



Electrical Engineering Colloquium
Dallas Chapter of IEEE Signal Processing Society Presents

Multuser MIMO Systems: Theoretical Limits and Practical Strategies

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Wireless systems continue to strive for ever higher data rates. This goal is particularly challenging for systems that are power, bandwidth, and complexity limited. However, another domain can be exploited to significantly improve system performance - the use of multiple transmit and receive antennas. The study of the fundamental limits of these multiple antenna (also called multiple input multiple output) systems is essential for understanding and exploiting the enormous potential of these systems. In this talk we discuss two important multiuser systems - the multiple antenna broadcast (downlink) and multiple access (uplink) systems. The downlink is a one-to-many communication system, where one transmitter (a base-station, an access-point) transmits different data to many receivers (such as cellular phones and laptops). The uplink is a "mirror image" of the downlink - a many-to-one system. Characterizing the capacity region of the uplink is a relatively easier problem than that of the downlink, and the uplink capacity region is in fact well known. However, the Gaussian broadcast channel is a much harder problem, with its capacity region only recently characterized. In our work, we discuss a "duality" connection between Gaussian downlink and uplink systems. We build a mathematical connection that highlights the synergy between the two systems. Specifically, we show that the capacity region of one system can be calculated from that of the other. This duality connection has many useful applications. First, we exploit duality to characterize the entire capacity region of the multiple antenna broadcast channel. Second, the duality connection and Karush-Kuhn-Tucker conditions from optimization theory allow us to obtain fast iterative algorithms that make the numerical computation of the sum capacity of broadcast channels highly efficient. As the third and final application of duality in this talk, we employ duality in conjunction with channel hardening arguments to obtain asymptotic results on the growth rate and limiting distribution of capacity as the number of antennas at the base-station/access-point grow to infinity.

Biography: Dr. Sriram Vishwanath received his B.Tech. from the Indian Institute of Technology (IIT), Madras, M.S. from CalTech and his Ph.D. from Stanford University, all in electrical engineering. His research interests include information theory, wireless communications and coding theory. His industry experience includes work at the National Semiconductor Corporation, CA and at the Lucent Bell labs, NJ.

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