# ANALYSIS OF PAIRWISE ERROR PROBABILITY BOUNDS FOR SPACE-TIME CODED MIMO SYSTEMS

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## ABSTRACT

Space-time codes have attracted considerable attention in the area of wireless communications due to their ability to exploit the enormous capacity promised by the multiple-input multiple-output (MIMO) antenna system in comparison with a single antenna system. The main idea behind MIMO is to establish independent parallel channels between multiple transmit and receive antennas. But in reality, the spatial correlation and the tap correlation in the case of frequency selective channel degrade the performance of space –time codes. For that reason, analytically derived pairwise error probability (PEP) expressions or bounds are of great importance in analyzing the performance of space-time codes over different fading environments. The main contribution of this thesis is to provide a broad mathematical framework to derive PEP bounds, which ultimately pave the way to design good codes.

A new analytical PEP upper bound is derived in this thesis for frequency selective Rician fading channels with dependent fading coefficients and tap coefficients. The mathematical analysis presented in this thesis in deriving the former bound is sufficiently general to handle any form of fading environment except Nakagami-m fading model. With this bound the impact of correlation towards the code performance is also discussed. An exact PEP expression is also presented in the form of a definite integral, which doesn't have a closed form while the closed form is presented when the codewords are taken from orthogonal designs. Since the exact PEP expressions have complicated closed forms, an approximate expression is presented which is valid for sufficiently high signal-to-noise ratios.

Although the Nakagami-m fading model is of practical importance compared to the other models, the mathematical complexity is very high if one follows the same classical approach, due to the unavailability of probability density function for a linear sum of several Nakagami-m random variables. There is not much literature available related to the properties of space-time codes due to this complexity. The thesis provides a new way of approach to the PEP upper bound derivation in the case of Nakagami-m fading channels employing two transmit antennas and subsequently it is extended to a more general case. Furthermore, exact PEP expressions are also derived in the case of orthogonal designs. Validity of the bounds is verified by the simulations at the latter part of the thesis.