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Editorial

Editorial for the Special Issue on "Wireless Energy Harvesting for Future Wireless Communications"

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Radio communications is considered as one of the pillars for future smart and connected communities that envision the enhancement of the overall quality of our everyday life in terms of social, environmental, and economic well-being. However, the number of connected sensors, smart devices, and machine-type devices is forecasted to increase exponentially in the coming years, leading to several challenges in supporting these resource-constrained devices with the limited available wireless infrastructure and scarce radio resources. Out of several other challenges, enhancing the energy efficiency of the upcoming fifth generation (5G) and beyond wireless networks is considered as an important research issue due to the ever-increasing demand of energy required to operate several existing, as well as the emerging communication networks. Accordingly, the investigation of far-field wireless power transfer techniques in energy-constrained wireless networks such as dense outdoor cellular networks, indoor wireless networks, wireless sensor networks, and Internet of Things (IoT) systems has recently received significant attention. As the Radio Frequency (RF) signals can carry two important entities, i.e., energy and information, the wireless energy signal can be sent over the air with the sole objective of providing energy or with the possibility of being combined with the information signal. In the latter approach, RF energy harvesting and information decoding can be theoretically carried out from the same RF signal input, leading to the concept of *Simultaneous Wireless Information and Power Transfer* (SWIPT). However, the two objectives of maximizing the information rate and maximizing the energy transfer compete with each-other, and there occurs a clear trade-off between information decoding and energy harvesting. This has been studied for SWIPT systems in the literature in various system settings. Furthermore, there are several challenges to be addressed to fully incorporate SWIPT in emerging 5G and beyond wireless networks such as improving RF energy harvesting efficiency, balancing energy-throughput trade-off, adaptive resource allocation, and enhancing the security of a SWIPT system. In this direction, this special issue on "Wireless Energy Harvesting for Future Wireless Communications" includes two papers whose contributions are briefly described below.

In the paper entitled "Rate Optimization of Two-Way Relaying with Wireless Information and Power Transfer", *Thinh Phu Do et al* studied resource allocation problems of a SWIPT receiver in two-phase Decode-and-Forward (DF) two-way relaying networks. The joint optimization problem of optimizing the time-phase ratio of the DF two-way relaying and the splitting ratio of the SWIPT receiver by considering the objective of maximizing the sum-rate is formulated and solved by transforming the problem to a convex form. Furthermore, sub-optimal methods to optimize the splitting ratio for the fixed time-phase have been presented to reduce the implementation complexity. It is demonstrated that the power-splitting SWIPT receiver outperforms the time-switching SWIPT receiver in terms of outage probability in both the optimal and sub-optimal methods. Future works could be the extension of the sum-rate optimization problem to optimize the SWIP receiver parameters, as well as the transmit power of the end-devices, by considering the constraints of total power consumption and total battery capacity at the relay node, and the application in multi-way relay communications supporting more than two devices.

In another paper entitled "Physical Layer Security and Optimal Multi-Time-Slot Power Allocation of SWIPT System Powered by Hybrid Energy", *Dandan Guo et al.* considered a constrained optimization problem of reducing the grid power consumption and enhancing the physical layer security of a SWIPT system in the presence of a potential eavesdropper. In the considered system, a multi-time-slot artificial noise-assisted transmission strategy is proposed to reduce the signal to noise ratio (SNR) of an eavesdropping link by dividing the transfer process into multiple time slots. Subsequently, a power allocation algorithm based on the multi-time-slot golden section search is employed in order to dynamically allocate the renewable energy at each time slot with the objective of minimizing the grid power consumption. The proposed methods are validated with the help of simulation results in terms of different system trade-offs, and their effects on the secrecy performance and grid energy consumption have been analyzed. It has been shown that by utilizing artificial noise-assisted multiple slot transmission, a SWIPT system can be sufficiently secured against an eavesdropper. Accordingly, the extension of the proposed approach with a full-duplex mode or an information receiver as a jammer could be future research topics.

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