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IEEE COMMUNICATION SOCIETY North Jersey Chapter

Wireless Network Communications: Unifying Source, Channel and Network Coding

by Tiffany Jing Li, Lehigh University

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Place: 202 ECEC, NJIT

About the Speaker

Tiffany Li received the Bachelor's degree in computer science from Peking University, Beijing, China, and the Master's and Ph.D. degree in electrical engineering from Texas A&M University, College Station, USA, in 1997, 1999 and 2002, respectively. After obtaining her Ph.D., she joined the electrical and computer engineering department at Lehigh University, Bethlehem, PA, where she is currently an associate professor. She spent the summer of 2000 and 2001 with Seagate Research, Pittsburgh, PA, and with Tyco Communications Laboratories, Eatontown, NJ. Li's research interests include channel coding, network coding, and distributed algorithms and strategies for wireless networks. Li is the recipient of the TAMU Ethel Ashworth-Tsutsui Memorial Award for Research in 2001. She is widely published in scientific journals and conferences, and has served a number of professional roles, including a symposium co-chair for IEEE Globecom 2006, IEEE WirelessCom 2006, ChinaCom 2006 and IEEE ICC 2008.

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About the Talk

The information world is undergoing an exciting paradigm shift from point-to-point to network communication and from centralized to distributed architecture. While the new paradigm promises unprecedented communication capabilities, it imposes new challenges on the way we collect, disseminate, represent and process information. One example of network information processing is wireless user cooperation, where multiple wireless users share antennas to exploit cooperative diversity over (time-limited) fading channels and to extend the dynamic transmit range.

We present two innovations for wireless user cooperation using ideas from channel coding, Slepian-Wolf coding and network coding. The first is the development of "Slepian-Wolf (SW) Cooperation" -- the first practical compress-and-forward (CF) coding scheme in literature. We discuss a general framework which makes clever use of the (high) correlation between the (noisy) packet overheard by the relay and the original packet at the source, and which efficiently exploits SW coding techniques to combat inter-user outage. The second is the exploitation of adaptive network coded cooperation (ANCC) in wireless ad-hoc networks. The network coding literature uses the prevailing assumption of static or lossless networks, but real wireless networks comprising randomly-faded channels are inherently unstable and unreliable. By matching code-on-graph with network-on-graph in a distributed and real-time manner, we show that network coding for ad-hoc networks is not only feasible, but also highly beneficial. We further extend ANCC through a simple but powerful mechanism of integrative channel-and-network coding. In addition to remarkable performance gains, the generalized scheme provides a constructive example for the notion that channel coding (and source coding) must be unified with network coding (routing) in order to achieve end-to-end optimality.

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