

Editorial: Game Theory for 5G Wireless Networks

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Editorial

Driven by the rapid development of wireless terminal equipments and wide usage of bandwidth-hungry mobile Internet applications, wireless data traffic is increasing in an exponential manner, which intend to integrate and benefit from many recent technical advances including ultra dense network (UDN), cloud radio access network (C-RAN), heterogeneous small cell networks, interference management and resource allocation, software defined wireless networks (SDN), self-organizing networks, cognitive radio, millimeter wave, massive multiple input multiple output (MIMO), and so on.

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Specifically, UDN can also offload the wireless data traffic of user equipments from macrocells, especially for an indoor environment where more than 80% of the data traffic occurs. C-RAN is also a promising wireless network architecture in 5G networks. In heterogeneous small cell networks, low power small cells (such as picocell and femtocell) when overlaid on top of the macrocells, can improve the coverage and capacity of cellular networks by exploiting spatial reuse of the spectrum. However, there are still many challenges and problems in 5G networks. Game theory is a powerful tool for modeling and analyzing the challenging problems in 5G wireless networks, which can be classified as cooperative games and non-cooperative games. Different game theories are suitable for various scenarios of 5G wireless networks in interference mitigation, resource allocation, spectrum access, economic analysis, etc.

This special issue features six selected papers with high quality. The first article titled “Tracking areas planning based on community detection in heterogeneous and small cell networks” proposes a tracking area (TA) planning method based on cooperative game for heterogeneous cellular networks in order to reduce the signaling overhead, improve the performance of calling successes and system utilizations while maintaining the offloading abilities of small cells.

The second article titled “Joint Resource Block and Power Allocation for Interference Management in Device to Device Underlay Cellular Networks: A Game Theoretic Approach” proposes a two-stage game theoretic approach for the problem of joint resource block (RB) and uplink transmission power allocation in a D2D underlay cellular network and confirms that the framework achieves to mitigate the interference of every link in the network while every link satisfies its SINR requirement.

In the next article with the title “Dormancy Mechanism Based Power Allocation in Heterogeneous Networks: A Stackelberg Game Approach”, the authors studied dormancy

mechanism of smallcells to improve energy efficiency and mitigate interference in two-tier heterogeneous networks (HetNets). By considering both the cross-tier interference and the smallcell dormancy mechanism, a power optimization oriented Stackelberg game considering dormancy mechanism for the downlink of two-tier HetNets were proposed to improve the smallcell network throughput and meanwhile dramatically reduce smallcells transmit power while increase smallcells performance in dense smallcell networks.

Wireless network virtualization (WNV) is widely regarded as one of the most promising technologies for 5G wireless communications. The fourth article titled “Equilibrium Price and Dynamic Virtual Resource Allocation for Wireless Network Virtualization” proposed an effective virtual resource (VR) allocation scheme for WNV from the perspective of the market-equilibrium theory. Considering the infrastructure providers (InPs) and the virtual network operators (VNOs) are willing to maximize its own benefit, the VR allocation problem is formulated as a multi-objective optimization problem. The effectiveness of the proposed VR allocation scheme has also been testified through extensive experiments.

Device-to-device (D2D) communication as an underlay coexistence with cellular networks allows mobile devices in close proximity to communicate directly, which offloads the cellular traffic. Relaying with D2D communications can further enhance the system performance and may promote the development of 5G. The fifth article, which is entitled “Moderate Incentive Design for Delay-Constrained Device-to-Device Relaying”, proposed a moderate incentive-compatible data forwarding mechanism based on a Markov decision process framework with the principal-agent model. With implementation consideration, the authors proposed a greedy algorithm which only requires the past information. Compared with the existing inventive mechanisms, the proposed algorithm achieves a better performance on system utility.

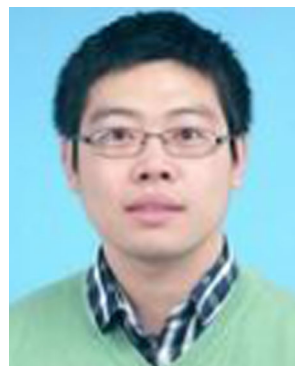
C-RAN is recognized as one of the key enabling techniques for 5G due to its advantages in flexibility. In addition, the greatly increased energy efficiency (EE), which is evaluated by bits/Hz/J, is listed as one main objective when designing 5G wireless network. The last article titled “Mobile Networks and Applications Energy Efficient Clustering and Beamforming for Cloud Radio Access Networks” concentrated on EE optimization through C-RAN enabled flexible multicell cooperative transmission. The authors proposed a hierarchical iterative framework to solve the problem. Coalition formation game theory and fractional programming are utilized to obtain the optimal network cluster partition and beamformers respectively. Simulation results demonstrate the superior performance of the proposed algorithms.

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