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Submission deadline: 15th January 2027

Driven by large language models, generative artificial intelligence(AI), GPU/TPU supercomputing clusters and hyperscale data center expansion, modern optical communications and optical networking systems are facing unprecedented multi-dimensional performance constraints: exponential bandwidth demand, ultra-rigorous latency thresholds, strict power consumption caps, compact chip/package area budgets, and complex dynamic traffic fluctuation across inter-rack, inter-data-center and long-haul transmission layers. On the one hand, traditional rule-based optical interconnect design and static digital signal processing (DSP) equalization can no longer satisfy the stringent requirements of AI-native computing infrastructure. Conventional 112G/224G electrical and optical interconnect architectures hit critical bottlenecks in signal integrity, energy efficiency and bandwidth density when scaling up to massive AI accelerator pools. Emerging beyond 224G optical interconnect paradigms, including 448G/lane, 1.6T and 3.2T transceivers, co-packaged optics (CPO), silicon photonic integrated circuits, introduce new trade-offs among data rate, latency, power dissipation, chip/package area footprint, linear and nonlinear channel distortion.

On the other hand, AI has become the pivotal driving force to break the bottlenecks of high-speed optical interconnection. A wide range of AI technologies are widely adopted, including deep learning nonlinear impairment compensation for high-speed links, reinforcement learning multi-objective co-optimization of photonic devices, neural network-based dynamic optical network resource scheduling, and generative AI automatic layout design for silicon photonic chips. These innovations greatly improve the transmission efficiency of terabit optical links, reduce overall energy overhead, and realize autonomous monitoring, fault diagnosis and intelligent operation of optical networks tailored for distributed AI training and edge inference tasks.

This special issue aims to collect cutting-edge research achievements of AI-driven optical interconnects, intelligent optical systems and next-generation beyond-224G

optical interconnection hardware. We welcome original works covering photonic device design and fabrication, AI signal processing, intelligent optical networking, multi-dimensional latency-power-performance-area optimization, and practical deployment of AI-driven terabit interconnect systems. By gathering frontier outcomes from global researchers, this issue intends to deliver a comprehensive overview and forward-looking insights and boost cross-disciplinary breakthroughs between AI and optical interconnect technologies.

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