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EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: RECENT ADVANCES IN FULL-DUPLEX RADIOS AND NETWORKS

With the explosive growth of wireless communications, frequency resources have become scarcer, considering the dramatically increasing demands for higher communication rates. However, by examining the existing duplex modes, e.g., time division duplex (TDD) and frequency division duplex (FDD), it is observed that more than half of the resources are wasted due to the "half-duplex" constraints, as well as the uses of guard zones in the time or frequency domain to avoid interference from neighbor time slots or frequency bands. Therefore, efficiently utilizing the expensive frequency resources to provide high spectrum-efficient communications becomes one of the most important challenges in the design of the next generation wireless communication systems.

In academia, it has long been known that full-duplex (FD), allowing radios to simultaneously transmit and receive at the same time and frequency, can potentially double the spectrum efficiency of single-link wireless communications. Unfortunately, severe self-interference (SI) from the transmitter to the local receiver is the key obstacle for the implementations of these radios. Adopting FD radios will also introduce extra inter- and intra-cell interferences to the multi-cell cellular networks. Thus, how to suppress the undesired SI at the FD radios and manage the intricate interferences in the newly mixed-duplex networks is the most critical challenge for the implementation of FD techniques.

This Special Section in IEEE Access includes five articles.

To deal with the SI cancellation challenge, Liu *et al*, in the invited article entitled "On the analog self-interference cancellation for full-duplex communications with imperfect channel state information," studied the performance of the analog multi-tap (MT) canceller, where the tap coefficients are calculated based on the estimated SI channel state information (CSI). Closed-form expressions of the residual SI power and the corresponding achievable rate of the FD transceivers were derived.

For FD cooperative transmission, Li *et al*, in the article entitled "Outage performance of the full-duplex two-way DF relay system under imperfect CSI," studied the outage performance of the two-way FD decode-and-forward relay network under the joint effects of the residual self-interference and imperfect CSI. The results revealed that the imperfect CSI only affects the optimal power allocation, while the optimal relay placement is only determined by the power ratio between the user nodes.

Furthermore, Wang *et al*, in the article entitled "Hybrid one-way full-duplex/two-way half-duplex relaying scheme," proposed a hybrid one-way full-duplex (OWFD)/two-way half-duplex (TWHD) relaying scheme to improve the performance of the relay system with asymmetric channel gains and traffic requirements. A power control scheme was also proposed to mitigate the effect of residual SI when the relay is operated in the OWFD mode.

For FD multiple-input multiple-output (MIMO) radios, Chung *et al*, in the article entitled "Compact full duplex MIMO radios in D2D underlaid cellular networks: From system design to prototype results," considered the implementation and application possibilities of a compact FD MIMO architecture, where direct communication exists between users, e.g., device-to-device (D2D) and cellular link coexisting on the same spectrum. For an over-the-air wireless experiment of FD testbed with a two-user-pair, the authors implemented a FD MIMO physical layer, supporting 20-MHz bandwidth, on a Field-Programmable Gate Array-based software-defined radio platform.

For cellular FD multi-user communications, Nguyen *et al*, in the article entitled "Spectral efficiency of full-duplex multiuser system: Beamforming design, user grouping, and time allocation," studied the joint design of transmit beamformers, uplink users (ULUs) and downlink users (DLUs) group assignment, and time allocation for each group to maximize the sum rate under the ULU/DLU minimum throughput constraints.

The Guest Editors are happy with the technical depth and span of this Special Section, and also recognize that it cannot cover all the research topics about FD radios and networking. Finally, we sincerely thank all the authors and reviewers for their tremendous efforts, and the Editor-in-Chief and staff members for their great guidance.

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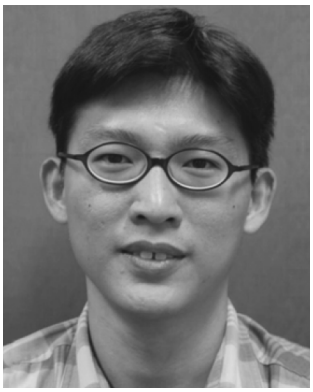
Dr. Joung was a recipient of the first prize at the Intel-ITRC Student Paper Contest in 2006. He has been serving on the Editorial Board of the *APSIPA Transactions on Signal and Information Processing* since 2014. He also served as a Guest Editor for the IEEE ACCESS for the special section on Recent Advanced in Full-Duplex Radios and Networks in 2016. He is recognized as the Exemplary Reviewers from the IEEE COMMUNICATIONS LETTERS in 2012, and the IEEE WIRELESS COMMUNICATIONS LETTERS in 2012 and 2013.



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