

CS Seminar

Supporting Delay-Sensitive Applications in Next-Generation Wireless Networks --- A New Theory Combining Large Deviations with Lyapunov Stability

Prof. Xiaojun Lin
Purdue University

Date:

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Tuesday

11:00 am

Venue:

Room 308

Chow Yei Ching Bldg

The University of Hong Kong

Abstract:

The trend of wireless communication networks is to move towards fully packet-based wireless networks that can support both data applications and high-rate delay-sensitive applications. The key to the success of such networks is to be able to provide the stringent delay guarantees that delay-sensitive applications require, and to maximize the capacity of the system at the same time. Unfortunately, analyzing delay-performance and providing delay-guarantees in wireless networks have long been a very difficult problem due to both the scarcity of the wireless resources and the unpredictable channel-variation.

In this talk, we focus on using large-deviations theory to study the delay- and queueing- performance of wireless networks operating under queue-length-based scheduling algorithms. Although large-deviations theory allows us to focus on the (simpler) asymptotic regime with small queue-overflow probabilities, it still leads to a complex multi-dimensional calculus-of-variations problem that is very difficult to solve. Hence, analyzing the large-deviations delay-performance and optimality remains a difficult challenge. In our recent work, we develop a new theory that combines large deviations with Lyapunov stability to circumvent this difficulty. We show that if a control policy minimizes the drift of a Lyapunov function, then the policy is optimal for maximizing the large-deviations decay-rate of the overflow probability that corresponds to large Lyapunov function values. We will demonstrate how this result can be applied to both packet-based cellular networks and multi-hop wireless networks to easily draw conclusions on the delay-performance of existing wireless control policies, and to design new delay-optimal control algorithms.

About the Speaker:

Xiaojun Lin received his B.S. from Zhongshan University, Guangzhou, China, in 1994, and his M.S. and Ph.D. degrees from Purdue University, West Lafayette, Indiana, in 2000 and 2005, respectively. He is currently an Assistant Professor of Electrical and Computer Engineering at Purdue University.

Dr. Lin's research interests are in the analysis, control and optimization of large and complex wireless and wireline networks. He received the IEEE INFOCOM 2008 best paper award and 2005 best paper of the year award from Journal of Communications and Networks. His paper was also one of two runner-up papers for the best-paper award at IEEE INFOCOM 2005. He received the NSF CAREER award in 2007. He was the Workshop co-chair for IEEE GLOBECOM 2007, the Panel co-chair for WICON 2008, and the TPC co-chair for ACM MobiHoc 2009.

All are welcome!

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