IEEE AWPL Special Cluster 2027 on
"Emerging Physical Computing Paradigms for Antennas and Wireless Intelligence"

Wireless systems are evolving beyond information transfer toward integrated communication, sensing, computing, learning, and adaptation. Conventional wireless architectures rely heavily on repeated signal conversion, memory transfer, and digital processing, introducing increasing challenges in latency, energy efficiency, and scalability. Physical computing offers a complementary paradigm in which electromagnetic (EM) waves, radiating apertures, devices, materials, and propagation environments directly participate in processing information. By transforming EM interactions and material responses into computational resources, physical computing opens new opportunities for embedding sensing, inference, and adaptive intelligence directly into antennas, devices, and wireless propagation environments.

The purpose of this Special Cluster is to provide a forum for advancing and disseminating emerging research on physical computing paradigms for antennas and wireless intelligence. We invite original theoretical, modelling and experimental contributions exploring wave-based, neuromorphic, quantum computing, computational and memory-enabled metasurfaces, adaptive antennas and reconfigurable intelligent surfaces (RIS), intelligent propagation environments, nonlocal and topological EM platforms, advanced integrated sensing and communications (ISAC), in-memory and microwave photonic processing, and hybrid physical and optical computing architectures. By bringing together fundamental advances in EMs, emerging computing architectures, and practical wireless systems, this Special Cluster provides an interdisciplinary forum for advancing the next generation of intelligent, energy-efficient, and adaptive wireless technologies. Topics of interest include, but are not limited to:

- Physical and analog EM computing using metamaterials, metasurfaces, and advanced wave manipulation;
- Neuromorphic computing, physical neural networks, and reservoir computing for radio frequency (RF), microwave, mmWave and terahertz (THz) applications;
- Computational, programmable, and adaptive metasurfaces with integrated memory and computing capabilities;
- Advanced reconfigurable antennas, adaptive arrays, and intelligent reflecting surfaces for real-time EM control;
- Intelligent and programmable propagation environments for wireless communications, localization, and embedded computation;
- Nonlocal metamaterials, spatially dispersive media, and emerging EM materials for information processing;
- Quantum technologies and quantum-inspired computing for EM systems, and related wireless applications;
- Topological, nonlinear, non-Hermitian, and time-varying EM platforms for robust wave manipulation and unconventional computing for sixth generation (6G) and beyond;
- Integrated EM processing within antennas and sensors for radar, imaging, spectrum awareness, distributed detection, and ISAC;
- In-memory computing and processing using EM materials, programmable devices, and emerging hardware architectures;
- Microwave photonic and optical analog computing for RF signal processing, beamforming, classification, and high frequency applications;
- Hybrid physical and digital computing architectures with joint optimization of antennas, propagation channels, and computing hardware;
- Experimental demonstrations, prototype development, and benchmarking of physical computing systems in terms of bandwidth, latency, energy efficiency, scalability, and robustness.

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Submission Instructions

Prospective authors may contact the Guest Editors regarding suitability. Manuscripts must follow regular IEEE AWPL instructions (maximum four pages of technical content plus one reference page, IEEE double-column format), available at the Information for Authors website. The cover letter to the Editor-in-Chief should identify the submission as a response to this Special Cluster Call for Papers.

Key Dates:

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Revised manuscripts deadline: June 15, 2027
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