Editorial: Introduction to the Issue on Distributed Machine Learning for Wireless Communication

I. Introduction

With the emergence of new application scenarios (e.g., real-time and interactive services and Internet of Things) and the fast development of smart terminals, wireless data traffic has increased drastically, and the existing wireless networks cannot completely meet the technical requirements of the next generation mobile communication networks, e.g., 6G. In recent years, machine learning-based methods have been considered as potential technologies for 6G, because in wireless communication systems, key issues behind synchronization, channel estimation, signal detection, and iterative decoding can be solved by well-designed machine learning algorithms. Currently, most wireless network machine learning solutions require the training data and learning process to be centralized in one or more data centers. However, these centralized machine learning methods expose disadvantages, e.g., privacy security, significant signaling overhead, increased implementation complexity, and high latency, which limit their practicality. The wireless networks of the future must make quicker and more reliable decisions at the network edge. To address these challenges, distributed machine learning frameworks, e.g., federated learning (FL), MapReduce, and AllReduce, will need to push intelligence to the network edge in future wireless communication networks. In these frameworks, mobile devices can collaborate to build a shared learning model, training the data they collect locally. This intriguing concept is inspiring many research activities in distributed machine learning.

However, the field of distributed machine learning is still in its infancy, with many open theoretical and practical problems needing to be solved, such as robustness, privacy, communication cost, convergence, complexity, and how to optimally combine with physical layer transmission networks. This special issue (SI) in IEEE Journal of Selected Topics in Signal Processing (J-STSP) aims to capture the latest advances in emerging distributed intelligent communication systems from the perspective of signal processing to advance its theoretical underpinnings and practical applications.

We wish to keep this editorial brief and refer to the overview article, titled "Distributed Learning for Wireless Communications: Methods, Applications and Challenges" by L. Qian *et al.* [A1] that follows, for a recent overview of distributed learning for wireless communications and a comprehensive list of references. Below we summarize the papers that comprise the present SI.

II. Summary of the Papers in This SI

The first paper, entitled "Reconfigurable Intelligent Surface-assisted Multi-UAV Networks: Efficient Resource Allocation with Deep Reinforcement Learning," proposes reconfigurable intelligent surface (RIS)-assisted unmanned aerial vehicles (UAVS) networks to enhance the networks performance. To maximize the energy efficiency (EE) of the proposed network, the authors jointly optimize the power allocation of the UAVs and the phase-shift matrix of the RIS. The authors also propose a deep reinforcement learning (DRL) approach to solve this problem and a parallel learning approach to reduce the information transmission requirement of the centralized approach. Simulations show a significant improvement of the proposed schemes in terms of EE, flexibility, and processing time.

The second paper, "Distributed Learning for MIMO Relay Networks," introduces a novel perspective of relating a relay network to an artificial neural network (ANN) to optimize the nonlinear transceivers of the distributed nodes in a multi-antenna multi-user and multi-relay network. With this perspective, the authors propose a distributed learning-based relay beamforming (DLRB) scheme. The authors also present a frame design to support the DRLB to adapt well with time-varying channels. Simulations verify the effectiveness of the proposed scheme.

The third study, which is entitled as "Communication-Efficient Federated Learning via Predictive Coding," proposes a predictive coding based communication scheme for FL, which has shared prediction functions among all devices and allows each worker to transmit a compressed residual vector derived from the reference. In each communication round, the predictor and quantizer are selected based on the rate-distortion cost to further reduce the redundancy with entropy coding. Simulations reveal that it can greatly reduce communication cost with better learning performance compared to traditional techniques.

The fourth contribution, entitled "Blockchain and Semi-Distributed Learning-Based Secure and Low-Latency Computation Offloading in Space-Air-Ground-Integrated Power IoT," combines blockchain, space-air-ground integrated power Internet of Things (SAG-PIoT), and machine learning to meet stringent and delay requirement on computation offloading. Specifically, the authors propose a Blockchain and semi-distributed leaRning-based secure and low-latency electromAgnetic interferenCe-awarE computation offloading algorithm

Date of current version May 10, 2022.
Digital Object Identifier 10.1109/JSTSP.2022.3165356

(BRACE) to minimize the total queuing delay under the long-term security constraint. Simulation results verify that BRACE achieves superior delay and security performance.

The fifth paper, "Distributed Few-Shot Learning for Intelligent Recognition of Communication Jamming," introduces a novel jamming recognition method based on distributed few-shot learning. The proposed method employs a distributed recognition architecture to achieve the global optimization of multiple sub-networks by FL. The authors also introduce a dense block structure in the sub-network structure to improve network information flow by the feature multiplexing and configuration bypass to improve resistance to over-fitting. Simulations demonstrate excellent recognition performance of this proposed method with a small data set.

The sixth paper, namely "Revisiting Analog Over-the-Air Machine Learning: The Blessing and Curse of Interference," proposes a new route to establish the analysis of convergence rate, as well as generalization error, of distributed learning algorithm. The authors conclude that the training algorithm can be run in tandem with the momentum scheme to accelerate the convergence. The authors also show that the interference on the overall training procedure has a two-side effect. On the negative side, heavy tail noise slows down the convergence rate of the model training. On the positive side, heavy tail noise has the potential to increase the generalization power of the trained model.

The seventh paper entitled "Optimal Myopic Policy for Restless Bandit: A Perspective of Eigendecomposition," considers restless multiarmed bandit (RMAB) problem involving partially observed Markov decision process with heterogeneous state transition matrices in discrete time slot. To show the optimality of the myopic policy, the authors generalize the concept of the first order stochastic dominance ordering and then decompose each state transition matrix into a weighted sum of a series of eigenmatrices. The authors also identify two sets of sufficient conditions on both eigenvalues and eigenmatrices to guarantee the optimality of the myopic policy for two instances, respectively.

The eighth paper, "Incorporating Distributed DRL into Storage Resource Optimization of Space-Air-Ground Integrated Wireless Communication Network," proposes a Space-air-ground integrated network (SAGIN) storage resource management algorithm based on distributed DRL. To realize the distributed training, the authors extract the network attributes represented by storage resources for the agent to build a training environment in each edge physical domain. The authors also propose a SAGIN resource management framework based on distributed DRL. Simulations show that the proposed algorithm can significantly improve the allocation revenue of network resources and the acceptance rate of user requests, and it has good flexibility, compared to other algorithms.

The ninth contribution addresses the issue of "Joint Beam Training and Data Transmission Control for mmWave Delay-Sensitive Communications: A Parallel Reinforcement Learning Approach," by considering the problem of joint beam training and data transmission control of delay-sensitive communications over mmWave channels. To minimize the cumulative energy consumption over the whole considered period of time under delay constraint, the authors formulate the problem as a constrained Markov Decision Process (MDP). The authors then reformulate it to an unconstrained one by introducing a Lagrange multiplier and solve it by using parallel-rollout-based reinforcement learning method. The simulation results show that the optimized parallel deployment strategy improves energy consumption and latency performance.

The tenth study, which is entitled as "Distributed Machine Learning for Multiuser Mobile Edge Computing Systems," presents a distributed machine learning approach for multi-user mobile edge computing (MEC) networks. Three optimization criteria for MEC networks are proposed based on the requirements of latency and energy consumption, and the optimization problem is solved using a FL optimization framework in which each user uses DRL to solve the optimization problem. Simulation results show that the method can effectively reduce the delay and energy consumption of the system.

The eleventh work, "Federated Meta-Learning Enhanced Acoustic Radio Cooperative Framework for Ocean of Things," proposes a deep neural network (DNN)-based data enhancement receiver for chirp modulation-based underwater acoustic communications at a single buoy. To further address the problem of possible insufficient training data at a single buoy, an enhanced acoustic radio cooperative (ARC) framework based on federated meta-learning (FML) is proposed to use model parameters of multiple buoys to train a randomly scheduled wireless network environment based on DNN-based receivers in a randomly scheduled wireless network environment. Simulation results show that the proposed receiver trained with sufficient data has better BER performance and lower complexity than the conventional matched filtering based detector.

The twelfth paper, which is entitled as "Distributed Reinforcement Learning for Age of Information Minimization in Real-Time IoT Systems," proposes a distributed QMIX algorithm to find the global optimal sampling strategy for devices. This algorithm aims to enable base stations and devices in IoT systems to collaboratively monitor realistic physical processes simultaneously with minimal age of information cost and energy consumption. Compared with the traditional RL algorithm, this method enables each device to use its local observations to estimate the Q value under global observations. Simulations verify the feasibility of the proposed scheme.

The thirteenth paper, namely "Decentralized Federated Learning with Unreliable Communications," proposes a robust decentralized stochastic gradient descent (SGD) method, called Soft-DSGD, to solve the unreliability problem. soft-DSGD updates the model parameters using partially received messages and optimizes the mixing weights based on the link reliability matrix of the communication link. Simulations demonstrate that the proposed Soft-DSGD algorithm achieves the same asymptotic convergence rate as the normal decentralized SGD algorithm with perfect communication, even under unreliable communication networks.

The fourteenth paper, entitled "Communication-Efficient Decentralized Subspace Estimation," designs a new decentralized subspace estimation (DSE) algorithm, and the gradient tracking technique in consistency optimization is used to improve the complexity of the algorithm. In addition, in a subarray environment, the authors combine the DSE and the decentralized

ESPRIT (d-ESPRIT) algorithm to estimate Direction of Arrival (DoA). Experimental results show that the DSE algorithm can obtain smaller errors than the reference algorithm for a given number of communications.

The fifteenth paper, entitled "Collaborative Intelligent Reflecting Surface Networks with Multi-Agent Reinforcement Learning," investigates a multi-user communication system assisted by cooperative IRS devices with the capability of energy harvesting, aiming to maximize the long-term average achievable system data rate. The authors develop a novel multiagent Q-mix (MAQ) framework with two layers to decouple the optimization parameters. Simulation results confirm the performance advantage of the proposed algorithms over other conventional algorithms.

The sixteenth paper, entitled "Loss-Privacy Tradeoff in Federated Edge Learning," proposes a personalized differential privacy based federated mobile edge learning (FMEL) scheme to alleviate the privacy leakage by adding different noise perturbations to the model updates of each edge device. The authors derive the convergence upper bound of the nonconvex loss function to measure the machine learning model performance. From the simulation results provided, the proposed method achieves a better loss-privacy tradeoff compared to the conventional methods.

The seventeenth paper, entitled "User-centric Online Gossip Training for Autoencoder-based CSI Feedback," proposes a user-centric online training strategy to improve CSI feedback performance based on applying the autoencoder. Three frameworks that differ in the methods of changing encoders are proposed. It is shown that the feedback accuracy can be markedly improved.

The penultimate paper titled "Learning Progressive Distributed Compression Strategies from Local Channel State Information," proposes a deep learning framework to design a compression strategy for intelligences with only local channel state information (CSI) as input. To address the challenge of modeling quantization operations, the authors propose a new approach to set the dynamic range of uniform quantizers using the statistics of batch training data. Numerical results show that the local CSI-based approach can significantly reduce the signaling overhead of the global CSI-based approach while outperforming the existing local CSI-based approach based on local eigenvalue decomposition.

The closing paper titled "Distributed Learning With Sparsified Gradient Differences," designs an adaptive sparse gradient descent method with error correction (ASGD) to improve the communication efficiency in general worker-server architectures. It is also shown that the ASGD algorithm converges for strongly convex, convex and nonconvex optimization problems. The results show that for a given target accuracy, ASGD can significantly reduce the communication load compared to the best available algorithms while maintaining a fast convergence rate compared to other distributed learning algorithms.

PING YANG, *Lead Guest Editor*
University of Electronic Science and Technology of China
Chengdu 611731, China
Email: yang.ping@uestc.edu.cn

OCTAVIA A. DOBRE, *Guest Editor*
Memorial University of Newfoundland
St. Johns, NL A1B3C5, Canada
Email: odobre@mun.ca

MING XIAO, *Guest Editor*
Royal Institute of Technology (KTH)
10044 Stockholm, Sweden
Email: mingx@kth.se

MARCO DI RENZO, *Guest Editor*
Université Paris-Saclay
91190 Gif-sur-Yvette, France
Email: marco.di-renzo@universite-paris-saclay.fr

JUN LI, *Guest Editor*
Nanjing University of Science and Technology
Nanjing 210094, China
Email: jun.li@njust.edu.cn

TONY Q.S. QUEK, *Guest Editor*
Singapore University of Technology and Design (SUTD)
Singapore, 487372
Email: tonyquek@sutd.edu.sg

ZHU HAN, *Guest Editor*
University of Houston
Houston, TX 77004 USA
Email: zhan2@uh.edu

ACKNOWLEDGMENT

Our guest editorial team would like to thank all authors of published/unpublished papers who have contributed their work and wisdom to this SI. Our guest editors would also like to express our sincere gratitude to the reviewers who have made indelible contributions to improving the quality of the special issue through their timely and comprehensive reviews.

APPENDIX
RELATED ARTICLES

[A1] L. Qian *et al.*, "Distributed learning for wireless communications: Methods, applications and challenges," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3156756.

[A2] K. K. Nguyen, S. Khosravirad, D. B. Da Costa, L. D. Nguyen, and T. Q. Duong, "Reconfigurable intelligent surface-assisted multi-UAV networks: Efficient resource allocation with deep reinforcement learning," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2021.3134162.

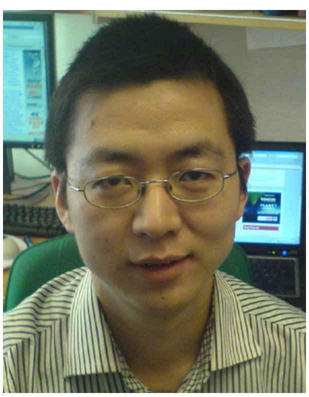
[A3] R. Wang, Y. Jiang, and W. Zhang, "Distributed learning for MIMO relay networks," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3140953.
[A4] K. Yue, R. Jin, C.-W. Wong, and H. Dai, "Communication-efficient federated learning via predictive coding," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3142678.
[A5] H. Liao *et al.*, "Blockchain and semi-distributed learning-based secure and low-latency computation offloading in space-air-ground-integrated power IoT," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2021.3135751.
[A6] M. Liu, Z. Liu, W. Lu, Y. Chen, X. Gao, and N. Zhao, "Distributed few-shot learning for intelligent recognition of communication jamming," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2021.3137028.
[A7] H. H. Yang, Z. Chen, T. Q. S. Quek, and H. V. Poor, "Revisiting analog over-the-air machine learning: The blessing and curse of interference," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2021.3139231.
[A8] K. Wang, J. Yu, L. Chen, P. Zhou, and M. Win, "Optimal myopic policy for restless bandit: A perspective of eigendecomposition," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3142502.
[A9] C. Wang, L. Liu, C. Jiang, S. Wang, P. Zhang, and S. Shen, "Incorporating distributed DRL into storage resource optimization of space-air-ground integrated wireless communication network," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2021.3136027.
[A10] W. Lei, D. Zhang, Y. Ye, and C. Lu, "Joint beam training and data transmission control for mmWave delay-sensitive communications: A parallel reinforcement learning approach," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3143488.
[A11] Y. Guo, R. Zhao, S. Lai, L. Fan, X. Lei, and G. K. Karagiannidis, "Distributed machine learning for multiuser mobile edge computing systems," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3140660.
[A12] H. Zhao, F. Ji, Q. Li, Q. Guan, S. Wang, and M. Wen, "Federated meta-learning enhanced acoustic radio cooperative framework for Ocean of Things," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3144020.
[A13] S. Wang *et al.*, "Distributed reinforcement learning for age of information minimization in real-time IoT systems," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3144874.
[A14] H. Ye, L. Liang, and G. Y. Li, "Decentralized federated learning with unreliable communications," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3152445.
[A15] Y. Jiao and Y. Gu, "Communication-efficient decentralized subspace estimation," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3157437.
[A16] J. Zhang, *et al.*, "Collaborative intelligent reflecting surface networks with multi-agent reinforcement learning," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3162109.
[A17] T. Liu, B. Di, B. Wang, and L. Song, "Loss-privacy tradeoff in federated edge learning," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3161786.
[A18] J. Guo, Y. Zuo, C.-K. Wen, and S. Jin, "User-centric online gossip training for autoencoder-based CSI feedback," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3160268.
[A19] F. Sohrabi, T. Jiang, and W. Yu, "Learning progressive distributed compression strategies from local channel state information," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3158820.
[A20] Y. Chen, R. S. Blum, M. Takac, and B. M. Sadler, "Distributed learning with sparsified gradient differences," *IEEE J. Sel. Topics Signal Process.*, vol. 16, no. 3, Apr. 2022, doi: 10.1109/JSTSP.2022.3162989.

Ping Yang (Senior Member, IEEE) received the Ph.D. degree from the University of Electronic Science and Technology of China, Chengdu, China, in 2013. He is currently a Full Professor with the University of Electronic Science and Technology of China. From 2012 to 2013, he was a Visiting Student with the School of Electronics and Computer Science, University of Southampton, Southampton, U.K. From 2014 to 2016, he was a Research Fellow with the School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore. He has authored or coauthored and presented more than 100 papers in journals and conference proceedings. His research interests include 5G and beyond wireless systems, machine learning, and bionic communication systems. He is currently the Editor of IEEE COMMUNICATIONS LETTERS and the Lead Guest Editor of IEEE JOURNAL OF SELECTED TOPICS IN SIGNAL PROCESSING.

Octavia A. Dobre (Fellow, IEEE) received the Dipl.Ing. and Ph.D. degrees from the Polytechnic Institute of Bucharest, Bucharest, Romania, in 1991 and 2000, respectively. Between 2002 and 2005, she was with the New Jersey Institute of Technology, Newark, NJ, USA. In 2005, she joined Memorial University, St. John's, NL, Canada, where she is currently a Professor and Research Chair. She was a Visiting Professor with the Massachusetts Institute of Technology, Cambridge, MA, USA, and Universit de Bretagne Occidentale, Brest, France.

She has authored coauthored more than 400 refereed papers in his research areas, which include wireless communication and networking technologies, and optical and underwater communications.

Dr. Dobre is the Director of Journals and Editor-in-Chief of IEEE OPEN JOURNAL OF THE COMMUNICATIONS SOCIETY. She was the Editor-in-Chief of IEEE COMMUNICATIONS LETTERS, Senior Editor, Editor, and Guest Editor of various prestigious journals and magazines. She was also the General Chair, Technical Program Co-Chair, Tutorial Co-Chair, and Technical Co-Chair of symposia at numerous conferences. Dr. Dobre was a Fulbright Scholar, Royal Society Scholar, and Distinguished Lecturer of the IEEE Communications Society. She was the recipient of the best paper awards at various conferences, including IEEE ICC, IEEE Globecom, IEEE WCNC, and IEEE PIMRC. Dr. Dobre is an Elected Member of the European Academy of Sciences and Arts, a Fellow of the Engineering Institute of Canada, and a Fellow of the Canadian Academy of Engineering.



Ming Xiao (Senior Member, IEEE) received the bachelor's and master's degrees in engineering from the University of Electronic Science and Technology of China, Chengdu, China, in 1997 and 2002, respectively, and the Ph.D. degree from the Chalmers University of Technology, Gothenburg, Sweden, in November 2007. From 1997 to 1999, he was a Network and Software Engineer with ChinaTelecom. From 2000 to 2002, he also held a position with the SiChuan Communications Administration. Since November 2007, he has been with the Department of Information Science and Engineering, School of Electrical Engineering and Computer Science, Royal Institute of Technology, Stockholm, Sweden, where he is currently an Associate Professor. From 2012 to 2017, he was the Editor of IEEE TRANSACTIONS ON COMMUNICATIONS, has been the Senior Editor of IEEE COMMUNICATIONS LETTERS since January 2015, was the Senior Editor of IEEE WIRELESS COMMUNICATIONS LETTERS during 2012–2016, and has been the Editor of IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS since 2018. He was the Lead Guest Editor of IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS Special issue on Millimeter Wave Communications for future mobile networks in 2017.

Marco Di Renzo (Fellow, IEEE) received the Laurea (*cum laude*) and Ph.D. degrees in electrical engineering from the University of L'Aquila, L'Aquila, Italy, in 2003 and 2007, respectively, and the Habilitation Diriger des Recherches (Doctor of Science) degree from University Paris-Sud (now Paris-Saclay University), Bures-sur-Yvette, France, in 2013. Since 2010, he has been with the French National Center for Scientific Research, where he is currently a CNRS Research Director (a Professor) with the Laboratory of Signals and Systems (L2S) of Paris-Saclay University C CNRS and CentraleSupelec, Paris, France. In Paris-Saclay University, he is the Coordinator of the Communications and Networks Research Area of the Laboratory of Excellence DigiCosme, and a Member of the Admission and Evaluation Committee of the Ph.D. School on Information and Communication Technologies. He is the Editor-in-Chief of IEEE COMMUNICATIONS LETTERS and a Distinguished Speaker of the IEEE Vehicular Technology Society. From 2017 to 2020, he was a Distinguished Lecturer of the IEEE Vehicular Technology Society and IEEE Communications Society. He was the recipient of several research distinctions, which include, the SEE-IEEE Alain Glavieux Award, IEEE Jack Neubauer Memorial Best Systems Paper Award, Royal Academy of Engineering Distinguished Visiting Fellowship, Nokia Foundation Visiting Professorship, Fulbright Fellowship, and 2021 *EURASIP Journal on Wireless Communications and Networking* Best Paper Award. He is a Fellow of the U.K. Institution of Engineering and Technology, a Fellow of the Asia-Pacific Artificial Intelligence Association, an Ordinary Member of the European Academy of Sciences and Arts, and an Ordinary Member of the Academia Europaea. He is also a Highly Cited Researcher.

Jun Li (Member, IEEE) received the Ph.D. degree in electronics engineering from Shanghai Jiao Tong University, Shanghai, China, in 2009. In 2009, he was with the Department of Research and Innovation, Alcatel Lucent Shanghai Bell, as a Research Scientist. From 2009 to 2012, he was a Postdoctoral Fellow with the School of Electrical Engineering and Telecommunications, University of New South Wales, Sydney, NSW, Australia. From 2012 to 2015, he was a Research Fellow with the School of Electrical Engineering, The University of Sydney, Sydney, NSW, Australia. Since 2015, he has been a Professor with the School of Electronic and Optical Engineering, Nanjing University of Science and Technology, Nanjing, China. His research interests include network information theory, channel coding theory, wireless network coding, and cooperative communications.

Tony Q. S. Quek (Fellow, IEEE) received the B.E. and M.E. degrees in electrical and electronics engineering from the Tokyo Institute of Technology, Tokyo, Japan, in 1998 and 2000, respectively, and the Ph.D. degree in electrical engineering and computer science from the Massachusetts Institute of Technology, Cambridge, MA, USA, in 2008. He is currently the Cheng Tsang Man Chair Professor with the Singapore University of Technology and Design, Singapore. He is also the Director of Future Communications R&D Programme, Head of ISTD Pillar, and Deputy Director of SUTD-ZJU IDEA. His research interests include wireless communications and networking, network intelligence, Internet-of-Things, URLLC, and Big Data processing.

He has been actively involved in organizing and chairing sessions, and was a Member of the Technical Program Committee and was also Symposium Chair in a number of international conferences. He is currently the Editor of IEEE Transactions on Wireless Communications and an Elected Member of the IEEE Signal Processing Society SPCOM Technical Committee. He was an Executive Editorial Committee Member of IEEE Transactions on Wireless Communications, Editor of IEEE Transactions on Communications, and the Editor of IEEE Wireless Communications Letters.

Dr. Quek was honored with the 2008 Philip Yeo Prize for Outstanding Achievement in Research, 2012 IEEE William R. Bennett Prize, 2015 SUTD outstanding education awards C Excellence in Research, 2016 IEEE Signal Processing Society Young Author Best Paper Award, 2017 CTTC Early Achievement Award, 2017 IEEE ComSoc AP Outstanding Paper Award, 2020 IEEE Communications Society Young Author Best Paper Award, 2020 IEEE Stephen O. Rice Prize, 2020 Nokia Visiting Professor, and 2016–2020 Clarivate Analytics Highly Cited Researcher.

Zhu Han (Fellow, IEEE) received the B.S. degree in electronic engineering from Tsinghua University, Beijing, China, in 1997, and the M.S. and Ph.D. degrees in electrical and computer engineering from the University of Maryland, College Park, MD, USA, in 1999 and 2003, respectively. He is a John and Rebecca Moores Professor with the University of Houston, Houston, TX, USA. His research interests include wireless resource allocation and management, wireless communications and networking, and smart grid. He was the recipient of the NSF Career Award in 2010 and IEEE Kiyo Tomiyasu Award in 2021. He was an IEEE Communications Society Distinguished Lecturer from 2015 to 2018, and has been an AAAS Fellow since 2019 and an ACM Distinguished Member since 2019. Since 2017, he has been a 1% highly cited Researcher according to the Web of Science.