Sunday Workshops and Short Courses

pass filters with cross couplings; dual mode filters; environmental effects on filter performance.

08:00–12:00 TSD

SDR and Cognitive Radio — The Need for Reconfigurable RF Front-Ends

Topics and Speakers:
- RF Requirements for Evolution of SDR, C. Bostian, A.B. MacKenzie, and S. Raman, Virginia Tech
- Front End Challenges for Cognitive Radio, J. Mitola, Mitre Corporation
- Front Ends for Commercial Digitally Controlled Radios, B. Krenik, Texas Instruments
- Tunable RF Front-End Technologies, S. Toncich, Qualcomm
- Reconfigurable Front-End Microsystems, J. Papapolymerou, Georgia Tech
- BST Technology for RF Front-Ends, T. Watson, AgileRF

Organizers: A.S. Morris, wiSpry, Inc.; R.F. Drayton, University of Minnesota

Sponsor: MTT-21

This half-day workshop will begin with the system requirements for tunable front-end sub-systems to enable SDR and CR. Details of needed components for these subsystems will be presented and their required performance and features will be elucidated. Candidate technology solutions will follow including details of remaining challenges. Both industrial and academic perspectives will be presented.

08:00–17:00 CSA

Micro Coaxial Lines: Theory, Design, and CEM Lab

Instructors: Dejan S. Filipović, University of Colorado; Chris Nichols, Rohm and Hass

Topics: Miniature Coaxial Lines; Recta-Coax Design; Multiphysics Modeling; Fabrication and Measurements; Resonators; Antennas; Butler Matrix as Integration Example

Sponsor: MTT-1

High level of three-dimensional (3D) integration of various passive components is necessary for achieving compact, low-cost, multifunctional millimeter-wave systems designed to deliver high quality performance. In this course, attendees will be introduced to the theory, modeling, design, fabrication, measurements and application of rectangular coaxial lines (RCLs) and components built using surface micromachining. Focus will be on a recently developed PolyStrata process (by Rohm and Hass). Low loss, high packaging density, low crosstalk, dispersion-free transmission lines, high Q-factor resonators and filters, multilevel directional couplers, efficient antennas are just a few topics that will be covered. Ka-band phased array with Butler matrix beamforming network will be used to demonstrate the integration capabilities. The laboratory component will include three computational exercises, where attendees will develop conformal mapping and finite element based analytical and numerical models of RCLs.

08:00–12:00 CSB

Galileo — Europe's Share for a Global Navigation Satellite Service

Instructors: Henning Ehm and Robert Weigel, Institute for Electronics Engineering, University Erlangen-Nuremberg, Germany

Topics: Satellite Navigation; Galileo; GPS; Receiver Technology; Modulation

Sponsor: MTT-9

Galileo is Europe's first satellite navigation system, which is at present in the in-orbit validation phase and will be fully available from 2011 on. With Galileo, the first civil and global satellite navigation system will be introduced. With Galileo a completely new set of services and signals will be introduced, with higher accuracy than today's GPS, which will lead to new classes of applications. Furthermore, for the first time availability and integrity data of the satellite navigation signal will directly be available on a global scale, paving the way to security critical applications, e.g., aircraft landing and train- and ship-guiding.

This course gives a broad introduction to the Galileo satellite system. The course will start with a general introduction into satellite navigation. In the second part the Galileo system will be presented in detail, containing services, signals, system architecture, etc. In the third part advanced receiver architectures for combined Galileo/GPS reception will be presented and an outlook to upcoming and future trends in the area of satellite navigation will be given.

Monday Workshops and Short Courses

08:00–17:00 WMA

Advances in Active Device Characterization and Modeling for RF and Microwave

Topics and Speakers:
- Nonlinear FET Modeling Fundamentals and Neural Network Applications, D. E. Root, Agilent Technologies
- The Chalmers University FET Model and Applications, I. Angelov, Chalmers University
- Characterization of FET Dynamics and Nonlinearity, A. E. Parker, Macquarie University
- Large-Signal Characterization and Modeling of Transistors, D. Schreurs, Katholieke Universiteit Leuven
- HBT Characterization and Modeling, M. Rudolph, Ferdinand Braun Institute
- High-Power Measurements of RF Transistors, P. J. Tasker, Cardiff University
- Product and Package Modeling for High Power RF Transistors, P. H. Aaen, Freescale Semiconductor
- Global Modeling of Nonlinear Transistors and Devices, M. B. Steer, North Carolina State University
- Neuro-Space-Mapping Techniques for Transistor Modeling, Q. J. Zhang, Carleton University

Organizer: J. Wood, Freescale Semiconductor; D. Schreurs, Katholieke Universiteit Leuven

Sponsors: MTT-1, MTT-11, ARFTG

In recent years, several new microwave device technologies have been developed and are entering the marketplace, including LDMOS, GaN FETs; SiGe and III-V HBTs, and RF CMOS. There have been contemporary developments in nonlinear device characterization methods during this time, such as fast pulse measurement systems at DC and RF, and the large-signal network analyzer, for example. We have also seen a tremendous development in nonlinear device modeling techniques, including optimization for parameter extraction, in multivariate function-fitting for generating the model functions, and advances in integration of several simulation engines, in "Global Modeling" methods. In this workshop, we bring together the leading exponents in these fields to present an up-to-date view of a range of nonlinear RF and microwave transistor modeling and characterization methods, reviewing established practices and presenting new techniques.

08:00–17:00 WMB

On-Chip/Off-Chip DC, RF, and Microwave Measurement Modules for RFIC, SoC, and SiP Self Characterization, Self Test, Self Debug, and Diagnosis

Topics and Speakers:
- RF and Microwave Measurement Block Requirements for DFC, DFT and DFDD, J.L. Carbonéro, ST Microelectronics
- RF to DC Correlation Used for Pass/Fail Screening to Reduce Test Cost in Production Environment, M. Slamani, IBM
- Current Sensor Design for ZIGBEE LNA Monitoring, H. Lapuyade, University of Bordeaux
- Low Cost Built-In Test of Wireless DATA Transceivers, A. Chatterjee, Georgia Tech Institute
- Progress in On-Chip S-Parameter Measurement Techniques, W.R. Eisenstadt, University of Florida
- On-Chip Estimation of RF Power Amplifier's Non-Linearity, J.M. da Silva, University of Porto
- Embedded Test Strategies for System in Package and Multi Technology MEMS, A. Richardson, University of Lancaster
- Effect of Advances in RF and Radio Architectures on Test Strategies, S. Abdennadher, Intel

Organizers: J.L. Carbonéro, ST Microelectronincs; H. Lapuyade, University of Bordeau; W.R. Eisenstadt, University of Florida

Sponsors: MTT-11, MTT-23

More and more SoC or SiP products incorporate Analog, Mixed-Signal and RF parts. The Characterization, Test, Diagnostic and Debug of these parts are very challenging and costly, especially when the parts are embedded in a larger digital system. One way to reduce these test costs is to design and develop off-chip measurement modules to be incorporated on the test board itself or to implement DFT inside the chip in order to reduce either the test time or the required test resources. This workshop will present recent results obtained in the RF and microwave frequency range for on-chip and off-chip measurement blocks. DC measurement modules for these circuits will also be presented as an alternate or companion methods to test microwave and RF circuits. A mini-panel will conclude the workshop by a discussion on the advantages and drawback of on-chip solutions compared to off-chip ones.

08:00–17:00 WMC

High-Speed Signal Integrity

Topics and Speakers:
- Building Bridges between Today's Digital and Microwave Technologies, M. Resso, Agilent Technologies
- Measurement-based Modeling for High Speed Semiconductor Test Interface Boards, H. Barnes, Verigy
- Challenges and Solutions for Measuring Multiple Aggressor Differential Crosstalk, B. Schaefer, Agilent Technologies
- Practical Design and Implementation of Stripline TRL Calibration Fixtures for 10 Gigabit Interconnect Analysis, D. Dunham, Molex
- Packaging a Supercomputer in a PCI Express Form Factor, G. Edlund, IBM

- Analysis of Supply Noise-Induced Jitter in Gigabit I/O Interfaces, R. Schmitt, Rambus
- Why Do We Need Multi-port VNA's for Signal Integrity? T. Ruttan and B. Grossman, Intel Corp.
- Panel Session, H. Barnes, Verigy, B. Schaefer, Agilent, D. Dunham, Molex, G. Edlund, IBM, R. Schmitt, Rambus, B. Grossman, Intel

Organizers: T. Ruttan, Intel Corp., M. Resso, Agilent Technologies, J. D'Ambrosia, Force 10 Networks

Sponsors: MTT-12, ARFTG, MTT-11

In industry there is demand for higher data-transfer rates from computer and communications systems for fast internet downloads, streaming video, CAD applications, and graphics for gaming. As a result, designers are focusing on increasing the bandwidth of ICs, connectors, and board-level interconnects. Most design tools and techniques are well adapted to the boundary conditions found in shielded, constant-impedance microwave and RF products. However, they not well sutied to modeling high-speed IO lines with dense routing, nonideal impedances, and little shielding.

This workshop presents the opportunity for microwave engineers to understand these new boundary conditions, apply microwave modeling and measurement techniques to these problems and to gain insight into the architectural challenges that drive these system designs. This workshop will cover measurement techniques, modeling of key interconnect structures along with verification methods, the role of industry standards and how they drive design practices, optimization of channel performance through equalization and show how typical impedance discontinuities and other transmission line anomalies translate to data errors, such as increased timing jitter and eye diagram closure.

08:00–17:00 WMD

Emerging Packaging Technology and Applications at Millimeter-Wave Frequencies

Topics and Speakers:
- 60 GHz Technology On The Way to Standardization, K. Kimyacioglu, Phillips Research
- Multigigabit Wireless: CMOS and FR-4 at 60 GHz, J. Laskar, Georgia Institute of Technology
- Low-Cost Alternatives for the Partitioning and Packaging of mm-Wave Subsystems, E. Stoneham, Endwave Corporation
- Packaging for Microwave and Millimeter-wave Microsystems, K.J. Herrick, Raytheon Company
- Development of Gpbs Wireless Modules at 60 GHz, L. Franca-Neto, Rambus
- Development of Millimeter Wave Surface Mount Packages, A.V. Pham, University of California, Davis
- Manufacturing of Liquid Crystal Polymer Flex and its Characteristics, K. Takata, Nippon Steel Chemical
- Fabrication of Low-cost, High-frequency Circuits Utilizing Liquid Crystal Polymer (LCP) Substrates and Standard Printed Circuit Board Manufacturing Techniques, K. Walker, Dynaco Corporation

Organizers: A.V. Pham, University of California, Davis; J. Laskar, Georgia Institute of Technology

Sponsor: MTT-12

Traditionally, millimeter-wave components and systems have been perceived as low-volume and high-end products. A fundamental challenge in millimeter wave packaging is how to manufacture affordable, lightweight and small-sized components in low volume and with infrastructure that is not scalable toward mass production. The continued development of defense and commercial markets (including renewed interest in the 60 GHz band) has created opportunities for high-volume communications and radar products. The packaging paradigm for millimeter-wave products must be shifted toward cell-phone-like manufacturing technology to further enable the millimeter-wave application space. This workshop will review and explore challenges in millimeter-wave packaging for both traditional and emerging applications. It will also cover commercially available packaging methods and emerging technology.

08:00–17:00 WME

High-Q RF MEMS Tunable Filters

Topics and Speakers:
- High-Q Tunable Filters for Multiband Wireless Systems, S. Mollenkopf, Qualcomm
- High-Q Tunable Filters for Defense Applications, J. Evans, DARPA
- 2-18 GHz Tunable Filters with High Rejection, B. Pillans, Raytheon
- Low-Loss Bandpass and Notch RF Filters Using MEMS Capacitance Switches, J.D. Adam and R. M. Young, Northrop Grumman Corp.
- RF MEMS High-Q Tunable Bandpass Filters for 4-6 GHz Applications, G. M. Rebeiz, UCSD
- RF MEMS Tunable Filters in Europe: MEMS2Tune and Other Efforts, P. Blondy, Univ. Limoges
- High-Q 3-D Tunable RF MEMS Filters for 2-6 GHz, W. Chappell, Purdue University
- RF MEMS Reliability: An Overview of the Latest Results, J. Ebel, AFRL
- 3-D Waveguide Based mm-Wave MEMS Filters: Results and Potential Tuning Capabilities, J. Reid, AFRL

Organizers: G. M. Rebeiz, UCSD; W. Chappell, Purdue University

Sponsor: MTT-21

WORKSHOPS

Monday Workshops and Short Courses

This workshop will present a commercial and defense perspective to high-Q tunable filters, followed by state of the art work at Purdue, UCSD, Raytheon, NG, R&H, and Europe. The workshop will also cover 3-D high-Q filters, and even though these are not tunable yet, they have a high potential for integration with MEMS. The workshop will conclude with a summary of RF MEMS reliability, which is very important for this field.

08:00–17:00 WMF

Theory and Design of Phase Locked Loops

Topics and Speakers:
- Design of Phase Locked Loops, L. Dayaratna, Lockheed Martin
- Phase Locked Loop Design Optimization, P. White Applied Radio Labs
- Fractional-N PLL Frequency Synthesizers, R. Reedy, Peregrine Semiconductor
- PLL System Design and Optimization, C. Vaucher, Phillips Research
- Phase Locked Loop Components and Measurements, D. Gamliel, Mini-Circuits

Organizers: L. Dayaratna, Lockheed Martin; P. White, Applied Radio Labs

Sponsors: MTT-22, MTT-20, MTT-17, MTT-16, MTT-11

The workshop is tailored as a laboratory hands-on course with live hardware and software demonstrations. The following topics will be addressed in detail: Voltage controlled Oscillators, Phase detector Circuits, Loop filter design, Phase Locked loop design, Loop characterization, Fractional-N synthesis, DDS, Multi Loop synthesis, Composite DDS/PLL solutions, Noise in Phase Locked loop circuits.

08:00–17:00 WMG

Challenges of High Power Device Characterization and Modeling

Topics and Speakers:
- Physical Models for Linearity and Reliability Modeling of AlGaN/GaN HFET's, R. J. Trew, North Carolina State University
- High Power GaN HEMT Modeling, N. Ui, Eudyna Devices, Y. Tajima, Auriga Measurement Systems
- Large Signal GaN HEMT Models and their Application to Hybrid and Monolithic Circuit Designs, W. Pribble, Cree
- Meeting the Challenges in High-Power Device Modeling, L. Dunleavy, Modelithics, Inc., University of South Florida
- Multiharmonic Tuner for Wideband Load Pull Testing, C. Tsironis, Focus Microwaves
- Application of Pulsed S Parameter and IV Measurement to High Power Device Modeling, D. Wandrei, Auriga Measurement Systems
- Measurement of Large-Signal, Time-Domain I/V Characteristics of High-Power HEMTs, W. Stiebler, Raytheon
- LDMOS Device Characterization and Modelling for RF Power Applications, L. de Vreede, Delft University of Technology

Organizer: Y. Tajima, Auriga Measurement Systems

Sponsors: MTT-5, MTT-11

Challenges of modeling and characterizing high power devices will be discussed. The first papers discuss the challenges of modeling high power devices with output power extending to 100 W. Actual application of these models to hybrid and monolithic circuit designs will be presented. The second group of papers discusses the challenges in measuring large devices. New development in harmonic load-pull, device IV and S parameter characterization techniques will be introduced.

08:00–17:00 WMH

High Power Issues of Microwave Filter Design and Realization

Topics and Speakers:
- Introduction to High Power Issues of Microwave Filter Design and Realization, M. Yu, COM DEV
- Basic Physical Theory of Microwave Breakdown in Air and Recent Theoretical Results, V. Semenov, Russian Academy of Sciences
- Microwave Breakdown in Air, Testing and Prevention, T. Olsson, Powerwave Technologies
- Multipactor RF Breakdown at ESA: Standards, R&D Investigations and Testing Techniques, D. Raboso, European Space Agency
- Prediction Tools of Multifactor Breakdown Effects in Passive Components, W. Pribbl and V. E. Boria, Universidad Politécnica Valencia
- High Power Design for Microwave Bandstop Filters, D. Snyder, RS Microwave
- Passive Intermodulation at Junctions, H. L. Hartnagel, Technische University Darmstadt
- Design of Low PIM Diplexers, C. Radcliffe, Phase2 Microwave

Organizers: M. Yu, COM DEV; A. Atia, Orbital Sciences Corp.

Sponsor: MTT-8

High power related issues such as Multipactor, Corona breakdown and Passive Intermodulation (PIM) will be covered for passive microwave components especially filters.

08:00–12:00 WMI

Noise in Nonlinear Circuits: Theory, Modeling, and Measurement Techniques

WORKSHOPS

Monday Workshops and Short Courses

Topics and Speakers:
- Nonlinear Noise in Devices: Sources, Frequency Conversion Mechanisms and Statistical Noise Process Characterization, F. Bonani, Politecnico di Torino
- Compact Noise Modeling of GaAs HBTs for Nonlinear Simulation, M. Rudolph, Ferdinand-Braun-Institut für Höchstfrequenztechnik
- Empirical Non-Linear Noise Models of Field-Effect Devices for Microwave Circuit Large-Signal Noise Analysis, F. Filicori, Bologna University
- Minimization of Noise in Frequency Conversion Circuits, S. Maas, Applied Wave Research, Inc.
- Nonlinear Noise Measurement of Microwave Amplifiers: HF Noise Parameters and Residual Phase Noise, O. Llopis and L. Escotte, Laboratoire d'Analyse et d'Architecture des Systèmes (LAAS) du CNRS
- Fundamentals of Phase Noise and its Relationship to Jitter and Bit Error Rate in Digital Communications Systems, E. M. Godshalk, Maxim Integrated Products

Organizers: F. Bonani, Politecnico di Torino; A. Ferrero, Politecnico di Torino

Sponsors: MTT-14, MTT-11

In this half day workshop, the participants will receive a wide perspective on up-to-date modeling, design and measurements techniques applied to the determination of noise properties in nonlinear microwave circuits and systems where the effect of noise frequency conversion plays a significant role. Topics covered by the presentations (from both academia and industry) will include the following: 1) Introduction and basic theory of noise in nonlinear systems including the frequency conversion effect 2) Non linear modeling of state-of-the-art device technologies, both bipolar and III-V FET-based 3) Design techniques for low noise applications 4) Non linear noise measurement techniques in amplifiers 5) Fundamentals of phase noise and jitter in a digital communication system perspective, including a description of phase noise measurement techniques.

13:00–17:00 WMJ

Will Wide Band-Gap Power Transistors Render Silicon Power Transistors Obsolete?

Topics and Speakers:
- The Market for Wide Band-Gap Transistors at RF, P. Roussel, Yole
- Reliability and Linearity Issues of GaN HFET's, B. Trew, North Carolina State University
- Are Dinosaurs Obsolete: Is there Life Left for Si BJTs Operating at RF Frequencies?, J. Curtis, Integra Technologies
- Silicon VDMOS Transistors, J. L. B. Walker, Semelab PLC
- RF-LDMOS: An Ideal Device Technology for ISM to WiMAX?, W. Burger, Freescale Semiconductor
- GaN-on-Si RF Power Transistors: Status and Outlook, W. Johnson, Nitronex
- GaN HEMTs on SiC, S. Nakajima, Eudyna
- Diamond Transistors for RF Power Amplifiers, K. Ueda, NTT

Organizer: J. L. B. Walker, Semelab plc

Sponsor: MTT-17

Wide band-gap power transistors based on GaN and SiC have made significant progress in the last few years, but most results have focused on the microwave frequency range. The aim of this workshop is to consider their use at RF.

08:00-12:00 WMK

Ultrafast Analog-to-Digital (A/D) Conversion Technique and its Applications

Topics and Speakers:
- Overview of Optical and Optically-Assisted A/D Conversion, G. Valley, The Aerospace Corporation
- High Performance Analog-to-Digital Conversion Techniques for Emerging Telecom and Defense Applications, J. Lee, Lucent Technologies, Bell Labs.
- Ultrahigh-Speed Spatially Sampled All-Optical Analog-to-Digital Converter, A. S. Daryoush, Drexel University
- Demonstration of a 40 Gigasample per Second Real-Time Photonic Analog-to-Digital Converter, J. Stigwall, Chalmers University of Technology
- Analog-to-Digital Conversion in the Early 21st Century, R. H. Walden, The Aerospace Corporation
- An Approach to High-Speed, High-Resolution All-Optical A/D Conversion Using Nonlinear Optical Loop Mirror, Y. Miyoshi, Osaka University
- Femtosecond Real-Time Single-Shot Digitizer, J. Chou, University of California, Los Angeles

Organizers: K. Kitayama, Osaka University; B. Jalali, University of California, Los Angeles

Sponsor: MTT-3

This workshop is focused on cutting-edge ultrafast A/D conversion techniques that hold promise for direct conversion at 100 GS/s and toward TS/s regime. It will cover both optoelectronic as well as optical domain techniques. There have been growing demand for digital signal processing that employ ultrafast A/D converters for applications in advanced communications as well as emerging scientific applications.

08:00–17:00 TMA

High-Frequency Characterization of Printed-Circuit Board Materials

Topics and Speakers:

Monday Workshops and Short Courses

- Overview of Dielectric Measurement Methods, J. Baker-Jarvis, National Institute of Standards and Technology
- High-Frequency Electrical Testing of Printed-Circuit Boards — A Material Manufacturer's Perspective, S. Bertling, Park Nelco
- Complex Permittivity Measurement with a Split-Post Resonator, J. Krupka, Warsaw University of Technology
- Measurement of Dielectric Substrates at Millimeter-Wave Frequencies, S. Begley, Agilent Technologies
- High-Frequency Electrical Properties of PCB Materials Using a Split-Cylinder Resonator, M. Janezic, National Institute of Standards and Technologies
- Complex Permittivity of Printed Circuit Boards using Planar Transmission Lines, K. Bois, Hewlett-Packard Company

Organizers: M. D. Janezic, National Institute of Standards and Technology; S. Begley, Agilent Technologies

Sponsor: MTT-11

The first half of this tutorial will include an overview of the state-of-the-art measurement methods used to accurately characterize the electrical properties of dielectric substrates, such as printed circuit boards, from 1 to 100 GHz. A discussion of each technique's merits and limitations will be addressed. The second half of the tutorial will comprise of live demonstrations of several techniques, where experts in the field will explain how to perform accurate substrate measurements.

08:00–17:00 TMB

Practical Analysis, Stabilization, and Exploitation of Nonlinear Dynamics in RF, Microwave, and Optical Circuits

Topics and Speakers:
- Large-Signal Stability Analysis through Pole-Zero Identification, J. M. Collantes, University of the Basque Country
- Nonlinear Stability Analysis of Microwave Oscillators, T. Heath, Georgia Tech Research Institute
- Bifurcation Analysis and Control with Harmonic-Balance Techniques, A. Suaréz, University of Cantabria
- Hysteresis and Noisy Precursors in Power Amplifiers and Oscillators, S. Jeon, California Institute of Technology
- Overview of Chaos and Its Information Applications, C.P. Silva, The Aerospace Corporation
- Applications and Implications of Chaos for Radar and Sonar, C. Williams, Bristol University
- Optical Chaos-Based Communications at High Bit Rates Using Commercial Fiber-Optic Links, C.R. Mirasso, University of Balearic Islands
- Chaotic Waveform Generation and Radar, K.A. Lukin, Usikov Institute of Radiophysics & Electronics
- Chaotic Microwave Oscillators and Synthesizers for Chaotic Frequency Hopping Communications Systems, A. Layec, INRIA

Organizers: A. Suaréz, University of Cantabria; C.P. Silva, The Aerospace Corporation

Sponsor: MTT-16

This workshop addresses three closely related topics: the in-depth analysis and elimination of circuit instability phenomena using simple techniques, the optimized and efficient design of autonomous circuits, and the application of chaos to signal transmission, conditioning, and processing. Fundamental background on nonlinear dynamics will be provided, including the concepts of local and global stability, bifurcations, and chaos. Examples of bifurcation control will be given, together with a representative survey of chaos applications to cryptography, baseband through optical communications, signal detection, and radar. An RF chaotic oscillator suitable for these applications will also be demonstrated.

08:00–12:00 TMC

How to Do Business in Far East

Topics and Speakers:
- Doing Business in China
- Doing Business in India
- Doing Business in Korea
- Doing Business in Singapore
- Doing Business in Thailand

Organizers: **Canceled**

Sponsors: MTT-19, IMS 2007 Steering Committee

How to seek microwave and millimeter wave business opportunities in the Far East. Invited speakers from the following countries: China, Japan, Korea, India, and possibly Singapore, Malaysia, and Thailand. The business infrastructure and government business regulations to operate a successful business enterprise are the subjects for this workshop.

13:00 – 17:00 TMD

Novel Materials for RF MEMS

Topics and Speakers:
- CMOS/MEMS Monolithic Integration for Frequency References, E. Quevy, Silicon Clocks
- Application of Silicon Carbide to RF MEMS, X. Fu, Case Western Reserve University
- Science and Technology of Piezoelectric/Diamond Heterostructures for Monolithically Integrated High Performance MEMS/NEMS/CMOS Devices, O. Auciello, Argonne National Laboratory

Monday Workshops and Short Courses

- Piezoelectric Aluminum Nitride Contour-Mode MEMS Resonators and Filters, P. Stephanou, Harmonic Devices
- PZT Films for Low Voltage Operation RF MEMS Switch Devices, J. Y. Park, Kwangwoon University

Organizers: S. Pacheco, Freescale Semiconductor, Inc.; G. Piazza, University of Pennsylvania

Sponsor: MTT-21

This workshop will gather leaders in the research area of novel materials for RF MEMS from both academia and industry. The latest advancements on the development of RF MEMS using new classes of materials will be presented. Attendees will be exposed to proven material systems that are being presently commercialized (startups) and to innovative materials that are starting to gain traction in the RF MEMS arena. Finally, this workshop will allow the attendees to foster new networking opportunities. Topics specifically covered in this tutorial workshop include:

- CMOS/MEMS monolithic integration to enable high performance, compact frequency references. Process issues, device performances, and system level advantages will be discussed.
- Review of silicon carbide semiconductor technology for MEMS/NEMS devices and its application in the field of RF communications.
- Piezoelectric/diamond heterostructures based on ultrananocrystalline diamond (UNCD) films for the realization of low-power, high-performance MEMS/NEMS devices. The material science as well as the fabrication and integration of devices will be discussed.
- Introduction to CMOS-compatible, low-loss bandpass filters in the GHz range based on piezoelectric aluminum nitride contour-mode MEMS resonators.
- Low-voltage operation of RF MEMS devices achieved via use of sol-gel based PZT thin films. The design, fabrication methods, and experimental data for MEMS switches with operation biases as low as 2–4 V will be discussed.

08:00–12:00 CMA

RFID – Design of Integrated Passive Transponders

Instructors: Robert Weigel and Kay Seemann, Institute for Electronics Engineering, University Erlangen-Nuremberg, Germany

Topics: Introduction to RFID; Integrated RFID Transponders; Design and Modeling of Passive UHF-Frontend Devices for RFID

Sponsors: MTT-9, MTT-16

Beside several research activities concerning the high integration of multistandard communication devices, a lot of work is in progress to realize inexpensive ubiquitous communication and sensor networks. Recently, the passive radio frequency identification technology (RFID) has gained a lot of interest, since it is a widely used synonym for low-cost wireless identification and sensor devices.

This tutorial outlines general system considerations and specific aspects of the analogue and RF circuit design for the development of integrated passive CMOS-RFID tags. In the first part of the tutorial, the general passive transponder principles, the regulatory background and the existing standards are reviewed and summarized. We also address typical environmental parameters and properties, further we exemplify subsequent restrictions for common applications. Within part two the general architecture of RFID-Transponders and the main important analog and digital building blocks will be explained. Finally, part three deals with specific challenges given by the CMOS technology in the context of UHF-RFID devices. Therefore, the design and the modeling of the main important analog RF-Frontend devices will be discussed. These are the RF power-rectifier, the backscatter modulator and the RF power limiter.

08:00–17:00 CMB

Millimeter-Wave and THz Electromagnetics, Components, and Systems

Instructors: Zoya Popović, University of Colorado, Boulder; Elliott Brown, University of California Santa Barbara

Topics: Fundamental Electromagnetics; THz Transmission Lines and Antennas; Quasi-Optical Techniques and Components; THz Measurements; THz Properties of Materials; Survey of THz Solid-State and Vacuum Coherent Sources; THz Direct Detectors and Mixers; THz Remote Sensing Systems and Trade-Offs

Sponsor: MTT-4

The terahertz region remains as a last frontier of the electromagnetic spectrum where the engineering of components and systems has always been a fringe area involving quasi-optical techniques for radiation coupling and control, frequency multiplication (up conversion) or photomixing (down conversion) to produce coherent sources, and fast (unipolar) Schottky diodes for mixing and rectification. The goal of this short course is first to summarize the fundamental principles and the state of the art for each of these common techniques, particularly the quasi-optical techniques that have been successful in coupling detectors and mixers to free space. Then, the course will cover some of the key issues behind THz systems, such as the different modalities commonly used for point and remote THz sensors, both passive and active. A timely example is THz imaging of concealed objects where the trade-offs between passive heterodyne and direct detection will be analyzed.

Friday Workshops and Short Courses

08:00–17:00 WFA

Reconfigurable and Smart Antennas

Topics and Speakers:

- Impact of Smart Antenna Characteristics on Network Throughput and Communication Channel BER, C.A. Balanis, Arizona State University
- Reconfigurable Antennas for Universal Wireless Receivers, S. El-Ghazaly, University of Tennessee
- Smart Antennas and Digital Beam Forming, M. Salazar-Palma, Universidad Carlos III de Madrid
- Results from Experimental Trials Involving Smart Antenna and MIMO-based Testbeds, B. Daneshrad, UCLA
- Analog Smart Antenna System, H. Arai, Yokohama National University
- MEMS-based Reconfigurable Antennas – State of the Art and Future Potential, J. T. Bernhard, University of Illinois
- MEMS-Reconfigurable Reflect Arrays, R. Sorrentino, University of Perugia
- Wireless Smart Antennas for Noise Cancellation, S. Kanalamuru, Herley Industries
- Antenna Design and Optimizations for Modern Wireless and MIMO Applications, Y. Rahmat-Samii, UCLA

Organizers: A. Fathy, University of Tennessee; V. K. Nair, Intel; S. El-Ghazaly, University of Tennessee

Sponsors: MTT-15, MTT-20

Extensive efforts are under way to develop compact low cost multifunctional antennas for wireless systems including cell phones, laptops, and base stations. Well-known expert in the field will represent an overview of the latest breakthroughs in developing reconfigurable and smart antennas to address market needs. Detailed discussions of various design issues of developing low cost, compact products for multiband, multiservice, and diversity applications will be conducted.

08:00–17:00 WFB

Recent Advances in Electromagnetic Metamaterials: Theory, Computation, and Applications

Topics and Speakers:

- Advances in Subdiffraction Imaging by Magnetic Metamaterial Structures, R. Marqués and M. J. Freire, Univ. de Sevilla
- Field Energy Density and Effective Parameter Dispersion in Artificial Materials, S. Tretyakov and P. Ikonen, Helsinki University of Technology
- Computational Transmission Line (TLM) Models of Negative Refractive Index Metamaterials, W. J. R. Hoefer, University of Victoria
- Fundamental Structures of Two- and Three-dimensional Metamaterials, P. Russer, Technische Universität München
- Recent Advances in Negative-Refractive-Index Transmission-Line Metamaterials, G. V. Eleftheriades and A. K. Iyer, University of Toronto
- Metamaterial-Based Waveguides: Principles and Applications, S. Hrabar, University of Zhagreb.
- Recent Advances in Resonant type Metamaterial Transmission Lines, F. Martín and J. Bonache, Univ. Autònoma de Barcelona
- A Few Directions Towards the Next Generation of Electromagnetic Metamaterials, C. Caloz, École Poly. de Montréal
- Recent Progress on Dielectric Based Left Handed Structures, T. Ueda, Kyoto Institute of Technology, N. Michishita and T. Itoh, University of California Los Angeles.
- Metamaterials and Plasmonics: Bridging Microwaves to Optics, N. Engheta, University of Pennsylvania
- Metamaterial-Based Electrically Small Antenna Systems: Designs, Simulations and Experiments, R. W. Ziolkowski, University of Arizona

Organizers: C. Caloz, École Polytechnique de Montréal; F. Martín, Universitat Autònoma de Barcelona

Sponsors: MTT-15, MTT- 4

The workshop will focus on the latest results of metamaterials research carried out by leading experts. The scheduled talks allow for a wide vision of metamaterials, including the main challenging aspects for microwave and optical technology (computation and implementation of 3D metamaterials, conception of new subwavelength imaging devices, the development of new metamaterial based components and antennas, and the search for new directions and fields of applications).

08:00–17:00 WFC

Low-Cost, Integrated Automotive and Industrial Radar Sensors

Topics and Speakers:

- Introduction of Automotive Radar Sensors - Challenges, Solutions, and Benefits, J. Wenger, DaimlerChrysler AG
- Low Cost SiGe Technology for Automotive Radar Sensors in the 76-81 GHz Band, R. Lachner, Infineon AG
- Advances in Microsystems Technology and RF Microelectronics for Highly Integrated 77 GHz Automotive Radar Sensors, M. Schneider, University Bremen
- FMCW Radar Transceiver System Design and Simulation, O. Günther, University Erlangen-Nuremberg
- Front-End Concepts, Linearization Methods, and Systematical Errors in FMCW Radar Sensors, A. Stelzer, Johannes Kepler University Linz
- 24GHz UWB Radar Sensor Design, I. Gresham, M/A-COM
- Wideband Radar Sensors and its Antennas, S. Lindenmeier, Universität der Bundeswehr
- Challenges in Metrology for Automotive Radar SiGe-MMICs, E. Kolmhofer, DICE GmbH
- Pulsed Microwave and Millimeter Wave Measurements for Radar Component Characterization, L. Betts, Agilent