



Special Session Proposal

Title: AI-Driven Indoor Positioning: From Foundational Models to Real-World Robustness

Description of the proposed special session:

This session will spotlight practically grounded advances in AI-powered indoor positioning—moving beyond isolated deep learning benchmarks to address the core challenges that hinder real-world deployment: sensor heterogeneity, dynamic environment shifts (e.g., crowd movement, furniture rearrangement), energy-constrained edge inference, and the critical gap between academic accuracy metrics and operational reliability (e.g., failure mode analysis, uncertainty quantification). We emphasize co-design—where AI architectures are explicitly shaped by RF physics, inertial dynamics, and infrastructure constraints—not just “AI as a black-box regressor.”

Novelty and motivation:

Indoor positioning remains a cornerstone challenge for IPIN, yet conventional sessions often treat AI as a generic performance booster. This session is distinct because it centers on AI's role as an enabler of system-level robustness, not just accuracy gains. While prior IPIN sessions covered ML-based fingerprinting or SLAM enhancements, this proposal confronts three emerging, community-critical gaps: **(1) The “Sim-to-Real” Chasm:** Most AI models fail under unseen building layouts or sensor calibrations—this session prioritizes methods with provable generalization (e.g., physics-informed neural networks, domain-adaptive meta-learning); **(2) The Trust Deficit:** Industry adopters demand interpretable uncertainty estimates (e.g., Bayesian neural nets, conformal prediction) and failure diagnostics—topics rarely highlighted in standard AI-for-localization talks; **(3) The Infrastructure Reality:** With 5G/6G NR, UWB, and LiDAR sensors coexisting, we focus on unified AI frameworks that fuse heterogeneous signals without requiring synchronized hardware—a key pain point for deployable systems. For the IPIN community, this bridges cutting-edge AI research with the pragmatic rigor demanded by smart buildings, healthcare navigation, and industrial IoT—making it timely, necessary, and uniquely positioned within IPIN's mission.

Scope of the session:

In this Special Session, we invite authors to submit papers related (but not limited) to:

- **Physics-Aware AI Architectures:** Neural networks embedding RF propagation models, inertial dynamics, or geometric constraints (e.g., differentiable ray tracing, graph neural nets on building graphs).
- **Robustness-Centric Learning:** Domain adaptation, continual learning for evolving environments, uncertainty-aware inference (Bayesian, conformal, ensemble methods), and failure mode analysis.
- **Edge-Optimized AI:** Quantized/low-bit models for UWB/IMU chips, federated learning across distributed anchors, and hardware-aware neural architecture search (NAS) for resource-constrained nodes.
- **Cross-Technology Fusion Frameworks:** Unified AI backbones processing asynchronous Wi-Fi/Bluetooth/UWB/visual/LiDAR streams without rigid time synchronization or pre-aligned calibration.
- **Benchmarking & Standardization:** New datasets capturing real-world degradation (e.g., crowd-induced multipath), open-source evaluation protocols for robustness (beyond RMSE), and proposals for AI-integrated positioning standards.

Keywords:

- Artificial Intelligence for Localization
- Robust Indoor Positioning
- Physics-Informed Machine Learning

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IPIN2026
SIXTEENTH INTERNATIONAL CONFERENCE ON
INDOOR POSITIONING
AND INDOOR NAVIGATION
05th – 08th October 2026, Rome, Italy



- Edge AI for Navigation
- Multi-Sensor Fusion (UWB/Wi-Fi/IMU/Visual)

Session Chairs:

Prof. Qianxin Wang, China University of Mining and Technology (China)

Dr. Yue Yu, The Hong Kong Polytechnic University, Hong Kong (China)

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