

Special Issue on Interference Management in 4G Wireless Networks

Guest Editorial

The explosive growth of smart phones and other portable wireless devices such as iPad has necessitated the ubiquitous high-data-rate wireless communications more than ever. There have been extensive ongoing research and standardization efforts ongoing to meet such demand, and the operators worldwide are upgrading their wireless networks to support broadband wireless transmissions. The fourth generation (4G) wireless cellular network is one of the major efforts to fulfill such high-speed wireless communications. By employing advanced signal processing and communication techniques such as multiuser multiple-input-multiple-output (MIMO), link adaptation, relay technologies, and hybrid automatic repeat request (ARQ), the 4G system could substantially enhance the spectrum efficiency over traditional third generation wireless cellular networks.

However, due to the broadcast nature of the wireless channel, the interference, particularly the inter-cell interference, could severely limit the capacity of the 4G cellular network. As a result, effective interference management solutions are crucial for realizing reliable and spectrally efficient 4G networks. To this end, a broad set of interference mitigation/coordination methods have been investigated, ranging from the simple power control/cell breathing methods to more advanced multi-cell interference coordination techniques such as the coordinated multi-point (CoMP) transmission and reception technologies.

This special issue features six high-quality papers that have been selected after a thorough and rigorous peer review process. These papers cover a wide range of topics on interference management in 4G wireless networks, as detailed below.

The first paper is an invited survey paper. In this paper, L. Liu et al. investigated a set of interference mitigation/coordination schemes for both homogeneous networks and heterogeneous networks. Both the mechanism of these interference mitigation methods and the performance improvement are presented in details.

The second and third papers address the design of 4G wireless systems in the presence of limited feedback. The second paper contributed by L. Razoumov and R. R. Miller studied the power control scheme for a set of parallel channels when the transmitter only has limited channel state information from the receivers, which is a typical case for the mobile orthogonal frequency-division multiple access (OFDMA) system. Simulation studies show that the proposed power control solutions achieve a considerable performance gain over the traditional water filling method. A channel state information feedback scheme that is particularly suitable for a multi-cell wireless network with static Inter-Cell Interference Coordination (ICIC) techniques is proposed in the third paper contributed by D. González G et al. The proposed solution is simple and implementation-friendly. The performance of the proposed feedback mechanism is also investigated through simulation studies.

Inter-carrier interference (ICI) severely deteriorates the performance of an Orthogonal Frequency-Division Multiplexing (OFDM) system. In the fifth paper, T. Hashimoto et al. present asymptotic analysis of a collection of ICI reduction schemes, including the polynomial cancellation coding, symmetric cancellation coding, and windowing. Based on the theoretic analysis, an asymptotically optimal windowing scheme is also developed.

In the sixth paper, M. Mathew et al. propose a multi-user cognitive radio network using B-spline multiwavelets. The cross correlation and multi-user interference are derived and the performance of the multiwavelet based cognitive radio network is also compared with the OFDMA system through simulation studies.

We would like to thank all the authors and reviewers for their contributions and great efforts. We are also very grateful to the Editor-in-Chief and editorial staff of JCM for their strong support. We hope you enjoy reading this special issue that is devoted to interference management in 4G wireless networks.

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Kai Yang received the B.E. degree in electrical engineering from Southeast University, Nanjing, China and the M.S. degree in optimization and numerical methods from the Singapore-MIT Alliance, National University of Singapore (NUS). He received the Ph.D. degree in electrical engineering from Columbia University, New York.

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Dr. Yang was awarded the Eliahu Jury Award for the best Ph.D. thesis work from Columbia University. He is the recipient of the 2011 Bell Labs Teamwork Award for his work on Advanced Metro-cell Light Radio, which is the first Light Radio prototype in the wireless industry. Dr. Yang served as the Demo/Poster co-chair of 2012 IEEE INFOCOM and is serving as the executive editor of European Transactions on Telecommunications.



A S Madhukumar received his B. Tech degree from College of Engineering, Trivandrum, India, M. Tech from Cochin University of Science and Technology and Ph D from Indian Institute of Technology, Madras. He is currently an Associate Professor in the School of Computer Engineering, Nanyang Technological University, Singapore.

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Shiwen Mao received Ph.D. in electrical and computer engineering from Polytechnic University, Brooklyn, NY, USA (now Polytechnic Institute of New York University) in 2004. He was a research staff member with IBM China Research Lab from 1997 to 1998. He was a Postdoctoral Research Associate/Research Scientist in the Bradley Department of Electrical and Computer Engineering at Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA, USA from 2003 to 2006. Currently, he is an Associate Professor in the Department of Electrical and Computer Engineering, Auburn University, Auburn, AL, USA.

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Dr. Mao is a coauthor of *TCP/IP Essentials: A Lab-Based Approach* (Cambridge University Press, 2004). He received the US National Science Foundation Faculty Early Career Development Award (CAREER) in 2010. He is a co-recipient of The 2004 IEEE Communications Society Leonard G. Abraham Prize in the Field of Communications Systems and The Best Paper Runner-up Award at The Fifth International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness (QShine) in 2008. He also received Auburn Alumni Council Research Awards for Excellence—Junior Award in 2011 and two Auburn Author Awards in 2011. Dr. Mao holds one US patent.