

Canonical statistical models for MIMO channels: modeling, capacity and coding

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Abstract

Channel modeling for MIMO links in a multi-path scattering environment is an important problem - most realistic channels are spatially correlated as opposed to the idealized i.i.d model and much of statistical optimal signalling, in terms of capacity, space-time coding and channel estimation, becomes a function of the model. Hitherto known correlated models like the Kronecker model assume separation in the transmit and receive statistics, which imposes strong conditions on the degrees of freedom and diversity of the MIMO channel. Hence, the Kronecker model is not rich enough to model many practical scattering environments. Under some mild conditions, we introduce 'canonical statistical models' which do not assume this separation and in fact provide crucial insights in the interaction between the transmit and receive eigen-spaces. Some experiments on real data which show the effectiveness of these models in realistic environments are presented. We study the impact of this interaction between the transmit and receive spaces on MIMO capacity and space-time block codes. The relation of the available spatial multiplexing gain and diversity of the channel to the channel statistics and signal-to-noise ratio (SNR), in a statistical sense, is explored. This relation is directly revealed by the 'dominant' eigen-channels of the canonical model and shows that the available spatial multiplexing gain and diversity, and as expected the channel capacity, reduces with SNR. These results provide important insights in the design of space-time block codes like orthogonal codes and linear dispersion codes for correlated channels.

Bio

Jayesh H. Kotecha received his B.E. in Electronics and Telecommunications from the College of Engineering, Pune, India in 1995, and M.S. and Ph.D. degrees from the State University of New York at Stony Brook in 1996 and 2001 respectively. Between January 2002 - August 2004, he was with the Wireless Communications Research Group, University of Wisconsin-Madison as a post-doctoral researcher. Currently he is a Principal Staff Engineer with Freescale Semiconductor Inc. (formerly Motorola Semiconductors), Austin, TX. Dr. Kotecha's research interests are in the areas of wireless communications, sensor networks, statistical and adaptive signal processing, and particle filters.
