IEEE Communication Society & Vehicular Technology Society Malaysia Joint Chapter
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Speaker:
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Profile:

Since March 2010, Dr. Hossain is a Professor in the Department of Electrical and Computer Engineering at University of Manitoba, Winnipeg, Canada. He received his Ph.D. in Electrical Engineering from University of Victoria, Canada, in 2001. He was a University of Victoria Fellow and also a recipient of the British Columbia Advanced Systems Institute (ASI) graduate student award. Professor Hossain is an author/editor of the books Smart Grid Communications and Networking (Cambridge University Press, 2012), Green Radio Communication Networks (Cambridge University Press, 2012), Cooperative Cellular Wireless Networks (Cambridge University Press, 2011), Dynamic Spectrum Access and Management in Cognitive Wireless Networks (Cambridge University Press, 2009), Heterogeneous Wireless Access Networks (Springer, 2008), Cognitive Wireless Communication Networks (Springer, 2007), Wireless Mesh Networks: Architectures and Protocols (Springer, 2007), and Introduction to Network Simulator NS2 (Springer, 2007). Currently Dr. Hossain serves as the Editor-in-Chief for the IEEE Communications Surveys and Tutorials and an Editor for the IEEE Journal on Selected Areas in Communications - Cognitive RAdio Series and IEEE Wireless Communications. Also, he serves on the IEEE Press Editorial Board (for the term 2013-2015). Previously, Dr. Hossain served as the Area Editor for the IEEE Transactions on Wireless Communications (in the area of "Resource Management and Multiple Access") from 2009-2011 and an Editor for the IEEE Transactions on Mobile Computing (from 2007-2012). He is a Distinguished Lecturer for the IEEE Communications Society (for the term 2012-2013). Dr. Hossain is a registered Professional Engineer (P.Eng.) in the province of Manitoba, Canada.

Prof. Hossain's current research interest includes the following:

- Heterogeneous wireless access networks (spectrum/resource management, coexistence, distributed wireless access, scheduling, power control, network selection, mobility/handoff management)
- Cognitive wireless networks (interference modeling, dynamic spectrum access, power and admission control, spectrum management, spectrum trading, cognitive MAC protocols, performance modeling), IEEE 802.22-based systems
- Resource management in multi-tier cellular wireless networks
- Cognitive small cell networks
- Device-to-device and machine type communications in cellular wireless networks

- Economic and game-theory models for wireless/mobile communications networks.
- Green radio communications
- Smart grid communications and networking
- Multimedia over WiFi, WiMAX/OFDMA, LTE/LTE-Advanced networks (dynamic resource management, network optimization)
- MIMO-based wireless ad hoc/sensor/mesh networks (resource allocation, end-to-end performance modeling, analysis and optimization)
- Multi-hop cellular and mobile multihop cooperative/relay networks
- Wireless ITS (inter-vehicle and vehicle-to-infrastructure communications)
- Wireless body-area sensor networking and eHealth applications
- Network coding for wireless/mobile communications networks
- Service-oriented wireless/mobile network architectures and protocols

Abstract of the lecture

Lecture 1 (on 25 February, Monday): Radio Resource Management in Next Generation Hierarchical Cellular Wireless Networks
Venue: Universiti Malaysia Perlis, Perlis

Abstract: One of the major challenges for next generation wireless communication systems is to improve the indoor coverage and provide high-data-rate services to the users in a cost-effective manner and at the same time, to enhance the network capacity. In this regard, small cells such as femtocells, picocells, macrocells, and metrocells, are considered as a promising option for the mobile operators to improve the network coverage and to provide ubiquitous high speed connectivity to the end users or User Equipments (UEs). This gives rise to a hierarchical cellular network architecture. However, deployment of small cells in a hierarchical cellular network poses many challenges among which resource management (i.e., interference management, admission control, load balancing) is the most significant one. This lecture will provide an overview on the radio resource management problem in small cell networks considering both CDMA (e.g., 3G) and OFDMA (e.g., LTE, WiMAX) small cells, and review the state-of-the-art research on this topic. Several major open research issues and directions for future research on resource allocation and self-reconfiguration in small cell networks will be also discussed.

Lecture 2 (on 26 February, Tuesday): Interference Modeling in Random Carrier-Sense Multiple Access Wireless Networks
Venue: MIMOS Berhad, Kuala Lumpur

Abstract: In random networks, point processes are used to statistically describe the spatial distribution of the network nodes. A common and analytically tractable assumption is that the nodes are distributed in the space according to a homogeneous Poisson point process (PPP). Then the aggregate interference is obtained using the shot noise theory. However, a PPP cannot be directly used to model the spatial distribution of interference sources when modeling aggregate interference in random networks using carrier sense multiple access (CSMA). This is because using PPP does not forbid any two points of the process to coexist within a distance less than a certain value. This distance reflects the sensing range of the CSMA protocol and defines an exclusion region around a receiver. Hard core point process (HCPP) is one form of the point processes that has been used to model the spatial distribution of interferers in CSMA networks.

However, HCPP suffers from two major drawbacks. First, it highly underestimates the number of the interferers existing in the network, hence, underestimates the resultant aggregate interference. Second, HCPP is no longer a PPP; hence, the well-known formulas available in the literature for the PPP do not apply to it.

In this talk, I will present a modified HCPP model to eliminate the underestimation problem and obtain the intensity of the modified HCPP (MHCPP). Subsequently, closed-form approximate expressions for the moment generating function, mean and variance of the associated aggregate interference will be obtained. The accuracy of the MHCPP modeling and the aggregate interference approximation will be validated. Extension of the model for the generalized fading environments will be also discussed. The proposed modeling approach can be used for networks including cognitive femtocell and other small cell networks.

Lecture 3 (on 27 February, Wednesday): Dynamic Spectrum Access in Cognitive Radio Networks
Venue: Multimedia University, Melaka (Video Conferencing with Multimedia University, Cyberjaya)

Abstract: Dynamic spectrum sharing through cognitive radios can significantly enhance the spectrum utilization in a wireless network. Simultaneous sharing of the frequency bands among primary and secondary users (i.e., cognitive radios) is possible by restricting the transmission power of the secondary users so as not to cause any harmful interference to the active primary users. This talk presents a framework for resource allocation (i.e., transmission power and rate allocation and admission control) for cognitive radios for dynamic spectrum sharing using this interference control paradigm. A code-division-multiple-access (CDMA)-based wireless access scenario is considered where the cellular users are considered as the primary users. The cognitive radios, which communicate in an ad hoc mode using single-hop transmission, are able to dynamically measure/estimate the interference from primary users at their receiving ends. The resource allocation problem for cognitive radios is solved subject to their minimum signal-to-noise-plus-interference ratio (SINR) and transmission rate constraints and interference constraints for primary users. Since tracking channel gains instantaneously for dynamic spectrum allocation may be very difficult in practice, a case is considered where only mean channel gains averaged over short-term fading are available. Due to the usage of mean channel gains (i.e., perturbation in the channel state information) this results in sub-optimal resource allocation for cognitive radios. To this end, for an ad hoc/distributed dynamic spectrum access scenario, using some results from the stability analysis of optimization problems, perturbation in allocated power and transmission rate to cognitive radios is analyzed as a function of the number of secondary users.