Editorial

Energy Efficient Design and Control of Non-Orthogonal Multiple Access Systems

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Non-orthogonal multiple access (NOMA) has recently been recognized as a promising solution for cellular systems to meet exponentially growing demands for mobile data over limited radio spectrum. The key principle of NOMA is to enable multiple concurrent transmissions by allocating different portions of the total power or different codes to multiple users over the same spectrum. Accordingly, NOMA can bring substantial enhancement in the spectral efficiency of cellular systems. There have been a lot of preceding works on NOMA design from the viewpoint of spectral efficiency. However, multiple concurrent transmissions and interference cancellation of NOMA principle will complicate the overall system, increasing energy consumption. Along with the spectral efficiency, the energy efficiency is an important design criterion for the next generation of mobile communications. Nevertheless, energy efficient design and control in the context of NOMA has been less investigated and there are many important open problems and challenges.

The aim of this Special Issue is putting together recent original achievements and developments in the field of energy efficient design and control of NOMA systems. After extensive reviews, we have selected one review article and three research articles in the relevant areas. A comprehensive review article, “A survey on non-orthogonal multiple access: From the perspective of spectral efficiency and energy efficiency” [1] is a good starting point to understand NOMA technology. The article first introduces the principle of NOMA and identifies critical factors that influence the spectral efficiency and energy efficiency of NOMA-based systems. Then, the article presents numerous approaches to improving the spectral efficiency and energy efficiency of NOMA systems, and discuss emerging technologies that can be incorporated into NOMA to further enhance the performance. Last but not the least, technical challenges and future research directions of NOMA are highlighted.

The article “Rate fairness and power consumption optimization for NOMA-assisted downlink networks” [2] considers a NOMA downlink network, where a hybrid of NOMA and beamforming design is developed to improve the performance. The aim of the hybrid design is to improve the performance in terms of both fairness rate among all users and power consumption. Hence, a multi-objective problem with a joint optimization of user equipment pairing, beamforming vectors, power control, and quality-of-service requirements is addressed. To tackle the resulting mixed-integer non-convex problem, the authors propose two low-complexity algorithms based on the inner-approximation method, with the first algorithm using the relaxation method and the second one using a bipartite graph and binary search. Numerical results are provided to demonstrate that the two proposed algorithms outperform the existing schemes in terms of both the max-min rate and power consumption.

The article “Deep learning based successive interference cancellation scheme in nonorthogonal multiple access downlink network” [3] investigates a deep learning-based successive interference cancellation (SIC) scheme for NOMA systems. SIC is one of the most popular decoding schemes applied at NOMA receivers. The authors propose a convolutional neural network (CNN)-based SIC scheme to improve the performance of NOMA systems with multiple users. In contrast to existing SIC schemes, the proposed CNN-based

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SIC scheme can effectively mitigate rate loss resulting from imperfect SIC. Simulation results indicate that the CNN-based SIC method can successfully relieve conventional SIC impairments and achieve good detection performance. The study reveals that CNN-based deep learning approach is promising to enhance the performance of NOMA detection.

The article “Particle swarm optimization-based secure computation efficiency maximization in a power beacon-assisted wireless-powered mobile edge computing NOMA system” [4] studies physical layer security in a wireless-powered NOMA-enabled mobile edge computing (MEC) system with a nonlinear energy-harvesting user and a power beacon in the presence of an eavesdropper. The authors formulate a joint optimization problem of transmission power, time allocation for energy transfer, computation time, and central processing unit frequency in the NOMA-enabled MEC system, to maximize the secure computation efficiency under the constraints of minimum computation bits required by users, minimum amount of energy harvesting, and a limitation on the energy consumption. A low-complexity algorithm based on particle swarm optimization is proposed to solve the resulting nonconvex problem. Simulation results are provided to demonstrate the superiority of the proposed approach over baseline schemes based on time division multiple access and full offloading.

We hope that the articles published in this Special Issue will serve as good references for readers’ research work and promote further research in the emerging field of energy efficient design and control of NOMA systems. In particular, optimization frameworks developed in the articles can be used for future works. The topic of this Special Issue needs further investigation, as the energy efficiency as well as the spectral efficiency becomes increasingly important in future wireless networks. We would like to take this opportunity to thank all the authors who have submitted their papers to this Special Issue and express our gratitude to all the reviewers who provided valuable feedback to the authors. Their timely reviews and valuable comments helped us select the papers as well as improve the quality of this Special Issue.

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