-

Performance Analysis of a Common Aperture Antenna Diversity System

Fikadu T. Dagefu*, Jungsuek Oh, Jihun Choi and Kamal Sarabandi
The Radiation Laboratory, Department of Electrical Engineering and Computer Science, The university of Michigan, Ann Arbor, MI,48109-2122 Email: {fikadu,saraband}@umich.edu

An aspect of wireless communication that is of paramount interest is reliable connectivity unhampered by signal fading caused by scatterers such as walls, buildings and other obstacles. For power limited ad hoc networks in complex environments, various phenomenon including multipath, diffraction from sharp corners contribute to the fading and distortion of electromagnetic waves that severely limit the coverage and reliability. Because of the difference in path length among the various signal components and in the absence of a direct signal, the received electric field will have uneven spatial distribution and significant fluctuations. This phenomenon is called fast fading and results in intermittent signal drop-offs causing the communication channel to be unreliable. A viable approach to mitigate fast fading is the use of antenna diversity systems. Antenna Diversity Systems, when used in multipath environments such as indoor and urban environments, enable improvement in signal-to-noise-ratio (SNR) without increasing the transmit power. A thorough and accurate analysis of a diversity system requires three main components: the Tx and Rx antenna radiation patterns (phase and amplitude), the multipath coherent propagation model and calculation of figures of merit for the performance of the diversity system including complex and envelop correlation coefficients and diversity gain. Existing simulation based diversity analysis techniques essentially model the multipath channel using a stochastic model such as Rayleigh and Rician distributions. While these probabilistic models provide generalized approximations to the indoor channel, such models do not accurately capture all the propagation mechanisms such as angle of arrival and polarization, and hence diversity analysis techniques based on such models inherently lack the information needed to assess the true performance of a given diversity system.

In this work, we discuss a new diversity system analysis approach that takes into account the complex radiation pattern of the Tx and Rx diversity antennas and make use of an accurate deterministic, coherent, and polarization preserving propagation model for a complex indoor scenario. The new physics-based pattern diversity analysis approach will be introduced. The propagation modeling with specific focus on near-ground antennas will also be discussed. Measurement results in indoor scenarios utilizing a compact, co-located radiation pattern diversity antenna system will be utilized to assess the performance of the diversity system via complex correlation coefficients and diversity gain.