2024 Spring
DGIST EECS Colloquium

Date & Time Tuesday, March 19th at 4:30 pm
Venue E3 112

Programmable Photonic Circuits with MEMS : Photonic FPGA and More

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Abstract

The concept of programmable photonic circuits has been studied and developed extensively in the last few years. It has shown great potential in cutting-edge applications, including machine learning, quantum computing, radio frequency (RF) signal processing, and hardware accelerators. This concept, the so-called field-programmable photonic gate array (FPPGA), can evolve into a truly general-purpose photonic circuit if we successfully implement it on a large scale. However, there are several hurdles to scaling, including a large footprint, high power consumption, and high optical loss. These issues mainly originate from the low-efficient tuning mechanisms of photonic circuits. Thermo-optics, the most commonly used method, constantly dissipates heat to the surrounding area, and therefore it consumes large power even when the circuits are in static states. In addition, thermal crosstalk between the elements prevents increasing their integration density.

On the other hand, the MEMS-based tuning mechanism has shown its potential to implement large-scale photonic circuits by demonstrating large-scale photonic switches. The large scalability of the technology originates from its tuning mechanism that allows moving optical building blocks using an extremely small amount of power. By moving optical elements, large index contrast can be created, and therefore large optical effect follows. The electrostatic actuator creating the movements is just a simple variable capacitor that consumes electrical power only when the state of the elements is changing. Our team has been developing various MEMS-tunable photonic components for power-efficient and low-loss photonic circuits. We have demonstrated programmable photonic processors directly applicable to classical and quantum photonics applications using the MEMS-tunable elements. In this talk, we will show our recent progress on MEMS-based programmable photonic circuits and their perspective on large-scale photonic systems on a chip [1].

Reference

[1] Kim, D.U., Park, Y.J., Kim, D.Y. et al. Programmable photonic arrays based on microelectromechanical elements with femtowatt-level standby power consumption. Nat. Photon. (2023). https://doi.org/10.1038/s41566-023-01327-5

Biography

Sangyoon Han is an assistant professor at DGIST, Korea. He received the B.S. degree in Electrical Engineering from the Seoul National University in 2010, and the Ph.D. degree in Electrical Engineering and Computer Sciences from the University of California, Berkeley in 2016. Before joining DGIST, he served his mandatory Korean military service as a postdoctoral researcher at the physics department, KAIST, Korea. His research interests include silicon photonics, non-linear optics, MEMS, heterogeneous integration, and LiDAR. He has authored and co-authored over 30 papers in leading technical journals and conferences.

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