



# Special Topic on Reconfigurable Antenna Systems for Next-Generation Mobile Communications

## Guest Editors



 **Yang Kun**



 **Song Lingyang**



 **Wong Kai-Kit**



 **Zhao Yizhe**

**D**riven by the rapid development of 6G and beyond mobile communication technologies, future wireless networks are continuously evolving toward ultra-high data rates, ultra-reliable transmission, and massive ubiquitous connectivity, which significantly accelerates the iterative upgrading and intelligent transformation of modern wireless communication systems. As a core and enabling technology for enhancing network flexibility, environmental adaptability and anti-fading robustness, reconfigurable antenna systems have become indispensable to support the diversified and high-performance requirements of next-generation wireless communications. Representative and emerging research hotspots in this field include fluid antennas, movable antennas, pinching antennas, and reconfigurable holographic antennas. Fluid antennas utilize flexible liquid conductive materials to dynamically reshape antenna structures and adjust key electromagnetic parameters, exhibiting promising application prospects in high-frequency millimeter-wave and terahertz communication scenarios. Movable antennas effectively optimize wireless signal propagation paths, transmission quality and system throughput by flexibly adjusting their spatial positions and radiation attitudes, with intelligent resource optimization and mechanical

stability design serving as key research directions. Pinching antennas achieve flexible electromagnetic reconfiguration through controllable mechanical clamping and deformation, making them highly suitable for lightweight, flexible wearable devices and miniaturized Internet of Things (IoT) terminals. In addition, reconfigurable holographic antennas realize precise and adaptive beamforming based on electromagnetic holographic principles, and can be well integrated with advanced multiple-input multiple-output (MIMO) and non-orthogonal multiple access (NOMA) technologies to further improve the spectral efficiency, interference suppression capability, and communication reliability of wireless systems. It is worth noting that the research scope of reconfigurable antenna technologies is extremely broad, and the above architectures only represent a part of current research advances, rather than covering all innovative antenna solutions for future mobile networks.

In this special issue, we aimed to collect state-of-the-art studies focusing on the design, analysis and optimization of these innovative reconfigurable antenna systems for next-generation mobile communications. We sincerely welcomed high-quality original research and review contributions that investigate the theoretical foundations, practical design schemes, performance evaluation methodologies, and real-world application scenarios of advanced reconfigurable antenna systems tailored for future mobile communication networks. Our open call for papers successfully attracted numerous valuable submissions from researchers worldwide, fully demonstrating the surging research attention and vibrant development momentum within this fast-evolving wireless domain. After two rigorous and intensive rounds of anonymous peer review, we have carefully selected

DOI: 10.12142/ZTECOM.202603001

Citation (Format 1): Yang K, Song L Y, Wong K K, et al. Editorial: reconfigurable antenna systems for next-generation mobile communications [J]. ZTE Communications, 2026, 24(3): 1 – 2. DOI: 10.12142/ZTECOM.202603001

Citation (Format 2): K. Yang, L. Y. Song, K. K. Wong, et al., "Editorial: reconfigurable antenna systems for next-generation mobile communications," ZTE Communications, vol. 24, no. 3, pp. 1–2, Sept. 2026. doi: 10.12142/ZTECOM.202603001.

and curated a set of insightful, well-refined papers with solid innovation and practical significance, which are finally featured in this special issue.

The first paper, titled “Closed-Form Outage Expression of Fluid Antenna Systems for Ultra-Reliable Communications”, proposes an adjustable-precision approximation for ultra-reliable fluid antenna systems (FAS). Conventional FAS outage formulas either incur heavy computation or sacrifice accuracy. It adopts a block-correlated Rayleigh fading model and an N-term series expansion for the correlated-fading Bessel function, using N to balance precision and complexity. This method offers an efficient analytical tool for FAS outage evaluation and guides practical ultra-reliable FAS design.

The second paper, titled “Equivalent Degrees of Freedom Based Secrecy Outage Analysis for Fluid Antenna Wiretap Channels”, adopts equivalent degrees of freedom (EDoF) to build a closed-form secrecy outage framework under the Jakes model. It maps correlated physical ports to a small set of dominant spatial modes with eigenvalue weighting, simplifying wiretap-channel analysis for Bob and Eve. Derived theoretical results quantify secrecy effects of aperture sizes and signal-to-noise ratio (SNR) scaling. This method guides aperture planning and physical-layer security optimization for fluid antennas.

The third paper, titled “Prediction-Window Aided Fluid Antenna Systems for High-Mobility Communications”, resolves the scanning overhead bottleneck of fluid antennas for high-mobility intelligent agents via a prediction-tolerant window scheme. Centered on predicted antenna ports, the local sounding window leverages spatial correlation to tolerate prediction errors and restrain pilot overhead. The work builds a throughput optimization model and develops a lightweight two-stage algorithm for fast window tuning. This strategy cuts scanning overhead and improves throughput for fluid antennas supporting high-speed terminals.

The fourth paper, titled “Joint Resource Allocation for Movable-Antenna-Assisted Secure Integrated Data and Energy Transfer”, investigates movable-antenna supported secure IDET systems with passive eavesdroppers. Using a field-response channel model, it jointly optimizes beamformers and antenna positions under practical constraints to maximize the minimum secrecy rate, with energy signals reused as artificial noise. An iterative algorithm is designed to handle the resulting nonconvex problem. This framework supports resource optimization for secure movable-antenna data-and-energy transmission networks.

The fifth paper, titled “Robust Movable Antenna Position Optimization Under Imperfect Channel Path Parameters”, investigates robust beamforming and position optimization for downlink multiple-input single-output (MISO) movable antenna systems with imperfect channel information. Instead of conventional channel state information error modeling, it introduces bounded uncertainties for practical multipath parameters. By adopting discrete sampling and harmonic-mean approximation,

the work optimizes the worst-case SNR and develops an alternating optimization algorithm for beamforming and antenna position adjustment. This scheme provides a reliable robust optimization solution for movable antennas under inaccurate channel conditions.

To conclude, this special issue strives to advance the integration of reconfigurable antenna system designs for 6G and future wireless networks. We sincerely appreciate all authors for their original contributions and rigorous efforts, as well as the reviewers for their professional assessment and insightful suggestions. It is anticipated that the diverse research outcomes presented herein will offer valuable references, spark follow-up explorations, and foster continuous technical progress in the thriving field of reconfigurable antenna-enabled wireless communication systems.

### Biographies

**Yang Kun** is a Junshi Distinguished Chair Professor with the School of Intelligent Software and Engineering and the Director of the Institute of Intelligent Networks and Communications (NINE), Nanjing University, China. His research interests mainly cover wireless communications and networks, and artificial intelligence empowered wireless systems. He has authored over 500 peer-reviewed papers and holds 50 granted patents. Since 2019, he has been a judge for the GSMA GLOMO Awards at MWC Barcelona. He received the 2024 IET Achievement Medal and the 2024 IEEE CommSoft TC Technical Achievement Award. He is a member of the Academia Europaea (MAE), an IEEE Fellow, an IET Fellow, and a Distinguished Member of the ACM.

**Song Lingyang** is a Boya Distinguished Professor at Peking University, China. His research focuses on cooperative wireless communications and networking. He is an IEEE Fellow and a Clarivate Analytics Highly Cited Researcher. He has received 27 IEEE Best Paper Awards, including the IEEE ComSoc Leonard G. Abraham Prize, as well as major honors such as the second prize of the National Natural Science Award and the first prize of the Natural Science Award from the Ministry of Education. He serves as a Standing Director of the China Institute of Communications, a member of the Board of Governors of the IEEE Vehicular Technology Society, and an Area Editor for *IEEE Transactions on Vehicular Technology*.

**Wong Kai-Kit** is a Chair Professor of wireless communications at the Department of Electronic and Electrical Engineering, University College London, UK. He previously held appointments at the University of Hong Kong, China, and the University of Hull, UK, as well as visiting positions at Lucent Technologies, Bell Labs and Stanford University, USA. His current research centers on 6G and beyond mobile communications. He is one of the early researchers who proposed multiuser MIMO. His first paper on multiuser MIMO, published at WCNC 2000, is considered the first research paper on this topic. He is a Fellow of the CIC, IEEE and IET. He served as the Editor-in-Chief for *IEEE Wireless Communications Letters* between 2020 and 2023.

**Zhao Yizhe** is currently an associate professor at the School of Information and Communication Engineering, University of Electronic Science and Technology of China. He was selected for the Youth Talent Support Project of the China Association for Science and Technology. His research achievement was selected as one of the Top 10 Scientific and Technological Advances in the Internet of Things Sector in China (2025). His research interests include simultaneous wireless information and power transfer, and reconfigurable antenna systems.