

IEEE AWPL Special Cluster 2026 on “AI/ML-driven Wireless Propagation and Channel Modeling”

Wireless channels are the foundation of communication systems, and the integration of Artificial Intelligence (AI)/Machine Learning (ML) has opened a transformative paradigm for channel modeling, environmental sensing, simulation, and estimation. This Special Cluster aims to gather cutting-edge research that leverages AI/ML to address key challenges in wireless propagation and channel modeling, supporting the advancement of 5G-Advanced, 6G, and beyond systems.

The purpose of this special cluster is to provide a forum to disseminate the latest research addressing AI/ML-driven innovations in wireless propagation and channel modeling, a transformative direction for advancing 5G-Advanced, 6G, and beyond communication systems. We invite researchers to contribute original papers that describe emerging AI/ML-based methods, frameworks, and applications that advance the state-of-the-art in channel characterization, estimation, prediction, simulation, and propagation environment sensing. Furthermore, the topic area extends to include the intricacies of AI/ML integration tailored specifically for addressing non-stationary, heterogeneous, and complex 6G channel scenarios. The editors welcome theoretical and experimental works that address the following topics:

- AI/ML-driven channel parameter estimation and real-time channel estimation
- Data-driven channel prediction, inference, and radio-map generation
- Deep learning-based mapping between propagation environments and channel characteristics
- AI-enabled channel simulation frameworks and propagation environment reconstruction
- ML-optimized array signal processing for channel characterization
- AI/ML-driven interference prediction, mitigation, and dataset-driven modeling
- AI applications in 6G channel measurements, non-stationary channel modeling, and heterogeneous scenario adaptation

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Prospective authors are encouraged to contact the Guest Editors for any questions or to determine the suitability of their contribution for this special cluster. Papers should be prepared following the same submission instructions as for regular IEEE AWPL manuscripts (four-pages technical content maximum and one reference page, double-column, IEEE format), available via the Information for Authors website. The authors should indicate in the cover letter to the Editor-in-Chief that the manuscript is being submitted in response to the Call for Papers for the focused cluster. Prospective authors should refer to the timeline below for key dates.

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- Submission deadline: **March 31, 2026**
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IEEE AWPL Special Cluster 2026 on “Dielectric antennas from the microwave to the terahertz range, and beyond”

Dielectrics do not carry conduction current, and so are unaffected by Ohmic loss. Whilst this sort of loss is tolerable in the RF and microwave ranges, it worsens with increasing frequency, leading to inefficient systems in the mm-wave region and beyond. This was a key motivation behind the invention of the dielectric resonator antenna (DRA), as well as the prolific use of grating couplers (essentially dielectric leaky-wave antennas), in the lightwave range. This dielectric-centric paradigm is also gaining momentum in the terahertz range, for emerging efficient 6G wireless systems and standoff sensing applications. Another benefit of dielectric antennas is the great versatility of dielectric composites—control over permittivity and permeability, as well as magnetization i.e. using ferrites, and localizable loss e.g. with carbon-based materials—expanding the design space. This freedom is further enhanced by the potential to realize exotic geometries e.g. through 3D-printing techniques.

This special cluster is dedicated to the innovative use of dielectric materials to realize novel radiating structures. Researchers are invited to contribute original papers that describe state-of-the-art antennas across the electromagnetic spectrum, featuring prominent and innovative usage of dielectric materials in their radiation mechanism. The editors welcome theoretical and experimental work that addresses the following topics:

- All-dielectric, metal-free antennas
- Dielectric resonator antennas
- Integrated quasi-optical antennas and arrays
- Composite materials in antennas
- Dielectric rod antennas, and tapered edge-couplers
- Grating couplers and dielectric leaky-wave antennas
- GRIN-lens antennas (e.g. Luneburg lens)
- Effective media, dielectric metamaterials, and photonic crystals in antennas
- Photo-doped reconfigurable antennas
- Liquid dielectric antennas
- 3D-printed ceramic and polymer antennas
- Ferrites in antennas

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IEEE AWPL Special Cluster 2026 on
“Emerging Trends in Electromagnetic Sensing and Imaging: System Design, Algorithms, and Applications Across the Spectrum”

Electromagnetic sensing and imaging technologies have undergone significant evolution, enabling a wide range of applications across diverse domains. At microwave frequencies, traditional applications include radio detection and ranging, synthetic aperture radar, beam forming, beam steering and ground penetrating radar with widespread use in security and surveillance. In the medical field, imaging spans from conventional ionizing X-ray techniques to emerging non-ionizing microwave medical imaging and diagnostics. Although the system configurations may appear similar, the underlying mathematical models transition from far-field linear imaging problems to complex nonlinear inverse scattering problems in the near field. Beyond these established areas, novel applications continue to emerge—ranging from space exploration, automotive, industrial and agricultural sensing. This growing diversity highlights the importance of advancing system design, theoretical modeling, and algorithm development in electromagnetic sensing and imaging.

This Special Cluster aims to highlight recent advances— **from an electromagnetic perspective**— in all aspects of Electromagnetic Sensing and Imaging Systems (ESIS), in conjunction with **the use of artificial intelligence (AI) to break through traditional boundaries** in the following **four key components: sensor design, system configuration, signal pre-processing/processing, and image formation**. We invite high-quality submissions that present novel methodologies, innovative system architectures, and advanced algorithmic developments across these domains. The scope encompasses systems operating across a broad frequency spectrum, **from radio waves to terahertz radiation**, supporting a wide range of applications in both near-field and far-field environments.

Topics of interest include, but are not limited to, the following:

- Design of antenna, antenna array and meta-surface tailored for electromagnetic sensing and imaging applications.
- Modern manufacturing and fabrication techniques of antennas for sensing and imaging system (e.g. 3D printing).
- Innovative system configurations that leverage electromagnetic theory—for example, polarization diversity in radar sensing, impedance matching media for microwave-based medical diagnostics, and unique array architectures (e.g. multiple-input-multiple-output (MIMO) radar, passive radar) versus single-sensor systems (e.g. monostatic radar).
- Signal processing techniques that exploit electromagnetic insights, such as clutter suppression and background subtraction
- Methods for ranging, object detection, target classification, and automated recognition grounded in electromagnetic principles.
- Image reconstruction, including radar imaging and inverse scattering solutions that brings in novel electromagnetic insights
- Emerging applications across diverse domains, including medical (microwave, millimetre wave and terahertz imaging, cancer and stroke diagnosis, gait analysis, intelligent healthcare sensing), space (satellite sensing, space exploration and space mining), defense (security and surveillance, electronic warfare, automated target recognition, array signal processing, fast beamforming and beam steering), automotive sensing, as well as industrial and agricultural sectors (e.g., non-destructive testing).

We particularly welcome contributions that demonstrate the interplay between theoretical modelling, algorithm development, and experimental validation to push the boundaries to current electromagnetic sensing and imaging technologies.

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IEEE AWPL Special Cluster 2026 on
“Frontiers in the Glass-Based Manufacturing and Packaging: Design, Integration, and
Measurement of Antennas”

The relentless pursuit of higher data rates, integration density, and performance in 5G-Advanced, 6G, and electromagnetic sensing systems is accelerating the adoption of innovative packaging platforms. Leading semiconductor companies, including Samsung Electronics, have announced plans to integrate glass substrates into advanced semiconductor packaging by 2028—a move centered on replacing silicon interposers with glass interposers. Glass-based packaging has gained prominence owing to its superior material properties, such as ultra-low dielectric loss, excellent thermo-mechanical stability, and compatibility with large-area, cost-efficient panel-level processing. These characteristics position glass substrates as an ideal platform for highly integrated antenna-in-package (AiP) solutions, especially in millimeter-wave (mm-Wave) applications where minimizing interconnect loss is critical. By enabling co-design of antennas, active ICs, and passive elements, this technology facilitates the development of compact, high-efficiency radio-frequency front-end modules.

This special cluster aims to compile a collection of high-quality papers that highlight recent breakthroughs and address ongoing challenges in this rapidly evolving field. We solicit original contributions that explore innovative concepts, designs, fabrication techniques, and characterization methods for antennas and antenna systems within glass-based packages. The scope encompasses fundamental research, practical design methodologies, and system-level applications. Topics of interest include, but are not limited to:

- Novel antenna, antenna array, and metasurface designs on glass substrates;
- Co-design methodologies for multi-functional antennas integrated with ICs, filters, and other passives;
- Advanced system integration with glass substrate;
- Modeling of multi-physics effects (electromagnetic, thermal, stress);
- Advanced measurement, calibration, and over-the-air (OTA) characterization techniques;
- Panel-level fabrication, through-glass via (TGV) technology, and heterogeneous integration;
- Reliability, yield, and thermal management analysis for glass-based AiP modules;
- AI-assisted design, optimization, and performance prediction for glass-packaged antennas;
- Antenna solutions for chiplet-based architectures and high-power applications.

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IEEE AWPL Special Cluster 2026 on “Toward Intelligent Electromagnetic Sensing: AI-Driven Hardware Designs and Applications”

Electromagnetic (EM) sensing at microwave, millimeter-wave, and terahertz frequencies is rapidly expanding into applications such as human activity recognition, environmental monitoring, smart agriculture, healthcare, wireless power transfer, and autonomous driving. Emerging technologies like smart antennas, reconfigurable intelligent surfaces, and programmable apertures and metasurfaces enable dynamic EM wavefront control for enhanced information acquisition. Meanwhile, the rapid advancement of Artificial Intelligence (AI) and signal processing techniques facilitates the extraction of valuable insights from high-dimensional EM data. Moreover, the rapid evolution in Machine Learning (ML), particularly Deep Learning (DL) (e.g., CNN, RNN, GAN, LLM, Transfer Learning) has empowered AI-driven methods to achieve advanced functions such as antenna design, analog wave-domain computing, context-aware recognition, target classification, signal processing, and metamaterial agent – which further accelerates the development of intelligent EM sensing.

This special cluster aims to present cutting-edge developments in the theoretical and applied aspects of intelligent EM sensing, with a particular focus on advances in smart antenna (including metasurface) designs, propagation modelling, signal processing algorithms, and ML/DL/AI-based techniques. Contributions are sought in, but not limited to, the following areas:

- Novel antenna designs for EM imaging (e.g., RIS, reconfigurable antennas, holographic surfaces).
- Innovative OAM antenna designs (e.g. multi-mode OAM, divergence angle control) for applications in OAM-enabled sensing and communication systems.
- Progress in hardware architectures for integrated sensing and imaging, wireless power transfer, and integrated sensing and communication (e.g., localization, fingerprint prediction, target tracking).
- AI-assisted design and optimization of novel meta-devices (e.g., intelligent meta-imager/-recognizer, programmable topological metasurfaces, metamaterial agent).
- Deep learning techniques for sensing, imaging, DoA estimation, channel modelling (e.g. positioning, super-resolution imaging, gesture recognition, classification, sensing in IoT settings).
- Advanced antenna designs for other emerging sensing-related applications (e.g., automotive radar, freehand imaging, Ground-Penetrating Radar (GPR), biomedical imaging, non-destructive testing).

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**IEEE AWPL Special Cluster 2026 on
“Advanced Fluid and Reconfigurable Antenna Designs for Fluid Antenna Systems (FAS) in 6G
and Beyond”**

Sixth-generation (6G) wireless networks are anticipated to offer groundbreaking capabilities, including ultra-high capacity, exceptional reliability, extensive device connectivity, and integrated non-communication services. To meet these demands, next-generation reconfigurable antenna (NGRA) technologies have become essential for enabling adaptive wireless communications. The fluid antenna system (FAS) is an emerging paradigm that treats antenna as a software-controlled reconfigurable physical-layer resource focusing on utilization of the features of shape, position, aperture and radiation reconfigurability, broadening the scope of system and network optimization and inspiring NGRAs. State-of-the-art software-controlled reconfigurable structures, such as liquid-based mechanical antennas, RF pixel antennas, movable elements, massive/flexible arrays, and metasurfaces, to dynamically alter their physical properties (e.g., geometry, dimensions, spatial positioning, orientation) and radiation characteristics are examples that can help realize the concept of FAS. This approach represents a fundamental shift from conventional multi-antenna systems with fixed configurations. By leveraging ultra-fine spatial resolution and dynamic reconfigurability, FAS optimizes the use of spatial degrees of freedom, achieving significant performance improvements over traditional methods.

Despite these advancements, recent research has predominantly concentrated on system-level analysis of FAS within the communications community, including theoretical modeling, system optimization, coding, and modulation techniques. Practical antenna implementations and hardware realizations have received considerably less attention. This special issue seeks to bridge this gap by fostering, collecting, and disseminating the latest global developments in novel FAS topologies, design methodologies, and enabling materials. Potential topics include, but are not limited to:

- Prototype-validated FAS antenna designs
- Reconfigurable antennas for FAS (e.g., Reconfigurable reflect/transmit antennas, Meta-fluid antennas.)
- MIMO Reconfigurable antenna array for the FAS-MIMO
- Integrated design of FAS antenna and digital/analog beamformer
- Wideband reconfigurable antennas for FAS
- Electrically compact reconfigurable antennas for compact FAS systems
- Fast switching reconfigurable antennas for FAS
- FAS designs leveraging novel materials (e.g., Ferrofluids, Ferrite LTCC, VO₂ etc.) and fabrication techniques (e.g., 3D-printed microfluidics)
- Antenna designs enabled by metasurface for FAS
- AI-driven FAS antenna topology and optimization methodologies
- Liquid reconfigurable antennas for FAS
- Other NGRA technologies relevant to FAS concepts

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IEEE AWPL Special Cluster 2024 on

“Recent Progress of Multifunctional Antennas for Wearable and Implantable Devices”

The analysis and design of wearable and implantable antennas are relatively complex due to the couplings between the human body and radiators in close proximity. In the past, such antennas were designed to cover specific narrow frequency bands with tailored radiation properties. However, with the rapid growth of communications data volume in wearable and implantable devices, the functionality and diversity requirements of antennas have also increased significantly. To satisfy the different radiation patterns required by in-body, on-body and off-body communications in wireless body area network and overcome the negative effects of reflection and scattering under different dynamic postures of the human body, multifunctional antenna technology is expected to play an important role in future body-centric wireless systems. Antennas can achieve different radiation patterns in different working frequency bands, or through different feeding ports to meet the different communications channels requirements. In addition, multifunctional antennas can realize polarization diversity and/or pattern diversity with a compact structure, which will provide underlying hardware support for the deployment of MIMO communications systems on miniaturized wearable or implantable devices.

This special cluster aims to explore new theoretical concepts, designs and optimization approaches, materials and process technologies applicable to multifunctional wearable and implantable antennas. Innovative work in the following areas (but not limited to) is proposed to be included:

- New concepts of multifunctional wearable and implantable antennas;
- New design methods for multifunctional wearable and implantable antennas (including AI-assisted design);
- Design methods for MIMO antennas and multiport antennas in wireless body area networks (including decoupling of multiport antennas);
- Reconfigurable antennas for wearable and implantable devices;
- New materials and new processing technologies for multifunctional wearable and implantable antennas (such as flexible electronics, textiles, metamaterials, microfluidics, liquid crystals, 3D printing, etc.);
- Wireless Body Area Network communications and sensing systems using multifunctional antennas.

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IEEE AWPL Special Cluster 2026 on “Reconfigurable Antennas for Space–Air–Ground Integrated Networks”

The next generation of wireless communications is moving toward space–air–ground integrated networks (SAGINs) to provide seamless global connectivity, high capacity, and low latency. These networks combine satellite systems, aerial platforms such as high-altitude vehicles or unmanned aerial vehicles, and terrestrial infrastructures. To achieve reliable and efficient links across these highly dynamic environments, reconfigurable antennas have become a key enabling technology.

Reconfigurable antennas can adjust their operating frequency, radiation pattern, and polarization in real time, which is essential to overcome Doppler effects, link interruptions, and multi-band operation requirements in SAGINs. They also enable better spectrum utilization, interference mitigation, and energy efficiency. Recent advances in tunable materials, intelligent metasurfaces, and adaptive beamforming are opening new opportunities to design antennas that are compact, lightweight, and capable of meeting the harsh conditions of space and high-altitude operations. This special issue will provide a platform for presenting state-of-the-art research and emerging technologies in reconfigurable antennas for SAGINs. Topics of interest include, but are not limited to:

- Reconfigurable beam-steering arrays for LEO satellite communications (SATCOM)
- Reconfigurable antennas for aerial communication systems (HAPS, UAVs)
- All-metal reconfigurable antennas for harsh environmental conditions
- Reconfigurable antenna designs for high power applications
- Electronic-based and/or material-based antenna reconfiguration techniques for SAGINs
- Advances in reconfigurable intelligent surfaces (RISs)
- Reconfigurable millimeter-wave and terahertz antenna arrays
- Metamaterials, metasurfaces, and holographic structures for integrated communication and sensing (ISAC)
- AI-driven optimization and design of reconfigurable antennas and surfaces for SAGINs

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IEEE AWPL Special Cluster 2026 on

“Electromagnetic/Multiphysics Modeling and Design of Antennas and Arrays Based on Machine Learning Algorithms”

Over the past decade, machine learning, particularly deep learning technologies, have developed rapidly, achieving remarkable results in diverse fields such as image recognition and semantic analysis. In the realm of antenna and array design, machine learning algorithms have enhanced design efficiency by establishing nonlinear mappings between the electromagnetic response and structural features of devices. However, as antenna application scenarios become increasingly complex, such as satellite-borne antennas, the designer must consider not only the electromagnetic performance but also the operational stability under thermomechanical coupling stresses induced by varying temperature conditions. Consequently, multiphysics antenna modeling and design not only represents an emerging research trend in cutting-edge studies, but also holds significant practical implications for engineering applications.

This special cluster aims to present the latest advances in machine learning enabled electromagnetic and multiphysics modeling and inverse-design of antennas and arrays. The main goal is to present state-of-the-art research conducted in this field and highlight emerging technologies and algorithms for the analysis/design of advanced antenna systems in complex application environments. Contributions are sought in, but not limited to, the following areas:

- Advanced electromagnetics and multiphysics modeling for antennas and arrays.
- Multiphysics co-design for antennas and arrays.
- Machine learning enabled antennas and arrays design.
- Array design based on machine learning.
- Machine learning accelerated electromagnetics and multiphysics computation.
- Stability analysis with multiphysics for antennas and arrays design.
- Inverse-design methods for antennas and arrays.
- Parametric and topological modeling methods for antennas and arrays.
- Other relevant topics.

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**IEEE AWPL Special Cluster 2026 on
“Leaky Wave Antennas: Development and Applications in Communication,
Radar, Wireless Power Transfer, and Biomedicine”**

As a low-cost and high-gain antenna whose beam can be scanned by simply altering the frequency without necessitating mechanical motion or phase shifters, the leaky wave antenna (LWA) has garnered significant interest in recent years, particularly with the development of metamaterials, metasurfaces, and reconfigurable intelligent surfaces. Moreover, researchers have recently paid much attention to system applications of LWAs, especially in wireless communications (e.g., 6G communications in millimeter and THz bands, satellite communications, tunnel communication), radars, wireless power transfer (WPT), and biomedicine.

This special cluster specializes in the topic of LWAs, focusing on reporting cutting-edge developments in LWAs and their applications. Notably, this special cluster aims to provide a high-quality technical platform for worldwide researchers in the field of leaky waves to exchange their up-to-date research findings and discuss how the leaky wave community can better serve the current and future wireless world. To this end, this special cluster seeks contributions in, but is not limited to, the following research topics of LWAs:

- Fixed-frequency electrical beam-scanning LWAs
- Wideband fixed-beam LWAs
- Simultaneous suppression of multiple stopbands and grating lobes in periodic LWAs
- Rapid beam-scanning LWAs
- Multi-beam or multi-band LWAs
- End-fire LWAs
- Holographic LWAs
- LWA designs based on Fabry-Perot resonant cavity antennas
- LWA designs with metamaterials, metasurfaces, and reconfigurable intelligent surfaces
- LWA applications in wireless communications (future 6G, satellite, tunnel, etc.)
- LWA applications in radar detection/sensing/imaging
- LWA applications in joint communication and sensing (JCAS)
- LWA applications in near-field or far-field imaging
- LWA applications in vital sign monitoring
- LWA applications in wireless power transfer and energy harvesting
- LWA applications in biomedicine

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Prospective authors are encouraged to contact the Guest Editors if they have any questions or want to confirm the suitability of their contribution for this special cluster. Papers should be prepared following the same submission instructions as for regular IEEE AWPL manuscripts (four-page technical content maximum and one reference page, double-column, IEEE format), available via the Information for Authors website (<http://awpl.ee.cuhk.edu.hk/resources.html>). The authors should indicate in the cover letter to the Editor-in-Chief that the manuscript is being submitted in response to the Call for Papers for the focused cluster. Prospective authors should refer to the timeline below for key dates.

Key dates:

- Submission deadline: **March 31, 2026**
- First decision: May 15, 2026
- Revised manuscripts deadline: June 15, 2026
- Final decision: July 30, 2026
- Final manuscripts due by: September 1, 2026
- Online publication: Shortly after final manuscript submission
- Cluster publication: November (or December) 2026 issue of AWPL