ISTeC
The Information Science and Technology Center

COLORADO STATE UNIVERSITY

Distinguished Lectures

Spring 2023

Dr. Ray T. Chen

Keys and Joan Curry/Cullen Trust Endowed Chair Professor
Electrical & Computer Engineering
The University of Texas, Austin

ISTeC Distinguished Lecture

Silicon Photonics for Artificial Intelligence and Machine Learning

Monday, May 1, 2023
Reception with refreshments: 8:30 a.m.
Lecture: 9:00 a.m.-10:00 a.m.
Computer Science Building 130

Special Seminar

Integrated Photonics for Smart Sensing and Optical Computing

Monday, May 1, 2023
Lecture: 4:00-5:00 p.m.
Lory Student Center 328-330

Sponsored by
Information Science and Technology Center (ISTeC)
In conjunction with the Department of Computer Science and Department of Electrical and Computer Engineering Seminar Series

Abstracts

Silicon Photonics for Artificial Intelligence and Machine Learning

The saturation of Moore's law becomes a reality for semiconductor industry. Integrated photonics is a promising technology as next-generation efficient AI solution due to its ultra-high computational speed and ultra-low energy consumption. The intrinsic bottlenecks affiliated with electronics such as skin effects and dielectric constant loss and transmission line charging effects due to increased lumped elements are becoming serious problems for packaging and power consumption. The availability of silicon photonics foundry services also play an important role for the realization of chip-based neuromorphic computing. Photonic AI chips has many advantages compared to electronic AI accelerators, such as ultra-fast execution speed, >100 GHz photo-detection rate. Photonic chips also support implementing massively parallel MAC operations. Photonic chips can also consume near-zero energy consumption if weight matrix is configured. Theoretically, photonic AI accelerators can be orders of magnitude better than electronic AI accelerator in both speed and energy consumption.

Integrated Photonics for Smart Sensing and Optical Computing

Integrated photonics is poised to revolutionize inter-and intra-data center communications since internet traffic continues to increase exponentially making it difficult and costly for existing switching and interconnects in data centers to cope with the fast-growing bandwidth requirement. Silicon photonics is able to contribute data centers in terms of the lower cost, higher bandwidth, and lower power consumption. Integrated photonics is believed to have reached the tipping point with a surging global market. Besides the optical interconnects, silicon photonics also shows promise in abundant applications, ranging from high performance optical computing and autonomous cars, to biomedical sensing and even aerospace applications. In this seminar, an overview of the silicon photonics as well as a potential trend for 2023 and beyond will be provided. First, the recent development of optical components including passive and active modules as well as optical circuits in silicon photonics will be presented. Second, as Moore's law has been approaching the physical limitation, photonics-based high-performance computing is envisioned as a potential answer to the continuation of Moore's law. We demonstrate various photonic chips for digital and analog computing. This paves the way to the future integrated high-speed and power-efficient optical computing. Sensing related applications will also be addressed in the presentation. Finally, silicon photonics for bio-and chemical sensing applications such as CWAs (chemical warfare agents) will also be presented.

Speaker Biography

Ray Chen is the Keys and Joan Curry/Cullen Trust Endowed Chair at The University of Texas Austin. Chen is the director of the Nanophotonics and Optical Interconnects Research Lab, at the Microelectronics Research Center. He is the director of the AFOSR MURI-Center for Power-Efficient Silicon Nanophotonics for Optical Computing and Interconnects. His research work has been awarded over 150 research grants and contracts from such sponsors as Army, Navy, Air Force, Space Force, DARPA, MDA, NSA, NSF, DOE, EPA, NIST, NIH, NASA, the State of Texas, and private industry. His research is focused on four main subjects: (1) Nano-photonic passive and active devices for neuromorphic computing, sensing and interconnect applications, (2) Thin film guided-wave optical interconnection, computing and packaging for 2D and 3D laser beam routing and steering, (3) True time delay (TTD) wide band phased array antenna (PAA), and (4) 3D printed micro-electronics and photonics. Experiences garnered through these programs are pivotal elements for his research and further commercialization. Chen's group at UT Austin has reported its research findings in more than 1000 publications, including over 100 invited papers and 74 patents. He has chaired or been a program-committee member for more than 130 domestic and international conferences organized by IEEE, SPIE OSA, and PSC. He graduated 58 PhD students so far from UT Austin. He has served as an editor, co-editor or coauthor for over twenty books. Chen has also served as a consultant for various federal agencies and private companies and delivered numerous invited talks to professional societies. Chen is a Fellow of the National Academy of Inventors, IEEE, OSA, and SPIE. systems.

To arrange a meeting with the speaker, please contact Prof. Mahdi Nikdast {Mahdi.Nikdast@ColoState.edu}.

ISTeC (Information Science and Technology Center) is a university-wide organization for promoting, facilitating, and enhancing CSU's research, education, and outreach activities pertaining to the design and innovative application of computer, communication, and information systems. For more information please see ISTeC.ColoState.edu.