exponentials hence the name Fourier Modal Method (FMM), or polynomials giving the family of Polynomial Modal Methods (Legendre, Tchebychev, and Gegenbauer). These approaches behave differently when dealing with gratings with very low/high filling ratios. In the present work, we discuss this problem and compare the performances of the different Modal Methods.

09:00 : Invited talk
Graphene surface plasmons excited through diffraction gratings
Maha Ben Rhouma[1], Meherzi Oueslati[1], Brahim Guizal[2]
[1] *Universite de Tunis El Manar (Tunisia),* [2] *Universite de Montpellier (France)*

We propose a model taking into account the periodic spatial modulation of a doped graphene sheet conductivity influenced by a dielectric grating. We obtain the dispersion relation through the Fourier Modal Method (FMM) and study the excitation of surface plasmons on such structures. We compute and study the spatially localized fields on the graphene sheet.

08:00 - 08:40 — Coin

Session 2A2

SP14. Biomedical Applications of Electromagnetics

Organized by: Hulusi Acikgoz

Chaired by: Hulusi Acikgoz

08:00 : Invited talk
Microwave Antennas for Cancer Ablation Therapy: Backward Heating Problem
Hulusi Acikgoz
KTO Karatay University (Turkey)

During this presentation, some important developments on the use of microwave coaxial antennas for cancer ablation therapy will be detailed. Particularly, we will focus on the problem of backward heating where surface currents propagate on the antenna outer conductor and overheat regions far away from the cancerous tissue.

08:20 : Invited talk
Magnetic Particle Imaging for Probing Viscosity
Emine Ulku Saritas
Bilkent University (Turkey)

Magnetic Particle Imaging (MPI) is a recently introduced biomedical imaging modality that takes advantage of the nonlinear magnetization response of superparamagnetic iron oxide (SPIO) nanoparticles to image their distribution in vivo. As a hot spot imaging modality, MPI has shown promise for various applications such as angiography, stem cell tracking, and cancer imaging. Here, we show the potential of MPI for probing viscosity in vivo.

08:00 - 09:20 — Blanca

Session 2A3

SP2. Inverse Scattering and Imaging

Organized by: Rocco Pierri and Raffaele Solimene

Chaired by: Rocco Pierri and Raffaele Solimene

08:00 : Invited talk
Performance Evaluation of Linear Sampling Method for Mixed Boundary Objects in the Half-Space Scenario
Erramshetty Mallikarjun[1], **Amitabha Bhattacharya**[2]
[1] *NIT Goa (India),* [2] *IIT Kharagpur (India)*

This paper aims to investigate the performance of linear sampling method for mixed boundary (both dielectric and conducting) objects in the half-space domain. The study is based on the numerical evaluation of synthetic examples at different frequencies. It is shown that in half space scenario, dielectric objects are not detected at lower frequency whereas PEC objects do not suffer from such limitation.

08:20 : Invited talk
Inverse Scattering, Reciprocal Structures and Superresolution
Michael A. Fiddy
University of North Carolina at Charlotte (USA)

Using a nonlinear inverse scattering algorithm we have observed subwavelength scale features in the reconstructed image, strong or multiple scattering is responsible. We describe the use of reciprocal subwavelength-featured scattering structures that can encode and decode evanescent waves from an object thereby transferring the information to the far field. This approach can remove the need to apply an inverse scattering algorithm or alternatively, the measured encoded far field can be propagated numerically through the deco-

ding structure.

08:40 : Invited talk
Enhancement of multi-frequency microwave breast images using a tissue-dependent mapping technique with discontinuous Galerkin contrast source inversion
Cameron Kaye, Ian Jeffrey, Joe Lovetri
University of Manitoba (Canada)

An optimization-based microwave imaging algorithm has been used to produce 2D images of the dielectric properties of synthetic breast models using a frequency-hopping technique, where reconstructions from low-frequency data are used as initial guesses to stabilize higher-frequency inversions. An improvement in image quality has been observed when the imaginary part of the reconstructed low-frequency image is modified to reflect the identical tissue geometry as its real part before being passed back to the algorithm as an initial guess.

09:00 : Invited talk
Precision analysis based on Cramer-Rao bound for 2D inverse scattering
L. Diong, A. Roueff, Ph. Lasaygues, Amelie Litman
Aix-Marseille University (France)

This study aims at quantitatively predict the expected precision of the reconstructions obtained in 2D electromagnetic and acoustic inverse scattering configurations for a single object. We analyze the precision of the contrast estimators with the Cramer-Rao bound assuming an additive gaussian noise. Firstly, we have exploited it to derive design guidelines when selecting the parameters of an experimental configuration. Secondly, we have try to appraise the effect of the error model when the Born approximation is selected or not.

Coffee Break and Exhibit Inspection

09:20 - 10:00

10:00 - 11:20 — Nerja

Session 2A4

Plenary Session

10:00 : Plenary talk
Coordinate-Free Classifications of Electromagnetic Media
Ismo V. Lindell
Aalto University (Finland)

Different natural (coordinate independent) possibilities to classify electromagnetic media are considered in terms of compact four-dimensional differential-form and dyadic formalism. Various classifications based on Hehl-Obukhov decomposition, on representation of medium bidyadic in terms of a dyadic of lower dimension, on medium bidyadic being a solution of algebraic equation of certain order, and on certain properties of fields in the medium, are reviewed.

10:40 : Plenary talk
Back-end Si photonics for high-performance photonic systems
Koji Yamada
National Institute of Advanced Industrial Science and Technology (Japan)

Advanced functionality integration using back-end-on-line (BEOL) silicon process technologies is reviewed for high-performance silicon-based photonic platform. The functionalities can be realized by add-on waveguide systems made of silicon-rich silica, silicon oxynitride, silicon nitride and amorphous silicon, which can be constructed on silicon waveguide system by using the BEOL technologies.

11:50 - 12:20 — Nerja

Session 2A5

SP12. Diffraction Grating theories as applied to nanophotonics, plasmonics and metamaterials

Organized by: Kofi Edee

Chaired by: Kofi Edee

11:50 : Efficient Fourier representation of complex crossed grating corrugations within the Generalized Source Method
Alexey Alexandrovich Shcherbakov[1], **Alexandre Valentinovich Tishchenko**[2]
[1] *Moscow Institute of Physics and Technology (Russia),* [2] *University of Jean Monnet (France)*

In this work we provide a unified approach for description of a wide variety of complex shape crossed grating corrugations in terms of polygons and polyhedrons within the framework of the Generalized Source Method. We use analytical expressions for both spatial permittivity function Fourier decomposition, and normal vector field Fourier decomposition. The proposed approach is implemented on graphical processing units allowing one to obtain a significant calculation time gain.

12:05 : Wide angle boundary models for periodic structures with subwavelength periods
Ya Yan Lu
City University of Hong Kong (Hong Kong)

For peridic structures with subwavelength periods, wide-angle boundary models are developed by matching the reflection and transmission coefficients for incident waves with different incident angles. For non-periodic structures with slowly varying subwavelength elements, such as some metasurfaces, rigorous numerical simulations are expensive, if the size of the structure is much larger than the wavelength. The wide-angle boundary models with spatially-varying coefficents may be used to speed up the numerical simulations.

12:20 - 12:50 — Nerja

Session 2A6

GEN13. Electroactive and Magnetoactive Materials

Chaired by: Arkady Zhukov

12:20 : Engineering of giant magnetoimpedance effect of amorphous and nanocrystalline microwires
Valentina Zhukova[1], **Ahmed Talaat**[1], **Mihail Ipatov**[1], **Arkady Zhukov**[2]
[1] *UPV/EHU (Spain),* [2] *Universidad del Pais Vasco (Spain)*

We studied giant magnetoimpedance (GMI) effect in magnetically soft amorphous Fe and Co-rich microwires in the extended frequency range. Selecting appropriate chemical composition and geometry Co-rich microwires we were able to achieve quite high GMI effect at GHz frequencies.

12:35 : Modeling and analysis of loaded multilayered magnetoelectroelastic structures composite materials: Applications
Mounia Ajdour, A. Bakkali, L. Azrar, A. El Omri
Abdelmalek Essaadi University (Morocco)

This paper presents the analysis of fiber- reinforced Magnetoelectroelastic composite plates. The work is divided into two major sections. The first one, deals with the homogenization of the properties of each layer based on the Mori-Tanaka mean field approach. Then in order to perform analysis of the considered, the Stroh formalism is used to provide solutions for multifunctional multilayered magnetoelectroelastic composites, to predict exactly the mechanical and electrical behaviors near or across the interface of material layers.

11:50 - 12:20 — Blanca

Session 2A7

SP2. Inverse Scattering and Imaging

Organized by: Rocco Pierri and Raffaele Solimene

Chaired by: Rocco Pierri and Raffaele Solimene

11:50 : Metric entropy in linear inverse scattering
Raffaele Solimene, Maria Antonia Maisto, Rocco Pierri
Dipartimento di Ingegneria Industriale e dell'Informazione (Italy)

The role of multiple views and/or multiple frequencies on the achievable performancein linear inverse scattering problems is addressed. In order to establish such a role, herethe impact of views and frequencies on the information that can be conveyed back from datato the unknown, is studied. For the sake of simplicity, the study deals with strip scatterers andthe cases of discrete angles of incidence and/or frequencies are tackled.

12:05 : Sensitivity study of homogenised parameters in the framwork of the subsoil water content imaging using microwave datas
Herve Tortel, Christelle Eyraud, Anabela Da Silva, Amelie Litman
Aix Marseille University (France)

Imaging systems aimed at imaging the near subsurface water content profile are faing many design problems(aspect limited data, roughness of the soil, heterogeneities ...) In this work we present a numerical study investigating the influence of different parameters (working frequency, type of soil, water content in the soil, size of the heterogeneities ...) on the value of the effective media found. Proposals for an optimal characterisation system will be also discussed.

Lunch and Exhibit Inspection

12:30 - 14:00

BANQUET

Departure by bus from the Convention Center entrance at 19:30

20:00 - 23:00

Thursday 28th July, 2016

08:30 - 09:45 — Alhaurin

Session 3A1

SP4. Applications of Nanoimprint in Photonics and Metamaterials

Organized by: Wei Wu

Chaired by: Wei Wu

08:30 : Invited talk
Sidewall relief gratings imprinted on optical fiber sidewall for sensing applications
Zhouyang Zhu, Wen-Di Li
The University of Hong Kong (China)

We proposed and demonstrated a new type of lab-on-a-fiber sensing devices with surface relief gratings directly imprinted on plastic optical fiber sidewall. Deformation of the optical fiber during the nanoimprint process allows the light guided in the fiber to access to the surrounding environment and achieve sensing applications. Fabrication process and results are demonstrated with prototype application of detecting refractive index change in a liquid environment.

08:50 : Invited talk
Nanoimprint-Assisted Shear Exfoliation + Transfer Printing (NASE+TP) for Producing Emerging Transition Metal Dichalcogenide Heterostructures
Xiaogan Liang, Da Li, Sungjin Wi
University of Michigan (USA)

Vertically stacked heterostructures of emerging layered materials are needed for modulating the band structures of new nanoelectronic/photonic devices based on layered materials. We present a nanofabrication route for producing arrays of such heterostructures, which uniquely combines nanoimprint-assisted shear exfoliation and transfer printing techniques. Using this route, we have demonstrated the fabrication of uniform arrays of heterostructures consisting of different multilayer transition metal dichalcogenides as well as photoresponse devices based on such structures.

09:10 : Invited talk
Sub-10-nm Three-Dimensional Plasmonic Probes and sensors
Stefano Cabrini[1], Giuseppe Calafiore[2], Aleksandr Koshelev[2], Keiko Munechika[2]
[1] *Lawrence Berkeley National Laboratory (USA),* [2] *aBeam Technology Inc. (USA)*

We will present the fabrication process of Campanile probes by ultraviolet nanoimprint lithography (UV-NIL) directly on the facet of commercial optical fibers,the 3D mold is fabricated by a combination of polymer embossing and FIB lithography in a Helium Ion Beam.

09:30 : High contrast gratings fabricated using Nanoimprint lithography for color reflective display
He Liu, Yuanrui Li, Yuhan Yao, Yifei Wang, Wei Wu
University of Southern California (USA)

We proposed a color reflective display which can have unprecedented vivid color and brightness. It has a stacked tunable color mirror architecture. Each color mirror is implemented with high contrast gratings fabricated by Nanoimprint lithography. The modulation of each color mirror will be realized using an electrowetting process. The working principle, design, fabrication and characterization of color mirror will be presented.

08:30 - 09:30 — Coin

Session 3A2

GEN3. Microwave and Millimeter Circuits and Systems

Chaired by: Enrique Marquez Segura

08:30 : A generalized approach to analyze broadband arrow-shaped loaded-stub phase shifters
Badar Muneer[1], An Sensong[2], Abdul Waheed Umrani[1], Faisal Karim Shaikh[1]
[1] Mehran University of Engineering and Technology (Pakistan), [2] University of Science and Technology of China (China)

This paper discusses a simple and analysis-efficient approach to develop and design wideband loaded-stub (WB-LS) phase shifters. The WB-LS phase shifter achieves a uniform phase shift of 130 degrees over a relatively wide bandwidth by utilizing a transmission line loaded with arrow-shaped open stubs and a reference line. Measured insertion loss is less than 0.5 dB for a 90 degrees dual-stub loaded phase shifter, a return loss of better than 10 dB is achieved over a wide bandwidth of 80 percent.

08:45 : New Six Ways Waveguide to Microstrip Transition applied in X Band Spatial Power Combiner
Davide Passi, Alberto Leggieri, Rocco Citroni, Franco Di Paolo
University of Rome Tor Vergata (Italy)

A Spatial Power Combiner is proposed using an innovative waveguide to microstrip transition capable to divide the electric field in six equal parts per card. This device can combine 12 MMIC Solid State Power Amplifiers in the whole X Band with 13 dB of return loss and only 2.2 dB losses in a small size, high power and high efficiency system.

09:00 : Exploring the Temporal Aspect of Energy-Tunneling in a Wire-Loaded Microstrip Cavity
Muhammad Arif Shah [1], Rashad Ramzan[2], Omar Farooq Siddiqui[3]
[1] FAST-National (Pakistan), [2] UAE University (United Arab Emirates), [3] Taibah University (Saudi Arabia)

The frequency domain behavior of energy tunneling is well studied, in this paper we will focus on the time domain behavior of wire-based energy tunneling using a Gaussian pulse as it propagates through an energy-tunneling microstrip channel. Simulation shows the temporal dispersion (due to highly selective frequency transmission response) results in considerable slowing of the propagating pulse. These large time delays from small physical length of wire can be used to design new type of delay lines.

09:15 : Investigation on EM radiations from Interconnects in Integrated Circuits
L. Belhimer, A. Benfdila, A. Lakhlef
University Mouloud Mammeri (Algeria)

The present paper deals with the study and investigation of radiations produced by the interconnects inside an Integrated circuits operated at high frequencies.

08:30 - 09:15 — Blanca

Session 3A3

GEN2. Recent Advances in Antenna Technology

Chaired by: Blaise Ravelo

08:30 : The Complementary Dumbbell-Shaped Strip-Slot Radiating Element
Rocio Rodriguez Cano, Elena Abdo Sanchez, Teresa M. Martin Guerrero, Carlos Camacho Penalosa
Universidad de Malaga (Spain)

The dumbbell-shaped strip-slot element is proposed to reduce the size of the rectangular-shaped strip-slot element and still providing an extra broad impedance bandwidth. Simulations have validated the theory and radiation efficiency is improved significantly around the third resonance.

08:45 : Performance Enhancement of Proximity Coupled Patch Antenna Using Fishnet Metamaterial
A. Yilmaz[1], **C. Sabah**[2]
[1]*KTO Karatay University (Turkey),* [2]*Middle East Technical University (Turkey)*

This paper investigates the performance improvements of proximity coupled patch antenna by using metamaterial. The designed antenna is covered with metamaterial and a wider bandwidth is obtained. Also, dual mode response of antenna is obtained when using metamaterial.

09:00 : Massive MIMO Approach for Cooperative Relay-Assisted Millimeter-Wave Cellular Systems
Mostafa Hefnawi
Royal Military College of Canada (Canada)

This paper proposes a massive multiple-input multiple-output (MIMO) beamforming scheme for cooperative relay-assisted millimeter-wave cellular systems employing orthogonal frequency-division multiplexing (OFDM) such as the upcoming 5th generation (5G) systems.

09:15 - 09:45 — Blanca

Session 3A4

GEN12. Electromagnetic and Nanophotonic Materials

Chaired by: Alexey A. Shcherbakov

09:15 : Properties of isofrequency surfaces of 3D periodic dielectric composites with finite periods
Andrey A. Ushkov[1], **Alexandre V. Tishchenko**[2], **Alexey A. Shcherbakov**[1]
[1]*Moscow Institute of Physics and Technology (Russia),* [2]*University of Jean Monnet (France)*

In this work demonstrate effective optical properties of 3D periodic dielectric composites unusual to natural crystals when the period of such composites is only several times smaller than the vacuum wavelength. Numerical simulations demonstrates deformation of isofrequency surfaces and existence of additional optical axes unusual to natural crystals.

09:30 : Family of paraxial Laguerre-Gaussian beams with complex shift in Cartesian coordinates
Alexey Andreevich Kovalev, Victor Victorovich Kotlyar, Alexey Petrovich Porfirev, Daria Sergeevna Kalinkina
Samara State Aerospace University (Russia)

We consider a family of asymmetrical paraxial Laguerre-Gaussian beams with complex shift in Cartesian coordinates. An expression for their orbital angular momentum (OAM) is derived. When the radial index is zero, we determine the coordinates of intensity maximum. We analytically and experimentally show rotation of the crescent-like diffraction pattern during propagation.

Index

Abbassi Abdellatif : 1P1
Abboud Mira : 1A5
Abdo Sanchez Elena : 3A3
Abdo-Sanchez Elena : 1A6
Abrahams I. David : 1A4
Acikgoz Hulusi : 2A2
Ahmed Osman : 1A8
Ajdour Mounia : 2A6
Al-Husseini Mohammed : 1A6, 1A6
Alonso-Roque Yordanis : 1A6
Antezza Mauro : 2A1
Antos Roman : 1P1
Arezki H. : 1A13
Arif Shah Muhammad : 3A2
Arriaga Jesus : 1A1
Assier Raphael : 1A4
Atia Khaled S. R. : 1A8
Azrar L. : 2A6
Bagci Hakan : 1A8
Bailly Guillaume : 1A15
Bakkali A. : 2A6
Bakli Hind : 1A3
Bakr Mohamed : 1A8
Baussard Alexandre : 1P1
Belhimer L. : 3A2
Ben Rhouma Maha : 2A1, 2A1
Benfdila A. : 3A2
Benjelloun N. : 1A15
Benson Trevor Mark : 1A8
Beran Lukas : 1P1
Bertrand V. : 1A6
Bhattacharya Amitabha : 2A3
Bo Fang : 1A5
Boix Rafael R. : 1A6
Bonnaudin Fabrice : 1P1
Bonnet Pierre : 1A5, 1A15
Borderies Pierre : 1P1
Boutchich M. : 1A13
Britel M. R. : 1P1
Brueck Steven : 1A5
Cabrini Stefano : 3A1
Calafiore Giuseppe : 3A1
Camacho Penalosa Carlos : 3A3
Camacho-Penalosa Carlos : 1A6
Chan C. T. : 1A1
Charon Julien : 1A5
Chen Huajin : 1A4
Chen Jianping : 1A14
Chen Yanfeng : 1A9
Cheng Y. : 1A14
Choi Jeong Ryeol : 1P1, 1P1
Chua Daniel H. C. : 1A13
Citroni Rocco : 1P1, 3A2
Coatanhay Arnaud : 1P1
Colin Valentin : 1A15
Corcolle Romain : 1P1
Cornet Jean-Francois : 1A5
Creagh Stephen : 1A8
Cuccaro Antonio : 1P1
Da Silva Anabela : 2A7
Daniel Laurent : 1P1
Dauchet Jeremi : 1A5
Delacressonniere Bruno : 1A10
Dell'Aversano Angela : 1P1
Demontoux Francois : 1P1
Dherbecourt Pascal : 1A10
Di Paolo Franco : 1P1, 3A2
Ding Jianfeng : 1A9
Diong L. : 2A3
Dirdal Christopher : 1A4
Dkiouak Rachid : 1P1
Dogmus E. : 1A10
Dolci Sibilla Renata : 1P1
Domenges Bernadette : 1A7
Drachev Vladimir P. : 1A1
Dufresne Jordan : 1A15
Duma Virgil-Florin : 1A11
Edee Kofi : 1A5, 1A5, 2A1
El Misilmani Hilal M. : 1A6
El Omri A. : 2A6
El Oualkadi Ahmed : 1A10
El-Hajj Ali : 1A6
El-Misilmani Hilal M. : 1A6
Elmesbahi Abdelilah : 1P1
Elshafiey I. : 1A3
Encinar Jose A. : 1A6
Ergul Ozgur : 1A11
Essaidi N. : 1A6
Esselle Karu P. : 1P1
Eyraud Christelle : 1A2, 2A7
Faccio D. : 1A13
Faist Jerome : 1A13
Fang Wei : 1A14
Fang Zhiwei : 1A14
Farhat Mohamed : 1A8
Feix N. : 1A6
Fiddy Michael A. : 2A3
Florencio Rafael : 1A6
Fouquet Francois : 1A7
Fragoso Jose Roberto : 1P1
Frongillo Marcello : 1P1
Fukumoto Keiki : 1A13
Gabdullina Alina R. : 1A2
Gardner R. L. : 1A10
Geffrin Jean-Michel : 1A2, 1A3, 1A5
Gennarelli Gianluca : 1P1
Ghanim AbdelRahman : 1A8
Giovannini D. : 1A13
Girard Sebastien : 1A15, 1A15
Gobin Vincent : 1P1
Gore Brandon : 1A2, 1P1
Gradoni Gabriele : 1A8

Granet Gerard : 1A5, 2A1
Guizal Brahim : 2A1, 2A1, 2A1
Gumen Lyudmila N. : 1A1
Guttin C. : 1P1
Haddadi Kamel : 1A3
Hagenvik Hans Olaf : 1A4
Hameed O. : 1A8
Hammar Mattias : 1A9
Hao Yang : 1A6
Hashmi Raheel M. : 1P1
Hefnawi Mostafa : 3A3
Heikal Ahmed M. : 1A8
Hossain Md. Anowar : 1A3
Hu Zhen : 1A8
Huray Paul : 1A2, 1P1
Hussein Mohamed : 1A8
Iff Wolfgang Alexander : 1A5
Inchaussandague Marina E. : 1P1
Ipatov Mihail : 1P1, 2A6
Janicek Petr : 1P1
Jeffers J. : 1A13
Jeffrey Ian : 1P1, 2A3
Jia Hao : 1A9
Jia Hongwei : 1A5
Joubert Eric : 1A7
Jourlin Yves : 1A5
Joyce Duncan : 1A4
Kabalan Karim Y. : 1A6, 1A6
Kadi Moncef : 1A7
Kadira Lhoussain : 1P1
Kaissa Djenkel : 1P1
Kalinkina Daria Sergeevna : 3A4
Kampfe Thomas : 1A5
Karaosmanoglu Bariscan : 1A11
Kasmi Chaouki : 1A15
Kawano Yukio : 1A13
Kaye Cameron : 1P1, 2A3
Kemp Brandon A. : 1A2
Khallil Kettir : 1P1
kiyani Arslan : 1P1
Kolokoltsev Oleg : 1P1
Koshelev Aleksandr : 3A1
Koshelev Salah S. Obayya : 1A8
Koshihara S. : 1A13
Kotlyar Victor Victorovich : 3A4
Kovalev Alexey Andreevich : 3A4
Krokhin Arkadii : 1A1
Kuball Martin : 1A7
Lai Yun : 1A4
Lakhlef A. : 3A2
Lalande M. : 1A6
Lallechere Sebastien : 1A15, 1A15
Lasaygues Ph. : 2A3
Lasri Tuami : 1A3
Latry Olivier : 1A7
Lee Seung Chang : 1A5
Leggieri Alberto : 1P1, 3A2
Lelong Martin : 1P1
Li Da : 3A1
Li Lifeng : 1A5
Li Penglei : 1A13
Li Ping : 1A8
Li Wen-Di : 3A1
Li Ying : 1A5
Li Yuanrui : 3A1
Liang Xiaogan : 3A1
Lin Jintian : 1A14
Lin Qiang : 1A14
Lin Zhifang : 1A4
Lindell Ismo V. : 2A4
Linge A. : 1A10
Litman Amelie : 1A2, 2A3, 2A7
Liu Haitao : 1A5
Liu He : 3A1
Liu Peter : 1A13
Liu Shiyang : 1A4
Liu Xiaoping : 1A9
Lopes-Esteves Jose : 1A15
Lotfi Erik S. : 1A11
Lovetri Joe : 1P1, 2A3
Lu Liangjun : 1A14
Lu Minghui : 1A9
Lu Xingye : 1P1
Lu Ya Yan : 1A8, 1A8, 2A5
Luo Huinqian : 1P1
Luo Jie : 1A4
Luxmoore Isaac : 1A13
Lyons A. : 1A13
Ma Guancong : 1A4
Ma Zhenqiang : 1A9
Macias Demetrio : 1P1
Maia Neto Paulo : 2A1
Maisto Maria Antonia : 2A7
Mallikarjun Erramshetty : 2A3
Martin Guerrero Teresa M. : 3A3
Martinez-de-Rioja Eduardo : 1A6
Martinod E. : 1A6
Matatagui Daniel : 1P1
Medjdoub Farid : 1A10
Messina Riccardo : 2A1
Mikhailov Sergey : 1A13
Mistrik Jan : 1P1
Moultif Niemat : 1A7
Mueller Thomas : 1A13
Munechika Keiko : 3A1
Muneer Badar : 3A2
Nadir Houda : 1A6
Nagarkoti Deepak S. : 1A6
Nash Geoff : 1A13
Nassar Elias : 1A6
Natale Andrea : 1P1
Negrier R. : 1A6
Obayya Salah : 1A8
Ogawa Kensuke : 1A12
Onda K. : 1A13
Oueslati Meherzi : 2A1

Padgett M. : 1A13
Paladian Francoise : 1A15
Palka Karel : 1P1
Parnell William James : 1A4
Passi Davide : 1P1, 3A2
Petermann Klaus : 1A9
Phang Sendy : 1A8
Pierri Rocco : 2A7
Poirier Jean-Rene : 1P1
Pomeroy James : 1A7
Poncelet Olivier : 1A4
Ponge Marie-Fraise : 1A4
Porfirev Alexey Petrovich : 3A4
Rabobason Y. G. : 1A15
Rajab Khalid Z. : 1A6
Ramzan Rashad : 3A2
Ravelo Blaise : 1A7, 1A15
Ren Xiaotao : 1P1
Restuccia S. : 1A13
Riccio Giovanni : 1P1
Rodriguez Cano Rocio : 3A3
Roger Thomas : 1A13
Romero J. : 1A13
Rossignol Jerome : 1A15
Rossignol S. : 1A6
Roueff A. : 2A3
Rouha Nacera : 1P1
Rueda Sanchez Alfredo R. : 1A14
Ruffie Gilles : 1P1
Sabah C. : 3A3
Saint-Paul M. : 1P1
Sakoda Kazuaki : 1A4
Sakurai K. : 1A13
Saleh Hassan : 1A3, 1A5
Santandrea Laurent : 1P1
Saritas Emine Ulku : 2A2
Savostiyanova Nadya : 1A13
Sayouri Salaheddine : 1P1
Schaeffer Bernard : 1A2
Schwefel Harald G. L. : 1A14
Sedlmeir Florian : 1A14
Sensong An : 3A2
Sewell Phillip : 1A8
Shaikh Faisal Karim : 3A2
Shaw Martin : 1A7
Shcherbakov Alexey A. : 3A4
Shcherbakov Alexey Alexandrovich : 2A5
Sheng Ping : 1A4
Sheppard Cheyenne J. : 1A2
Shi Yifei : 1A8
Siddiqui Omar : 1A6
Siddiqui Omar Farooq : 3A2
Skaar Johannes : 1A4
Skigin Diana C. : 1P1
Skobelev Sergei P. : 1A2
Smolnikova Olga N. : 1A2
Solimene Raffaele : 1P1, 1P1, 2A7
Song Dawei : 1A8
Stuerga Didier : 1A15
Sun Xiaomeng : 1A9
Swillam Mohamed : 1A11
Talaat Ahmed : 1P1, 2A6
Taoufik Sanae : 1A10
Temcamani Farid : 1A10
Tishchenko Alexandre V. : 1A5, 3A4
Tishchenko Alexandre Valentinovich : 2A5
Torrent Daniel : 1A4
Tortel Herve : 1A2, 1A3, 2A7
Ulku Huseyin Arda : 1A8
Umrani Abdul Waheed : 3A2
Ushkov Andrey A. : 3A4
Uysal Ismail Enes : 1A8
Valmorra Federico : 1A13
Veis Martin : 1P1
Vesely Sara Liyuba : 1P1
Vial Alexandre : 1P1
Vincent Julien : 1P1
Vlcek Miroslav : 1P1
Vukovic Ana : 1A8
Wan Zhao-Sheng : 1P1
Wang Min : 1A14
Wang Shubo : 1A1
Wang Yifei : 3A1
Wi Sungjin : 3A1
Wu Wei : 3A1
Wu Ying : 1A4, 1P1
Xu Jingjun : 1A5
Xu Yingxin : 1A14
Yahia Ashraf : 1A8
Yamada Koji : 2A4
Yang Hongjun : 1A9
Yang Lin : 1A9
Yang Min : 1A4
Yang Zhiyu : 1A4
Yao Yuhan : 3A1
Ye Peng : 1A2, 1P1
Yilmaz A. : 3A3
Yilmaz Akif : 1A11
Yu Xinning : 1A4
Zegaoui M. : 1A10
Zhang Guoquan : 1A5
Zhang Lei : 1A9
Zhang Xiujuan : 1P1
Zhang Yu : 1A8
Zhao Deyin : 1A9
Zhao Shuoyi : 1A14
Zhou Jialin : 1A4
Zhou Linjie : 1A9, 1A14
Zhou Weidong : 1A9
Zhu Feiyi : 1A7
Zhu Zhouyang : 3A1
Zhukov Arkady : 1P1, 2A6
Zhukova Valentina : 1P1, 2A6
Zimmermann Lars : 1A9