Performance of Multiple Input Multiple Output Communication System in Partially Known Channels


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ABSTRACT

In this thesis, novel and improved techniques are proposed for the simulation and performance evaluation of Multiple Input Multiple Output (MIMO) wireless communication systems in the presence of imperfect channel state information (CSI). Channel state is an important parameter in communication systems. Prior knowledge of this parameter is very advantageous to the analysis and system performance in term of a higher quality bit error rate (BER) and improved data rate (bits/sec). Both advantages can be used to increase the channel’s quality of service and throughput significantly. First, the performance of the Alamouti Space Time Code (STC) in a time varying Rayleigh fading channel in the presence of imperfect CSI is presented. The effect of estimation error is shown as a function of different parameters of the system. The derivation is also extended to the non-identical and correlated Rayleigh fading channel case. Next, a model for a mobile to mobile MIMO communication link is proposed. The model is based on a non-uniform, two ring scattering environment. A general and flexible model is derived. It allows for modeling of scatterers concentrated mostly in a certain sector, which relaxes the assumption of a very rich and isotropic scattering environment surrounding both antennas. Expressions for the space-time covariance function, level-crossing rate and average fade duration are derived. An analytical expression for the achievable rates and optimal frame lengths in channels with pilot assisted estimation for a given quality of estimation is derived. Optimal frame lengths are found for both analytical models and measured data. Also, an optimization of the pilot symbol spacing to maximize the spectrum efficiency using an adaptive M-PSK modulation technique is proposed. Expressions for the optimization of the pilot locations for a given frame length and desired target BER is derived. A number of applications is presented to show how their performance could be evaluated using the proposed model and techniques. In particular, we consider the effect of double mobility on a MIMO system, the sensitivity of a communication system to errors in models and the effect of channel estimation on the diversity of a MIMO channel.