ESL SHORT COURSES

August 5-7, 2015

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 20, 2015

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

Hilton Garden Inn Columbus- University Area
3232 Olentangy River Road Columbus,
OH 43202
614-263-7200

Each in-person short course registration fee includes the cost of tuition, breaks and lunches. Should you cancel before July 20, 2015, the registration fee will be refunded minus a $50 administration fee. No refunds will be made after the registration deadline, July 20.

Accommodations

Hilton Garden Inn Columbus- University Area
614-263-7200
Rate: $119/night (ask for the OSU rate)

Springhill Suites Marriott OSU
1421 Olentangy River Rd., Columbus, 43212
614-297-9912
Rate: $124/night (group code: ESL Short Courses Conference)

The Blackwell (located on OSU campus) 2110 Tuttle Park Pl., Columbus, 43210
614-247-4000 or 866-247-4003
Rate: $135/night (ask for the OSU rate)

Further Information

Visit the event website or contact:

Dr. Greg Creech
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Michelle Diefenbach
614-292-6191, diefenbach.8@osu.edu

Schedule & Course Descriptions

Wednesday August 5, 2015

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 included. Important TR features such as superresolution arising from multipath exploitation in rich scattering environments and statistical stability arising from frequency decorrelation under ultra-wideband operation will be explained. Further, application of TR-based techniques to enhance performance of iterative inverse scattering algorithms will also be considered.

UHF RFID Antennas, Tags and System Design **1:30pm—5:00pm**

Bob Burkholder, Research Professor. Electromagnetic modeling, radar scattering and imaging, and RFID

Radio Frequency IDentification (RFID) is showing up everywhere in the "Internet of things" as a means of remote wireless identification of any tagged item. This course will provide a brief introduction to the different types of RFID systems and focus on passive UHF readers and tags. Robust design principles for general purpose tag antennas will be presented, as well as more specialized applications such as tags for metal surfaces and for embedding inside materials. Additional topics to be covered include reader antennas, system design, tag locating algorithms and RFID sensors.

Thursday August 6, 2015

Integrated Photonics **8:30am—12:00pm**

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.

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

Graeme E. Smith, Research Scientist. 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.

Thursday August 6, 2015 (cont.)

High Resolution and Target Classification **1:30pm—5:00pm**

Chris Baker, Ohio Research Scholar, Professor. Coherent radar techniques, radar signal processing, radar signal interpretation, and radar imaging

Two dimensional high-resolution radar imaging is fundamental to many civilian and military radar applications and today is utilized in a very wide variety of applications. Map-like imagery provides detailed and real time information about the surface of the earth, objects located on the surface and can also enable imaging of airborne targets. High resolution radar imaging provides data for climate change modeling, crop growth, de-forestation and erosion estimation as well as being a key military surveillance tool. This short course will introduce the key concepts that underpin high resolution profiling and imaging using radar sensors. Particular emphasis will be given to Synthetic Aperture Radar (SAR), the workhorse tool of the remote sensing and military surveillance communities. In addition, its natural counterpart, Inverse Synthetic Aperture Radar (ISAR) used for imaging moving objects will be described along with methods for 3-D imaging that use interferrometric SAR (InSAR). The short course will also explore image interpretation and information extraction, concentrating on target classification, high resolution target signatures, classification processes, performance descriptors and multi-perspective target classification.

Friday August 7, 2015

Wideband PLLs and Frac-N Synthesizers for SDRs; 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 PLLs and Frac-N synthesizers 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 various PLL sub-components as well as how to tradeoff the 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 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.

RF Micro-Electro-Mechanical Systems and Devices **8:30am—12:00pm**

Nima Ghalichechian, Research Scientist. Reconfigurable antenna arrays and RF systems, mm-wave and terahertz microsystems, novel materials, and microfabrication processes

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 ($1\ \mu m=10^{-6}$ 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 short 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 such as RF MEMS switches will be presented. In the second half of this lecture, advanced RF concepts will be introduced. During this lecture, we hope the attendees acquire better understanding of a) the field of MEMS, b) fundamentals of microfabrication, c) reconfigurable antennas and RF systems, d) and challenges in realization of millimeter-wave and terahertz systems.

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.

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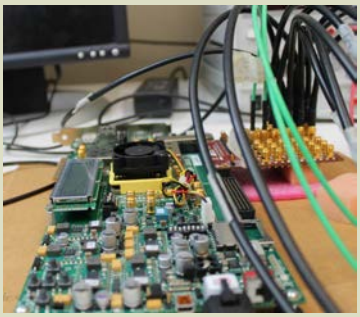
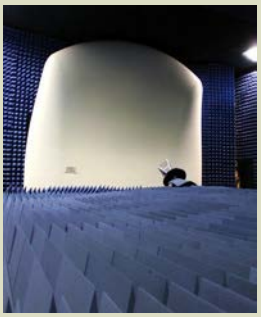
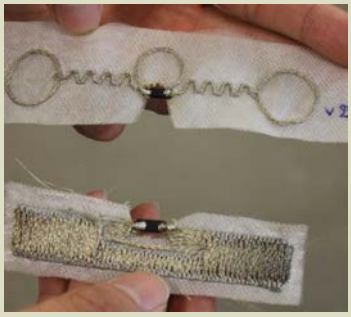

The Ohio State University's ElectroScience Laboratory Presents

August 5-7, 2015

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