Special Issue on Aerial Access Networks for 6G

Hongliang Zhang, Zhu Han, George C. Alexandropoulos, and Nguyen H. Tran

The current development of 5G networks represents a breakthrough in the design of communication networks, for its ability to provide a single platform enabling a wide variety of data services. With these significant enhancements enabled by 5G, it is already possible to envision the needs towards 6G. Providing "connectivity from the sky" is one innovative trend for upcoming 6G communication systems. Satellites, high and low altitude platforms (HAP and LAP), drones, aircrafts, and airships are being considered as candidates for deploying wireless communications complementing terrestrial communications. Combining these network elements, Aerial Access Networks (AANs) have attracted significant attention from both academia and industry, and are recognized as a candidate solution for 6G communications. AANs are heterogeneous networks that are engineered to utilize satellites, HAPs, and LAPs to build network access platforms. Unlike terrestrial wireless networks, AANs are characterized by dynamic, thus frequently changed, network topologies and more vulnerable communication connections. However, AANs are not intended to replace the existing technologies, but instead to work with them in a complementary and integrated fashion. Therefore, AANs are accompanied with the demand for seamless integration of heterogeneous networks, such that the network Quality-of-Service (QoS) can be improved. Therefore, it is essential to develop new communications, signal processing, and optimization approaches to accommodate diverse services and applications with different QoS requirements in various scenarios.

This IEEE/KICS Journal of Communication Networks Special Issue aims to solicit high-quality unpublished research papers by experts from mobile communication industries (operators, telecom vendors, as well as consulting firms) and academia in the fields of AANs. In the following, we would like to introduce the four excellent papers included in this Special Issue.

In "*Interference-Aware Path Planning Optimization for Multiple UAVs in Beyond 5G Networks*", coauthored by Lee *et. al*, a trajectory planning method is designed for Unmanned Aerial Vehicles (UAVs) in UAV-aided 5G/6G networks. The novelty of this method is to create interference-aware trajectory model by taking the interference with the unit disk graph. Simulation results reveal that the proposed method allows for approximately 21% gains, while being able to maintain a similar level of traveling time compared to the benchmark solution.

In "*Robust Secure UAV Relay-Assisted Cognitive Communications with Resource Allocation and Cooperative Jamming*", coauthored by Wang *et. al*, the physical layer security issue is studied in UAV-assisted cognitive relay systems. To prevent an eavesdropper wiretapping information, the average worst-case secrecy rate of the secondary relay network is maximized, by jointly optimizing robust trajectories and power of the UAV relay and jammer. The developed novel resource allocation scheme is shown to improve the security performance effectively in comparison with benchmark schemes.

In "*Beyond 5G: Reducing the Handover Rate for High Mobility Communications*", authored by Naor Zohar, proximity-based clusters, as nomadic cells integrated with AANs, are proposed to reduce the burden caused by rapid handover requests. This scheme is proved to be scalable and applicable for real-time services.

In "*Temporal Deep Learning Assisted UAV Communication Channel Model For Application in EH-MIMO-NOMA Set-Up*", coauthored by Misra *et. al*, a machine learning based channel modeling for UAV communications is presented. This paper introduces a deep learning method to capture the variance of channel gains. The effectiveness of the proposed method is verified with a Multi-Input Multi-Output (MIMO) and Non-Orthogonal Multi-Access (NOMA) set-up in urban areas.

We would like to express our sincere thanks to all the authors who contributed manuscripts to this Special Issue, as well as all the reviewers for their valuable and timely reviews that significantly improved the quality of these papers. We are also grateful to the IEEE/KICS Journal of Communications Networks for the opportunity to establish this Special Section and to all the editorial staff for their support and guidance during the whole editorial process. We hope that this Special Issue could serve as a useful reference for researchers, scientists, engineers, and academics who are working in the area of AANs.

Hongliang Zhang received the B.S. and Ph.D. degrees at the School of Electrical Engineering and Computer Science at Peking University, in 2014 and 2019, respectively. From 2019 to 2020, he was a postdoctoral fellow in the Department of Electrical and Computer Engineering at the University of Houston, Texas. Currently, he is a Postdoctoral Associate in the Department of Electrical and Computer Engineering at Princeton University, New Jersey. His current research interests include reconfigurable intelligent surfaces, aerial access networks, optimization theory, and game theory. He received the best doctoral thesis award from Chinese Institute of Electronics in 2019. He is an exemplary reviewer for IEEE Transactions on Communications in 2020. He is also the recipient of 2021 IEEE Comsoc Heinrich Hertz Award for Best Communications Letters and 2021 IEEE ComSoc Asia-Pacific Outstanding Paper Award. He has served as a TPC Member for many IEEE conferences, such as Globecom, ICC, and WCNC. He is currently an Editor for IEEE Communications Letters, IET Communications, and Frontiers in Signal Processing. He has also served as a Guest Editor for several journals, such as IEEE Internet of Things Journal, IET Communications, and Journal of Communications and Networks.

Zhu Han received the B.S. degree in electronic engineering from Tsinghua University, in 1997, and the M.S. and Ph.D. degrees in electrical and computer engineering from the University of Maryland, College Park, in 1999 and 2003, respectively.

From 2000 to 2002, he was an R&D Engineer of JDSU, Germantown, Maryland. From 2003 to 2006, he was a Research Associate at the University of Maryland. From 2006 to 2008, he was an assistant professor at Boise State University, Idaho. Currently, he is a John and Rebecca Moores Professor in the Electrical and Computer Engineering Department as well as in the Computer Science Department at the University of Houston, Texas. His research interests include wireless resource allocation and management, wireless communications and networking, game theory, big data analysis, security, and smart grid. Dr. Han received an NSF Career Award in 2010, the Fred W. Ellersick Prize of the IEEE Communication Society in 2011, the EURASIP Best Paper Award for the Journal on Advances in Signal Processing in 2015, IEEE Leonard G. Abraham Prize in the field of Communications Systems (best paper award in IEEE JSAC) in 2016, and several best paper awards in IEEE conferences. Dr. Han was an IEEE Communications Society Distinguished Lecturer from 2015-2018, AAAS fellow since 2019, and ACM distinguished Member since 2019. Dr. Han is a 1% highly cited researcher since 2017 according to Web of Science. Dr. Han is also the winner of the 2021 IEEE Kiyo Tomiyasu Award, for outstanding early to mid-career contributions to technologies holding the promise of innovative applications, with the following citation: ``for contributions to game theory and distributed management of autonomous communication networks."

George C. Alexandropoulos received the Engineering Diploma, M.A.Sc., and Ph.D. degrees in Computer Engineering and Informatics from the School of Engineering, University of Patras, Greece, in 2003, 2005, and 2010, respectively. He has held research positions at various Greek universities and research institutes, such as National Center for Scientific Research "Demokritos," National Observatory of Athens, Institute of Accelerating Systems and Applications, Athens Information Technology Center for Research and Education, Telecommunication Systems Research Institute of the Technical University of Crete, University of Patras, and University of Peloponnese, as well as at the Mathematical and Algorithmic Sciences Lab, Paris Research Center, Huawei Technologies France, and he is currently an Assistant Professor of Wireless Communication Systems and Signal Processing with the Department of Informatics and Telecommunications, National and Kapodistrian University of Athens (NKUA), Greece. His research interests span the general areas of algorithmic design and performance analysis for wireless networks with emphasis on multiantenna transceiver hardware architectures, full-duplex radios, active and passive reconfigurable metasurfaces, millimeter-wave communications, as well as distributed machine learning algorithms. He has received the Best Ph.D. Thesis Award 2010, the IEEE Communications

Society Best Young Professional in Industry Award 2018, the EURASIP Best Paper Award of the Journal on Wireless Communications and Networking 2021, the IEEE Marconi Prize Paper Award in Wireless Communications 2021, and a Best Paper Award from the IEEE GLOBECOM 2021. He currently serves as an Editor for IEEE Transactions on Wireless Communications, IEEE Communications Letters, IEEE Wireless Communications Letters, Computer Networks (Elsevier), Frontiers in Communications and Networks, and the ITU Journal on Future and Evolving Technologies, as well as a guest editor for various IEEE special issues. He has organized various special sessions and workshops in flagship conferences of the latter IEEE societies, where he also delivered various tutorials and invited talks on his fields of interest. He also serves as a distinguished lecturer of the IEEE Communications Society for 2022-2023. He has participated and/or technically managed more than 10 European Union (EU) research and innovation projects, as well as several Greek and international research projects. He is currently a Principal Investigator with NKUA for the EU H2020 RISE-6G Project under Grant 101017011. He is a Senior Member of IEEE Communications, Signal Processing, and Information Theory Societies, as well as a registered Professional Engineer at the Technical Chamber of Greece. More information is available at http://www.alexandropoulos.info.

Nguyen H. Tran received BS and Ph.D degrees, from HCMC University of Technology and Kyung Hee University, in electrical and computer engineering, in 2005 and 2011, respectively. He was an Assistant Professor with Department of Computer Science and Engineering, Kyung Hee University, from 2012 to 2017. Since 2018, he has been with the School of Computer Science, The University of Sydney, where he is currently a Senior Lecturer. His research interests include distributed computing, machine learning, and networking. He received the best KHU thesis award in engineering in 2011 and several best paper awards, including IEEE ICC 2016 and ACM MSWiM 2019. He receives the Korea NRF Funding for Basic Science and Research 2016-2023 and ARC Discovery Project 2020-2023. He was an Editor of IEEE Transactions on Green Communications and Networking from 2016 to 2020, and an Associate Editor of IEEE Journal of Selected Areas in Communications 2020 in the area of distributed machine learning/Federated Learning.