ELECTRICAL AND COMPUTER ENGINEERING SEMINAR

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Next Generation of Smart Wireless World: from High Data-Rate Mm-wave Directional Arrays to Reliable and Secured IoT Connectivity for 5G and Beyond

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3:00pm-4:00pm

Abstract: The next generation of smart wireless world requires massive and reliable connectivity as well as high datarate communication and sensing. Consequently, the immediate response of the wireless world is acquiring the mm-wave (MMW) wireless band (30 GHz–300 GHz) and the development of 5G and beyond. The major challenge of deploying high data-rate communication system at MMW frequency bands is the channel fading and multi-path diffraction effect. Hence, multiple-element transceivers such as scalable "directional" phased array or massive MIMO are required. Moreover, the next generation of wireless world is expected to have over one trillion Internet of Things (IoT) devices connected, requiring secured connectivity such as protection against interference, jammers, and eavesdroppers

In this talk, I will present novel techniques to overcome the challenges for future scalable high data-rate MMW transceiver array from silicon circuit toward RFIC system and packaging. This includes parasitic-insensitive, powerefficient, and wideband 2x2 arrays of injection-locked oscillators for efficient local oscillator (LO) distribution and phase shifting (circuit technique), image selection Weaver architecture to significantly reduce the required bandwidth of the LO generation circuitry for the MMW system from conventional 20% to only 4% (RFIC architecture), and compact differential aperture coupled LO distribution feed network for compact and scalable antenna-IC integration (packaging). I will also discuss several future directions toward high-frequency signal generation and modulation based on integrating the circuit and electromagnetics fundamental theories for communication and sensing above 100 GHz, namely, as 6G.

On the other hand, employing "directional" antenna for interference/eavesdropper cancellation for IoTs suffers from side-lobe leakage and requires accurate beam alignment and localization. In this talk, I will present a novel embedded architecture for distributed IoT network that utilizes a master-slave full-duplex communication using omnidirectional antenna to exchange a random modulated phase shift as the secret key while canceling out the eavesdropper effect. I will also discuss two future directions for interference cancellation from circuit level to system level; from cooperative and distributed pulse coupled synchronization for dynamically interference cancelling towards wideband interference canceller/filter at RF front-end of IoT devices using single antenna to turn the radio with one-bit ADC into reality

Bio: Najme Ebrahimi is a Post-Doctoral Research Fellow at the University of Michigan (U-M) since September 2017. At the University of Michigan, she is mainly conducting research on both mm-Wave/THz high data rate communication and sensing in addition to the connectivity of the next generation of distributed Internet-of-Things network. She earned her PhD from the University of California, San Diego (UCSD) in June 2017, with thesis emphasize on enabling high data rate and scalable mm-wave phased array for the next generation of smart wireless world. She received her MS degree and BS degree, with highest honors, from Amirkabir University of Technology, Tehran, Iran, in 2011 and Shahid Beheshti University, Tehran, Iran, in 2009, respectively.

She is a member of IEEE Solid-State Circuits and IEEE Microwave Theory and Techniques societies. She is the recipient of PhD Endowed Graduate Fellowship from UCSD (2012-2013) and U-M Departmental Postdoctoral Fellowship (20172019). She is currently serving as the vice-chair of IEEE Southeastern Michigan for Microwave Theory and Techniques Chapter where she is awarded MTT-s Travel Grant (2019). She is selected as 2019 EECS Rising Star by MIT launched Rising-star program and 2020 ISSCC Rising Star by IEEE Solid-State Circuits Society.