University of Pavia

Ph.D. School in Microelectronics

SEMINAR

mmWave-to-THz-to-Nano-optical Systems in Silicon: A Circuits-Systems-EM Codesign Approach

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Aula Seminari, ex Dipartimento di Elettronica, Piano D

Our ability to synthesize, control and detect electromagnetic fields across the spectrum in integrated chip-scale technologies have followed a quasi-Moore law allowing us access over a spectrum orders of magnitude larger than we have had at any point in time. In future, as sensing and communication converges across this enormous EM spectrum potentially shared among trillions of devices, enabling a seamless co-existence will require these participating devices to be able to sense available resources, make intelligent decisions and reconfigure accordingly.

In this talk, I will focus on how a co-design approach connecting circuits, EM and systems can result in fundamentally new architectures and methodologies across mm-Wave-to-THz-optics. In the mm-Wave and THz frequencies, the chip dimension becomes comparable to the order of the wavelengths leading to interesting radiating and scattering properties. Exploiting this, I will present a single chip THz spectroscope across 30-350 GHz that eliminates the classical spectrum analysis architecture including complex LO sources tunable across GHz-THz, mixers, amplifiers and reduces the entire receiver with a single on-chip scatterer and near-field detectors. I will also present a multi-port mm-Wave transmitter design that exploits a network synthesis approach to enable a frequency programmable architecture that can efficiently address the widely disjoined mm-Wave spectrum for future 5G networks and beyond.

At optical frequencies, where the wavelength becomes comparable to the smallest lithographic features in silicon, I will provide example on how metal-light interactions with sub-wavelength metal interconnect layers embedded in modern-day silicon processes can be exploited to enable complex multi-functional nano-optical components in the visible range. I will the first demonstration of nano-plasmonic components in CMOS and present examples of integrated optical SOCs such a optics-free single chip fluorescence-based bio-molecular sensor array, single-chip optical spectrometer in the visible range and an all-optical physically unclonable function in CMOS.

Bio: Dr. Kaushik Sengupta received the B.Tech. and M.Tech. degrees in electronics and electrical communication engineering from the Indian Institute of Technology (IIT), Kharagpur, India, both in 2007, and the M.S. and Ph.D. degrees in electrical engineering from the California Institute of Technology, Pasadena, CA, USA, in 2008 and 2012, respectively. In 2013, he joined the faculty of the Department of Electrical Engineering, Princeton University, Princeton, NJ, USA.

He received the Young Investigator Program Award from Office of Naval Research in 2017 and twice enlisted in the `Princeton Engineering Commendation List for Outstanding Teaching'. He was the recipient of the Charles Wilts Prize in 2013 from Electrical Engineering, Caltech, the Caltech Institute Fellowship and the Prime Minister Gold Medal Award of IIT (2007). He serves on the Technical Program Committee of IEEE Custom Integrated Circuits conference and European Solid-state Circuits Conference. He was the recipient of the IBM Ph.D. fellowship (2011), the IEEE Solid-State Circuits Society Pre-doctoral Achievement Award (2012), the IEEE Microwave Theory and Techniques Graduate Fellowship (2012), and the Analog Devices Outstanding Student Designer Award (2011). He was the co-recipient of the IEEE RFIC Symposium Best Student Paper Award in 2012 and co-recipient of the 2015 Microwave Prize from IEEE Microwave Theory and Techniques Society.

Organizer

Prof. Francesco Svelto

Ph.D. Coordinator

Prof. Guido Torelli

The seminar will be held in English

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