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Editorial

Advanced MIMO Techniques in the Heterogeneous Networks

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Since the first commercial long term evolution (LTE) was deployed in South Korea, 300 operators have commercially launched LTE networks in 107 countries reported by the global mobile suppliers association. At least 20% of network operators are investing to deploy LTE-Advanced techniques. The downlink throughput for LTE-Advanced category 6 (CAT6) user equipment (UE) is 300 Mbps. However, with the development of mobile internet service, the peak rate and spectrum efficiency of the cellular network need to be further enhanced. Multiple input multiple output (MIMO) and heterogeneous network (HetNets) are adopted in LTE and the fifth generation (5G) system to improve user experience. By employing multiple antennas in both base station (BS) and UE, a new space domain is introduced in MIMO architecture. Multiantenna precoding and receiving can achieve array gain and diversity gain. As the spectral efficiency in a single link between the BS and UE approaches theoretical limits, the demand of mobile traffic data requires increasing the node density to further improve cell capacity. Therefore, heterogeneous network performance optimization is of great importance in the wireless network, especially for scenario of MIMO technique in the heterogeneous network.

To fully realize the potential of advanced antenna technologies and to solve the problems of heterogeneous network performance optimization, this special issue aims to attract the attention of investigators to contribute original research articles. We have received a total of 11 submissions, out of which 9 papers were accepted for publication after peer reviewing. The accepted papers cover a broad area of advanced MIMO topics.

Different from the traditional wireless network, which only uses macrocell to provide outdoor coverage, plenty of small cells are adopted in the LTE-A and 5G stage to enhance the data rate in the hot spot area. Therefore manual optimization is not very efficient. One potential solution to address these issues is to introduce the extensively attracted self-organizing network (SON). There are three papers in this special issue focusing on SON technology. The paper entitled "*Capacity analysis and optimization in heterogeneous network with adaptive cell range control*" by X. Gu et al. proposed an adaptive cell specific offset updating algorithm. System-level simulations results indicate that the proposed algorithm can ensure a nearly optimal performance in all tested traffic load situations. The paper entitled "*Cell outage detection and compensation in two-tier heterogeneous networks*" by W. Xue et al. developed a cell outage detection and compensation methods in two-tier HetNets where macrocell and picocells coexisted. In the paper "*Advanced load balancing based on network flow approach in LTE-A heterogeneous network,*" Dr. S. Jia et al. first evaluated the negative impact of unbalanced load among cells through the Markova model. Then, they proposed a novel algorithm named optimal solution-based

load balancing. System-level simulation shows that the proposed scheme can provide up to 20% gain in load distribution index.

Due to deployment of small cell in HetNets, macro cell and small cell may be overlapped in some scenario. Therefore, interference cancellation needs to be well investigated. The paper entitled "*High energy efficient heterogeneous networks: cooperative and cognitive techniques*" by H. Wang et al. introduced both the cooperative communication and cognitive radio techniques to mitigate the interference in HetNet, while the authors of the paper entitled "*Coordinated beamforming with altruistic precoding and user selection for MU-MIMO system*" proposed an altruistic precoding method to minimize the sum of interference. Furthermore, the lower bound of the capacity and local optimal solution for multicell user selection problem were also discussed.

In the paper entitled "*Performance analysis of joint base-station multiantenna multibeam and channel assignment scheme for hierarchical cellular system,*" P. Yang et al. introduced a joint base-station multiantenna multibeam and channel assignment scheme for hierarchical cellular. Multibeam base-station antenna splitting and dynamic channel allocation scheme are studied.

Full duplexing mode is a hot topic recently because of its potential use in 5G. The paper entitled "*Full-duplex mode in amplify-and-forward relay channels: outage probability and ergodic capacity*" by R. Hu et al. investigated the outage probability and ergodic capacity performances for full-duplex mode in two-way amplify-and-forward relay channel scenarios.

In the paper entitled "*Model of handover and traffic based on cellular geometry with smart antenna,*" the authors discussed the impact of the width of the smart antenna beams in terms of dwell time and traffic performance.

The paper entitled "*Miniaturization design for 8 × 8 Butler matrix based on back-to-back bilayer microstrip*" by Y. Zhai et al. presented a low-cost compact 8 × 8 Butler matrix based on a novel bilayer microstrip configuration. Some measured results were also shown in this paper.

Acknowledgment

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