ESL SHORT COURSES

August 3 - 5, 2016

Small group learning experience with renowned experts

The ElectroScience Laboratory is offering 10 short courses, including half-day and full-day courses on key topics of interest. Instruction for each course is provided by renowned faculty and researchers from The Ohio State University's Department of Electrical and Computer Engineering and the ElectroScience Laboratory. The courses are designed for engineers, technicians, graduate students and others interested in learning about these specialized topics.

Select special topics of interest to you

Choose from 10 courses that cover the state-of-the-art in antenna design and measurement, photonics, computational electromagnetics, remote sensing, imaging, optics and radar. Learn from world-class instructors in a small group environment and attend multiple courses in the same location during this three-day event.

Can't come to Columbus? Attend and interact remotely

Attend in Columbus, Ohio, or avoid the cost and hassle of traveling, and attend and interact remotely via an online meeting with streaming video.

Registration Fees

Attend in-person or remotely via streaming video.

	Regular	Student
Half-day Course	$525	$265
Full-day Course	$1,045	$525

Registration deadline: July 18, 2016

Information and online registration:

https://electroscience.osu.edu/esl-short-courses

General Information

Professional Development/CPD

ESL Short Courses qualify for State of Ohio's Professional Engineers' Continuing Professional Development (CPD) Program hours. For more information please visit: http://www.peps.ohio.gov/ContinuingEd.aspx

Location

The Blackwell Pfahl Conference Center
2110 Tuttle Park Place
Columbus, OH 43210
614-247-4000

Each in-person short course registration fee includes the cost of tuition, breaks and lunches. Should you cancel before July 18, 2016, the registration fee will be refunded minus a $50 administration fee. No refunds will be made after the registration deadline, July 18.

Accommodations

The Blackwell Inn
614-297-4000 or 866-247-4003

Springhill Suites Marriott OSU
1421 Olentangy River RD, Columbus, OH 43212
614-297-9912

Hampton Inn and Suites Columbus OSU
3160 Olentangy River RD, Columbus, OH 43212
614-268-8700

Further Information

Visit the event website or contact:

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614-292-6191, diefenbach.8@osu.edu

Schedule & Course Descriptions

Wednesday August 3, 2016

Array Signal Processing for Geolocation of RF Emitters **8:30am—12:00pm**

Inder "Jiti" Gupta, Research Professor. Radar imaging, EM scattering, compact range technology, and adaptive antennas

There is significant interest in locating RF emitters using a single platform. To accomplish this objective, an antenna array is mounted on the platform and the digitized signals received by various elements of the antenna are processed to geolocate the RF emitters. The conventional approach is based on Angle of Arrival (AoA) estimation at various locations and orientation of the platform, multiple target tracking and drawing lines of bearing. Note that AoA estimation is the backbone of the conventional approach. In this short course, we will discuss various methods for AoA estimations. The discussion will include spectral-based techniques as well as parametric methods. We will describe the degradation in the performance of these methods due to mismatches in the available antenna array manifold and true in situ array manifold of the antenna. The discussion will include polarization of the signals incident on the antenna. Finally, we will present a novel method called 'Direct Mapping Method' for the geolocation of the RF emitters. This method bypasses the AoA estimation step and multiple target tracking.

Time-Reversal Based Techniques for Ultra-Wideband Sensing in Random Media **8:30am—12:00pm**

Fernando L. Teixeira, Professor. Analytical and numerical techniques for wave propagation and scattering

This course will introduce time-reversal (TR) techniques for detection, imaging, and tracking of obscured targets in random media. The application of subspace techniques such as TR-DORT and TR-MUSIC to image multiple targets will be discussed. Important TR features such as super-resolution arising from multipath exploitation in rich scattering environments and statistical stability arising from frequency decorrelation under ultra-wideband radar operation will be explained and demonstrated. Further, application of TR-based techniques to enhance performance of iterative inverse scattering algorithms for obscured targets will also be considered.

Fundamentals and Applications of Integrated Photonics **1:30pm—5:00pm**

Ronald M. Reano, Associate Professor. Integrated optics, electro-optics, and hybrid RF/optical devices

Integrated photonics encompasses the science and engineering of optical guided waves in highly integrated devices, components, circuits, and systems in a manner that is analogous to integrated circuits in electronics. This short course introduces the fundamentals of integrated photonics with an emphasis on silicon photonics. Fundamental building blocks will be discussed including waveguides, modulators, filters, couplers, resonators, switches, multiplexers, and detectors. Efficient fiber-to-chip couplers will also be covered. Applications in telecommunications, interconnects, sensors, and radio-frequency (RF) photonics will be discussed throughout the course within a theoretical and experimental context.

Ultra Wideband Phased Arrays and Transceivers **1:30pm—5:00pm**

John Volakis, Director and Professor. UWB antenna arrays, wearable electronics, millimeter waves, neurosensing, RFIDs, and EMI/EMC

Wide band antennas and arrays are essential for high resolution imaging, cognitive sensing, high data rate communication links, multi-waveform, and multi-function frontends for holistic spectrum utilization and secure communications. There is a longstanding difficulty in realizing small and conformal aperture versions of these arrays. But recent miniaturization techniques, bandwidth enhancements and establishment of theoretical limits, feed technology, digital beam forming transceivers and post-processing algorithms have led to a new class of conformal antennas and tight-coupled arrays that can operate from UHF to millimeter wave frequencies. This short course will cover RF front-ends from the array aperture to transceivers and digital processors to realize ultra-wide band communications with channel coding for spread spectrum communications.

Thursday August 4, 2016

RF Micro-Electro-Mechanical Systems and Devices **8:30am—5:00pm (full-day)**

Nima Ghalichechian, Research Assistant Professor. MEMS, RF microsystems, mm-wave antennas, phased arrays, reconfigurable antennas, and RF components

The field of micro-electro-mechanical systems (MEMS) is an interdisciplinary area that includes design, fabrication, and characterization of devices such as sensors and actuators that are (typically) capable of micron-size (1 μm=10^{-6} m) mechanical movements to achieve certain functionality. For more than a decade, commercial forms of these devices have been integrated into the technology that we use in our daily life. Microfabrication is a key building block of aforementioned microsystems and will be covered in this course with emphasize on processes that are unique to MEMS. Other aspects such as multi-physics design and simulation will be discussed. Classical examples and case studies for MEMS devices will be presented during the morning session. The afternoon session will solely concentrate on RF concepts and devices. During this lecture, we hope the attendees acquire better understanding of a) the field of MEMS, b) fundamentals of microfabrication, c) RF switches, reconfigurable antennas, and d) challenges in realization of millimeter-wave and terahertz systems.

For more information or to register, visit: https://electroscience.osu.edu/esl-short-courses

Thursday August 4, 2016 (cont.)

Radar Micro-Doppler Signatures **8:30am—12:00pm**

Graeme E. Smith, Research Assistant Professor. Radar systems, cognition for sensing, bioinspired signal processing, passive radar, radar target recognition, and micro-Doppler

The micro-Doppler effect provides a characteristic signature of radar targets that can assist in their recognition. The literature has reported micro-Doppler signatures being observed for targets as diverse as aircraft, ground vehicles, ballistic missile warheads, humans and animals and at frequencies as low as L-band. With the phenomena being observable under such a wide variety of conditions it would seem a natural choice for characterizing targets and, accordingly, there is much research on using the micro-Doppler signature in target recognition and classification systems. This short course will develop the theory of the micro-Doppler signature from fundamental radar principles. Techniques by which the signature can be analyzed will be presented and applied to experimental data to help demonstrate the nature of these signatures. Beyond the central theory, the short course will also consider more advanced topics such as micro-Doppler for: through-the-wall radars; multistatic radars; high range resolution/ultra-wideband systems; human targets; and target classification.

Reflector Antenna Analysis, Design and Characterization **1:30pm—5:00pm**

Teh-Hong Lee, Research Scientist. HF computational EM, reflector antenna system analysis/design, EM measurement techniques, compact range, and anechoic chamber designs

This half day short course will cover fundamentals of reflector antenna analysis and design with various computational electromagnetic techniques. Design considerations for applications in communication and sensors will be addressed. The course will also cover measurement techniques to characterize the performance of the reflector antenna.

Friday August 5, 2016

Wideband PLLs and Digital Frequency Synthesis: Challenges and Solutions **8:30am-5:00pm (full-day)**

Brian Dupaix, Research Scientist. Integrated digital/RF systems, multichannel mixed-signal receivers, and mm-wave Circuits

Waleed Khalil, Assistant Professor. RF and mm-wave circuits and systems, sub-THz circuits, front-end actives and passives, and high performance clocking circuits

The growing demand for multi-standard and multi-band systems has confronted the designers of clocking systems with a wide range of architecture and circuit challenges. In particular, an agile wideband coverage of frequency is required while demanding ultralow phase noise and spurs at both close-in and far-out offset frequencies. This in turn had dictated the need to understand – at the fundamental level – the key operation principles of digital frequency synthesis as well as various PLL sub-components in order to tradeoff architectures and adjust design knobs to arrive at the optimum performance for a particular application. This short course will cover at both macro and micro levels a wide range of topics related to the design of high performance PLLs and digital synthesizers. An overview of the main design principles followed by the architecture challenges will set the stage for a detailed consideration of key RF circuits and techniques that can be utilized to overcome these challenges. The course will also cover some simple modeling techniques to analyze the time and frequency domain behavior of PLLs and synthesizers. This course is intended for design, application and test engineers as well as technicians interested to learn about the PLL and synthesizer behavior as well as key and fundamental aspects at both architecture and circuit levels.

Cognitive Processing for Radar Systems: From Theory to Practice **8:30am—12:00pm**

Graeme E. Smith, Research Assistant Professor. Radar systems, cognition for sensing, bioinspired signal processing, passive radar, radar target recognition, and micro-Doppler

The tutorial provides an introduction to cognitive processing for radar systems. The emphasis is placed on how the emerging theories can be taken and applied in practice. Essentially, an attempt is made to answer the question *How does one build a cognitive radar?* The meaning of cognition, from an engineering perspective, is discussed and a case is made as to why future radar system needs to be cognitive. From this base position techniques by which cognitive-like algorithms can be developed are discussed and the role of bioinspired signal processing considered. A mathematically rigorous, generalized cognitive framework will be introduced and examples of its use in experimental tests given. Further examples will be provided of how cognition can be, and in some cases already is, used in radar processing. The tutorial will close with remarks on how the radar engineering community can move forwards with cognitive processing as a new part of its design toolkit.

Propagation over the Sea: Mechanisms & Models **1:30pm—5:00pm**

Caglar Yardim, Research Scientist. Electromagnetic theory, lower atmospheric propagation, sea clutter

Non-standard propagation in Earth's atmosphere can play an important role in radar and communication system design, particularly for systems operating near the coast or at sea. Ducting propagation mechanism can cause changes in radar system performance, including the presence of coverage holes, extended detection ranges, and increased clutter. The ducting mechanism depends on meteorological properties, so that understanding and forecasting ducting effects involves coupling electromagnetic and geophysical information. This short course will introduce the basic physical mechanisms of ducting propagation, and describe the standard techniques used to describe the related atmospheric properties and to forecast the impact on radio frequency propagation. Current research activities at the ElectroScience Laboratory involving both measurements and models for ducting propagation will also be presented.

THE OHIO STATE UNIVERSITY

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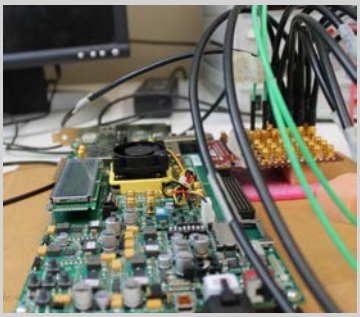
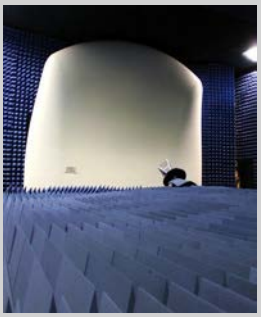
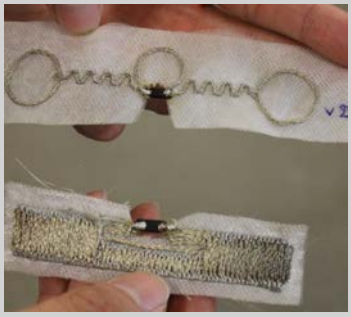

The Ohio State University's ElectroScience Laboratory Presents

August 3-5, 2016

The ElectroScience Laboratory Short Courses: A three-day event featuring 10 short courses from renowned experts on electromagnetics, RF, antennas, radar, photonics and more.

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Attend live in Columbus, Ohio, or remotely online.
Get details and register online at: https://electroscience.osu.edu/esl-short-courses