

STATISTICS/DEAS (EE) JOINT COLLOQUIUM

MONDAY, NOVEMBER 20, 2006

TALK: 4:00 PM — SCIENCE CENTER Rm. B-10

RECEPTION: 5:15 PM — SCIENCE CENTER, 7TH FLOOR

“A Multivariate Statistical Approach to Performance Analysis of Wireless Communication Systems”

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ABSTRACT

The explosive growth of wireless communication technologies has placed paramount importance on accurate performance analysis of the fidelity of a service offered by a system to a user. Unlike the channels of wireline systems, a wireless medium subjects a user to time-varying detriments such as multipath fading, cochannel interference, and thermal receiver noise. As a counter measure, structured redundancy in the form of diversity has been instrumental in ensuring reliable wireless communication characterized by a low bit error probability (BEP). In the performance analysis of diversity systems the common assumption of uncorrelated fading among distinct branches of system diversity tends to exaggerate diversity gain resulting in an overly optimistic view of performance. A limited number of works take into account the problem of statistical dependence. This is primarily due to the mathematical complication brought on by relaxing the unrealistic assumption of independent fading ! among degrees of system diversity.

We present a multivariate statistical approach to the performance analysis of wireless communication systems employing diversity. We show how such a framework allows for the statistical modeling of the correlated fading among the diversity branches of the system users. Analytical results are derived for the performance of maximal-ratio combining (MRC) over correlated Gaussian vector channels. Generality is maintained by assuming arbitrary power users and no specific form for the covariance matrices of the received faded signals. The analysis and results are applicable to binary signaling over a multiuse single-input multiple-output (SIMO) channel. In the second half of the presentation, attention is given to the performance analysis of a frequency diversity system known as multicarrier code-division multiple-access (MC-CDMA). With the promising prospects of MC-CDMA as a predominant wireless technology, analytical results are presented for the performance of MC-CDMA in the presence of correlated Rayleigh fading. In general, the empirical results presented in our work show the effects of correlated

fading to be non-negligible, and most pronounced for lightly-loaded communication systems.