Electrical & Computer Engineering

S E M I N A R

Louisiana State University

Reconfigurable active photonics and applications in sensing systems

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Abstract—Reconfigurable active photonics harnesses the nonlinear light-matter interactions in active materials to create ultrafast modulation responses, reconfigurable mode profiles, and quantum entanglement on a scalable integrated platform. Combining recent advances in both fundamental physics and fabrication technologies, large-scale reconfigurable active photonics promises revolutionary solutions to communications, sensing, and imaging in both classical and quantum regimes. In this talk, I will first show our recent progress in controlling the collective behaviors in large-scale multimode photonic systems to generate high-brightness, dynamically tunable coherent illumination. We experimentally demonstrated record-breaking intensity enhancement and robust reconfigurability in two-dimensional microlaser arrays using design modalities guided by symmetry and topology. Beam steering and ultrafast dynamical modulation were demonstrated using mechanisms intrinsic to the nonlinearity of the system. In the second part, I will discuss active sensing systems that harness reconfigurable structured illumination generated on the chip, including ultraminiature 3D imaging modules and quantum imaging schemes surpassing the classical resolution limit. Finally, I will conclude by presenting my vision for this integrated optical platform, outlining its usages, including fully integrated lensless imaging, scalable quantum state generation and detection, and optical computing.

Bio—Dr. Zihe Gao is a postdoctoral researcher at the University of Pennsylvania. Zihe received the B.S. degree in physics from Nanjing University, the M.S. degree in physics, and the Ph.D. degree in Electrical Engineering from the University of Illinois at Urbana-Champaign. Prior to joining Penn in 2020, he was a postdoctoral research scientist at the Meta Reality Labs. His research interests include reconfigurable photonic devices, high-speed dynamics in coupled nonlinear resonators, quantum illumination projectors, and their applications in communications, sensing, and computing in both classical and quantum regimes.

When: Monday, **6 March 2023,** 11:30 - 12:30
Where: Room 3316E Patrick F. Taylor Hall
Info: `https://www.lsu.edu/eng/ece/seminar`