Recent Advances in Millimeter-wave Silicon Photonics Circuits for Wireless Communications

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Abstract: Nowadays, continuously growing wireless traffic shapes the progress in the wireless communication systems. Therefore, next generation of wireless communication systems are actively investigated to accommodate expanding data traffic of the future. As one of the promising candidates, silicon photonics devices and circuits are able to improve the performance of the future wireless system.

In this seminar, potential hybrid-integrated mm-wave silicon photonics receivers for future wireless communication systems are explored. The proposed mm-wave silicon photonics reconfigurable receiver front-end can be programmed as either a mm-wave band-pass filter (BPF) for channel selection or a mm-wave notch filter for jammer rejection in adjacent and alternate channels within 20-43.5 GHz frequency range. This photonically-assisted mm-wave receiver is optimized for minimum noise figure (NF), maximum linearity or third-order input intercept point (IIP3) and maximum signal to noise ratio (SNR) by optical modulator bias control and optical amplification. Meanwhile, silicon photonics devices are vulnerable to process and temperature variations. As a result, they require manual calibration, which is expensive, time consuming, and prone to human errors. Therefore, precise automatic calibration solutions with modified monitor-based silicon photonic filter structures are demonstrated and employed in the mm-wave silicon photonics receiver. Also, thermal crosstalk effect in the photonic devices is investigated, and substrate thinning is proposed to suppress this effect and reduce calibration time to less than half. The proposed monitor-based tuning method compensates fabrication variations and thermal crosstalk by controlling micro-heaters as tuning elements individually using electrical monitors. This approach successfully demonstrates calibration and dynamic tuning of silicon photonics filters in the mm-wave receiver from severely degraded initial magnitude response to a well-defined magnitude response.

Biography:

Kamran Entesari received his Ph.D. degree from University of Michigan Ann Arbor, in 2005. In 2006, he joined the Department of Electrical and Computer Engineering at Texas A&M University, College Station, where he is currently a Professor. His research interests include the design of RF/mm-wave integrated circuits and systems, and integrated RF/mm-wave photonics for wireless communications and sensing.

Prof. Entesari was a recipient of the 2017 and 2018 Qualcomm Faculty Award, and the 2011 National Science Foundation CAREER Award. He was the corecipient of the 2009 Semiconductor Research Corporation Design Contest Second Place Award, the Best Student Paper Award of the IEEE RFIC Symposium in 2014 (second place), the IEEE Microwave Theory and Techniques Society award in 2011 (third place), and the IEEE Antennas and Propagation Society award in 2013 (Honorable Mention). He is currently a Technical Program Committee Member of the IEEE RFIC Symposiums and was an Associate Editor of the IEEE Microwave and Wireless Components Letters and a Member of Editorial Board for IEEE Solid-State Circuits Letters. He has published more than 150 peer-reviewed IEEE journal and conference papers.

Hosted by Prof. Hossein Hashemi, Prof. Mike Chen and Prof. Constantine Sideris
Organized and hosted by Vinay Chenna (vchenna@usc.edu).