Guest Editorial Circuits, Systems, and Algorithms for Beyond 5G and Toward 6G

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Guest Editorial Circuits, Systems, and Algorithms for Beyond 5G and Toward 6G

THIS special section of the IEEE OPEN JOURNAL OF CIRCUITS AND SYSTEMS (OJCAS) is dedicated to highlight the state-of-the-art research progress on circuits, systems, and algorithms associated with the design of beyond 5G (B5G) and 6G wireless systems.

In order to meet the requirements raised by emerging applications, such as Industry 4.0, Internet of Things, vehicle-to-everything (V2X), Smart City, Smart Healthcare, Intelligent Logistics, e-learning, new techniques have been identified for B5G and 6G. Research initiatives on circuits, systems, and algorithms are needed for the design, optimization, and implementation of B5G/6G systems. Advances in signal processing solutions, system architectures, and optimized implementations are expected. These new techniques of wireless systems are posing new challenges in an unconventional way, especially from the circuits and systems perspective. It is necessary to help interested researchers to identify the technical challenges, emerging techniques, and recent results related to this area.

This special section is devoted to providing a comprehensive perspective on the state of research on circuits, systems, and algorithms for B5G and 6G through a collection of recent contributions. The selected 5 papers cover both system and module design and implementation for B5G/6G systems.

The first paper is titled "Towards Intelligent Reconfigurable Wireless Physical Layer (PHY)," by Singh *et al.* and proposes the design and implementation of a reconfigurable PHY via a hardware-software co-design approach. Both the ARM processor and FPGA have been employed. Intelligence has been incorporated into the reconfigurability with online machine learning (OML) based decision-making algorithm. Following the first paper, the remaining papers focus on different components of emerging systems, including channelizer, sequence detection, channel estimator, and LDPC decoder.

The second paper is titled "A High-Throughput Oversampled Polyphase Filter Bank Using Vivado HLS and PYNQ on a RFSoC," by Smith *et al.* and focuses on the design and implementation of a 4 GHz oversampled polyphase channelizer implemented on a Xilinx RFSoC. Compared to the existing FPGA designs incorporating Vivado HLS, the presented design enjoys a larger input bandwidth (4 GHz) and greater FPGA fabric speed (512 MHz).

The third paper is titled "Massive Machine-Type Communication Pilot-Hopping Sequence Detection Architectures Based on Non-Negative Least Squares for Grant-Free Random Access," by Sarband *et al.* and proposes two hardware architectures to solve the NNLS problem for the mMTC pilot-hopping sequence detection. Both architectures have been evaluated with a 28 nm FD-SOI standard cell process at 1 V power supply voltage.

The fourth paper is titled "Channel Estimation for Advanced 5G/6G Use Cases on a Vector Digital Signal Processor" by Damjancevic *et al.* and proposes a software implementation process that can dynamically balance latency and throughput. Results have shown that the proposed process can effectively avoid both unnecessary hardware power cost for given use-cases.

The last paper in this group is titled "GPU-Based, LDPC Decoding for 5G and Beyond," by Tarver *et al.* and demonstrates a high-throughput and low-latency LDPC decoder based on GPUs. Experimental results have shown that this decoder can provide high performance required by 5G and beyond while maintaining the advantages of a software-based decoder.

ACKNOWLEDGMENT

The Guest Editors would like to thank all the authors for contributing technical excellence for this special section. Without their outstanding contribution, we would not be able to keep the high quality for this OJCAS special section. We also would like to thank the anonymous reviewers for providing their valuable comments in improving this special section. We are grateful to the Editor-in-Chief (EiC) Dr. Gabriele Manganaro for his consistent guidance, support, and advice. Last but not least, we are grateful to IEEE Publishing Operations personnel for their great efforts and patience in finalizing this special issue. By committing itself to the emerging techniques of circuits and systems for B5G and 6G, we hope this special section will be very interesting for a large portion of related researchers, and inspire further progress in this important research area.

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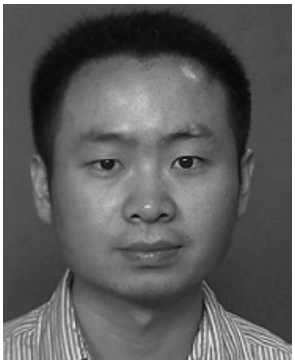
Dr. Zhang received the Best Contribution Award of the IEEE Asia–Pacific Conference on Circuits and Systems (APCCAS) in 2018, the Best Paper Award in 2016, the Best (Student) Paper Award of the IEEE International Conference on DSP in 2016, three Best (Student) Paper Awards of the IEEE International Conference on ASIC in 2015, 2017, and 2019, the Best Paper Award Nomination of the IEEE Workshop on Signal Processing Systems in 2015, three Excellent Paper Awards and two Excellent Poster Presentation Awards of the International Collaboration Symposium on Information Production and Systems from 2016 to 2018, the Outstanding Achievement Award of the Intel Collaborative Research Institute in 2018, and the Merit (Student) Paper Award of the IEEE APCCAS in 2008. He also received the Three-Year University-Wide Graduate School Fellowship of UMN and the Doctoral Dissertation Fellowship of UMN. He serves as an Associate Editor for the IEEE TRANSACTIONS ON SIGNAL PROCESSING and IEEE OPEN JOURNAL OF CIRCUITS AND SYSTEMS. He serves as a Corresponding Guest Editor for the IEEE JOURNAL ON EMERGING AND SELECTED TOPICS IN CIRCUITS AND SYSTEMS twice. He is also the Secretary-Elect of the Circuits and Systems for Communications TC of the IEEE Circuits and Systems Society. He is also a member of the Seasonal School of Signal Processing and Design and Implementation of Signal Processing Systems TC of the IEEE Signal Processing Society, and Circuits and Systems for Communications TC, VLSI Systems and Applications TC, and Digital Signal Processing TC of the IEEE Circuits and Systems Society.



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