

ICICN2026 Track 7

Basic Information:

专栏题目

Title

中文：可重构智能表面辅助的无线通信

英文：Reconfigurable Intelligent Surface-assisted Wireless Communications

专栏介绍和征稿主题

Introduction and topics

中文：

征稿范围与动机

随着无线通信系统向 6G 时代演进，动态控制电磁（EM）传播环境的理念受到学术界与工业界的广泛关注。可重构智能表面（RIS）已成为实现智能无线电环境（SRE）的关键使能技术。通过部署可编程的阵列元件，RIS 能够合乎逻辑地改变入射电磁波的相位、幅度和极化，从而将传统被动的无线信道转化为可控的系统变量。

这一范式转变为提升频谱与能量效率、扩展覆盖范围以及抑制干扰提供了显著增益。此外，RIS 与新兴网络架构（如大规模 MIMO、毫米波、次太赫兹通信以及通信感知一体化（ISAC））的深度融合，为满足未来网络严苛的性能指标提供了一条极具前景的路径。

尽管理论研究已取得长足进展，但 RIS 辅助通信的实际部署仍面临诸多跨学科挑战。目前的一个关键研究瓶颈在于：如何弥合精确但复杂的电磁一致性物理模型，与易于处理的通信理论抽象模型之间的鸿沟。此外，基于无源器件的高维信道估计、严重硬件非理想特性下的鲁棒波束赋形设计、动态资源编排以及实验平台验证等，仍是亟待解决的开放性问题。

本 Track 诚邀在 RIS 辅助无线通信的建模、优化、算法设计及实验验证等领域的高质量原创研究论文，以推动该技术在未来无线生态系统中的深度融合。

邀稿方向 (TOPICS OF INTEREST)

欢迎提交关于以下主题（但不限于）的原创研究论文：

- RIS 辅助系统的分析基础、基础性能极限与信息论特征
- 面向高维 RIS 架构的低开销信道估计、感知与跟踪方法
- 有源/无源联合波束赋形与波域处理的设计与优化
- 针对实际硬件非理想特性（如离散相移、相位相关幅度、互耦合）的鲁棒算法设计
- RIS 技术赋能的通信感知一体化（ISAC）
- RIS 辅助的物理层安全（PLS）与隐蔽通信
- 基于机器学习与优化的电磁感知网络设计与 RIS 配置方法
- RIS 在次太赫兹/太赫兹频段、毫米波、全息 MIMO 及可见光通信中的融合应用
- RIS 赋能的非地面网络（NTN）、空天地一体化网络及无人机通信
- 分布式 RIS 部署、MAC 层设计与网络级性能优化
- 新型有源 RIS、中继辅助及混合架构系统
- RIS 赋能智能环境的硬件实现、实验原型系统设计与外场测试验证

英文：

SCOPE AND MOTIVATION

As wireless communication systems evolve toward the 6G era, the concept of dynamically controlling the electromagnetic (EM) propagation environment has gained significant traction. Reconfigurable Intelligent Surfaces (RIS) have emerged as a pivotal technology to realize Smart Radio Environments (SREs). By deploying arrays of programmable elements, RIS can logically alter the phase, amplitude, and polarization of incident EM waves, thereby

transforming the traditionally passive wireless channel into a controllable system variable.

This paradigm shift offers substantial gains in spectral and energy efficiency, coverage extension, and interference mitigation. Furthermore, the integration of RIS with emerging network architectures, such as Massive MIMO, millimeter-wave (mmWave), sub-Terahertz (sub-THz) communications, and Integrated Sensing and Communications (ISAC), presents a promising pathway to meet the stringent performance metrics of future networks.

Despite extensive theoretical exploration, the practical deployment of RIS-assisted communications faces critical multidisciplinary challenges. A key research bottleneck lies in bridging the gap between electromagnetically consistent physical models, which are accurate but complex, and tractable communication-theoretic abstractions. Additionally, high-dimensional channel estimation with passive elements, robust beamforming under severe hardware impairments, dynamic resource orchestration, and experimental validation remain open problems requiring innovative solutions.

This track welcomes original and innovative research contributions on the modeling, optimization, algorithmic design, and experimental validation of RIS-assisted wireless communications, promoting their seamless integration into future wireless ecosystems.

TOPICS OF INTEREST

- Original research articles are solicited in, but not limited to, the following topics:
- Electromagnetically consistent channel modeling and abstraction bridging physics-based and communication-theoretic frameworks for RIS.
- Analytical foundations, fundamental performance limits, and information-theoretic characterization of RIS-assisted systems.
- Low-overhead channel estimation, sensing, and tracking methodologies for high-dimensional RIS architectures.
- Design and optimization of joint active/passive beamforming and wave-domain processing.
- Robust algorithmic design accounting for practical hardware impairments (e.g., discrete phase shifts, phase-dependent amplitude, mutual coupling).
- Integrated Sensing and Communications (ISAC) empowered by RIS technologies.
- RIS-assisted physical layer security (PLS) and covert communications.
- Machine learning and optimization-based approaches for EM-aware network design and RIS configuration.
- Integration of RIS in sub-THz/THz bands, mmWave, Holographic MIMO, and visible light communications.
- RIS-empowered non-terrestrial networks (NTN), space-air-ground integrated networks, and UAV communications.
- Distributed RIS deployment, MAC layer design, and network-level performance optimization.
- Novel active RIS, relay-assisted, and hybrid architectures.
- Hardware implementations, experimental prototypes, and testbed validation for RIS-enabled smart environments.

Track Chair(s):

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|  | 姓名 Name | 彭浩然 (Haoran Peng) |
| | 称谓 Prefix | 博士 (Doctor), 博士后研究员 (Postdoctoral researcher) |
| | 部门 Department | 信息工程系 (Department of Information Engineering) |
| | 单位 Organization | 香港中文大学 (The Chinese University of Hong Kong) |
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Organizer's Brief Biography

中文: 彭浩然于 2015 年获电子科技大学软件工程学士学位, 并于 2022 年获国立阳明交通大学电机与计算机工程博士学位 (荣誉毕业)。他目前是香港中文大学的博士后研究员。2015 年至 2018 年, 他曾担任全职软件工程师。2021 年 6 月至 2021 年 8 月, 他在罗切斯特理工学院戈利萨诺计算与信息科学学院全球网络安全研究所担任访问学生研究合作者。他目前的研究兴趣包括无线通信中的优化与机器学习。他曾担任多个国际会议的技术程序委员会 (TPC) 成员。他获得了 IEEE 车辆技术学会 (VTS) 2022 年秋季车辆技术会议 (VTC2022-Fall) 的学生旅行资助。因表现优异, 他荣获 2021 年度中技社科技奖学金之杰出研究奖学金。他还长期担任 IEEE

TWC/TCOM/TMC/TCCN/TVT 等多个通信领域内顶级期刊审稿人。

英文: Haoran Peng received the B.Eng. degree in software engineering from the University of Electronic Science and Technology of China in 2015 and the Ph.D. degree (Hons.) in electrical and computer engineering from National Yang Ming Chiao Tung University in 2022. He is currently a postdoctoral researcher at The Chinese University of Hong Kong. From 2015 to 2018, he was a full-time Software Engineer. From June 2021 to August 2021, he was a Visiting Student Research Collaborator with the Global Cybersecurity Institute, Golisano College of Computing and Information Sciences, Rochester Institute of Technology. His current research interests include optimization and machine learning for wireless communications. He has been a technical program committee (TPC) member of several international conferences. He received the IEEE VTS Student Travel Grant in VTC2022-Fall. He was honored with the Scholarship Award for Excellence in Research from the 2021 CTCI Foundation Science and Technology Scholarship, in recognition of his outstanding performance. He was also honored as the Outstanding Graduate Student from National Yang Ming Chiao Tung University in 2022.

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|  | 姓名 Name | 王菴君 (Li-Chun Wang) |
| | 称谓 Prefix | 終身講座教授 (Lifetime Chair Professor), IEEE Fellow, 院长 |
| | 部门 Department | 電機工程學系 (Department of Electrical Engineering) |
| | 单位 Organization | 台湾阳明交通大学 (National Yang Ming Chiao Tung University) |
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Organizer's Brief Biography

中文:

王菴君教授, IEEE FELLOW, 于 1996 年获得美国佐治亚理工学院的博士学位。从 1996 年至 2000 年, 在 AT&T 实验室, 担任无线通讯研究所的高级研究员。现任为阳明交通大学电机学院院长, 及电机工程学系的终身讲座教授。王博士因对无线网络的蜂窝架构设计和无线资源管理的贡献, 于 2011 年当选国际电机电子工程师学会会士 (IEEE, FELLOW)。王教授于学术贡献曾获得两次科技部杰出研究奖 (2012 年和 2016 年)、科技部未来科技奖 (2021 年)、中国工程师学会杰出工程教授 (2022 年)、中国电机工程学会杰出工程教授 (2009 年)、中华民国信息学会李国鼎会士奖 (2021 年)、信息月杰出人才奖 (2020 年)、有庠科技论文奖 (2013 年)、有庠科技讲座 (2023 年)、信息荣誉奖章 (2024 年)、中国电机工程学会会士 (2025 年)、潘文渊杰出研究奖 (2025 年) 及中国电机工程师学会工程奖章 (2025 年)。

王教授在无线通讯及信息科技研究领域贡献卓越, 多次担任 IEEE Tutorial Speaker, 推动国际合作暨国际人才培养。Google Scholar 统计显示, 王教授的研究著作总引用数超过 11,553 次, h-index 达到 54, 2024 年入选「2024 全球前 2% 顶尖科学家“年度影响力”」榜单 (World's Top 2% Scientists 2024) 及「终身科学影响力排行榜」(由史丹佛大学专家们透过 Scopus 的论文影响力数据发布); 名列 Guide2 Research 网站计算机科学领域顶尖台湾国际学者。

王教授致力于无线通讯系统与网络研究近三十年, 专长研究领域主要是无线通讯工程, 兼顾学理与实用性。他的研究涵盖了汽车行动通讯地台架构及资源管理技术, 旨在提高系统的高容量及无线电频谱使用效率, 并解决基地台节能问题以达到零碳排的目标。此外, 他进行跨领域研究, 结合网络和人工智能技术, 持续提出具有创新且实用价值的技术。他主持或共同主持多项大型整合型计划, 包括经济部产学大联盟计划「前瞻技术产学合作计划—三维通讯网络技术及其在智慧校园之应用」(2017-2018)、教育部下世代行动通讯垂直应用示范基地计划「迈向永续智慧城市第六代行动通讯网络垂直应用示范基地」(2023 年-2027 年)、和国科会 AI 和前瞻研究计划: 例如「韧性家园-以智慧无人机建构之智慧安全环境与防灾系统」(2021 年-2025 年)、「支援 3D 智能通讯之 6G 网络」(2022 年-2025 年)、以及「迈向第六代行动通讯网络与元宇宙世代人工智能与通讯网络技术之研究特约研究计划」(2022 年-2025 年)、「以韧性设计为核心的 6G 智慧通讯网络: 感知、学习与适应性技术研究特约研究计划」(2025 年-2028 年)、「开发实时闭环式智慧系统导入于轻度认知障碍之精准诊断与治疗」(2023 年-2027 年) 等。

王教授的研究成果提升学术荣誉与国际声望, 展现其在信息科技领域的领导地位与卓越贡献, 对国内科技发展与国际竞争力的提升影响深远。王博士同时担任『中华电信-阳明交大创新研究中心』主任及『阳明交大-IBM 智慧物联网

与巨量资料分析研发中心』主任，并与多家国内外公司进行产业合作，有国内外专利 53 篇，其中十六件技转应用于厂商产品。目前是 IEEE Transactions on Wireless Communications 和 IEEE Transactions on Cognitive and Communication Networking 的副编辑。目前的研究兴趣在数据驱动的智能无线通讯、脑科技技术与永续发展，并发表了 390 多篇期刊和会议论文，并共同编辑了《Key Technologies for 5G Wireless Communications》一书（剑桥大学出版社，2017 年）。

英文： Li-Chun Wang (IEEE FELLOW) received Ph.D. degree from the Georgia Institute of Technology in 1996. From 1996 to 2000, he served as a Senior Researcher at the Wireless Communications Research Institute at AT&T Labs. He is currently the Dean of the College of Electrical Engineering and a Lifetime Chair Professor in the Department of Electrical Engineering at National Yang Ming Chiao Tung University. Dr. Wang was elected as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 2011 for his contributions to the design of cellular architectures and wireless resource management in wireless networks.

Dr. Wang has received numerous awards and honors, including the Distinguished Research Awards from National Science and Technology Council twice (2012 and 2016), the Future Tech Award from the National Science and Technology Council (2021), the Chinese Institute of Engineers (CIE) Outstanding Electrical Engineering Professor Award (2022), the Outstanding Engineering Professor Award from the Chinese Institute of Electrical Engineering (2009), the K.T. Li Fellow Award (2021) and the Medal of Honor (2024) from the Institute of Information & Computing Machinery (iICM), the Outstanding ICT. Elite Award (2020), the Y. Z. Hsu Scientific Paper Award (2013), the Y. Z. Hsu Scientific Chair Professor (2023), the Chinese Institute of Engineers (CIE) Fellow (2025), and the Pan Wen Yuan Foundation, Outstanding Research Award (2025), the Chinese Institute of Engineers (CIE) Engineering Medal (2025).

Dr. Wang has made significant contributions to the research fields of wireless communication and information technology. He has served as an IEEE Tutorial Speaker multiple times, promoting international cooperation and talent cultivation. According to Google Scholar, Dr. Wang's research works have been cited over 11,553 times with an h-index of 54. He was listed in the "2024 Annual Global Top 2% Scientists" and "Lifetime Scientific Impact Rankings" by Stanford University. He is also ranked as a top Taiwanese international scholar in the field of computer science by the Guide2 Research website.

Dr. Wang serves as the Director of the Chunghwa Telecom-NYCU Innovation Research Center and the NYCU-IBM IoT Research Center. He has collaborated with numerous domestic and international companies and holds 49 domestic and international patents, sixteen of which have been applied in commercial products. He is currently an Associate Editor of the IEEE Transactions on Wireless Communications and the IEEE Internet of Things Journal. His recent research interests lie in data-driven intelligent wireless communications, brain technology, and sustainable development. He has published over 300 journal and conference papers and co-edited the book "Key Technologies for 5G Wireless Communications" (Cambridge University Press, 2017).