Large-Scale Photonic Computing Empowers Artificial General Intelligence

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The rapid development of artificial intelligence imposes extensive challenges in computing power, scalability and efficiency for next-generation computing systems. Recent progresses of photonic computing have shown great potential in superior processing speed, scale expandability, and energy efficiency. Photonic computing is becoming a competitive successor of digital electronics, and is making its own way to support modern artificial general intelligence (AGI).

This talk begins with large-scale photonic distributed computing architectures and integrated diffractive-interference-hybrid photonic models. Taking the Taichi chiplet as a demonstration, the talk presents the large-scale capability of integrated photonics in various advanced tasks with hundred-TOPS/W-level efficiency. This talk then explores the spatial symmetry and Lorentz reciprocity in photonics, demonstrating a full-forward-mode training method for precise and high-throughput photonic machine learning. The talk highlights that the compute-intensive training process can be implemented with on-site physical system while alleviating the constraints from numerical modelling. Together, these innovations exploit the high parallelism and connectivity of wave optics, paving a viable route for photonic AGI to support applications in beyond-billion-neurons foundation models, unmanned-system edge computing, *etc.*