Investigation of the Effects of Antenna Spacing and Orientation in MIMO System for Wireless Laptop Reception

Sung-Woo Lee*(1), Aly E. Fathy(1), Samir M. El-Ghazaly(2), Vijay K. Nair(3)
(1) EECS Department, University of Tennessee, Knoxville, TN 37996, USA
(2) ECE Department, University of Arkansas, Fayetteville, AR 72701, USA
(3)Intel Corporation, JF2-2-86, 2111 NE 25th Ave. Hillsboro, OR 97124, USA

Nowadays personal mobile communication demands multi-functional, high speed and throughput, robust connectivity and so more. Wireless traffic due to such as increasing number of users, services and reflective hot spots easily explodes and falls short due to their limited channel capacities. Recently, multiple-input multiple-output (MIMO) concepts utilizing multiple antennas are being applied to cope with multi-fading, reverberant wireless environment. The orthogonal frequency-division multiplexing technique in corporate with MIMO has been studied and successfully adapted into latest mobile communication. Antenna design and matching for MIMO application are no longer simple or deterministic because of the dynamic nature of channel characterization and adaptive algorithms. Number, type, spacing, and relative orientation of these antennas have become of great concern and very challenging design issues.

Optimum use of the multi-received signals in a MIMO system with multiple antennas can be monitored by evaluating their envelope correlation coefficient (ρ_e). Simple calculation of ρ_e using the antennas S-parameters rather than their three-dimensional field patterns enabled quantifying acceptable antenna mutual coupling/isolation as indicated by (S.W.Lee at al, AP-s Int. Sym. Jun. 2007). For example, in the case of only two antennas, it is required to have at least -6dB input match and isolation, which correspond to about 0.7 correlation coefficient.

In this work, the relationship between the envelope correlation coefficient and both mutual coupling and input matching will be discussed for different number of antennas. Additionally, extensive experimental studies have been carried out on the effect of various antennas orientations and their inter-spacing and will be presented. The measurement set up is based on selected laptop antenna types and the system's throughput performance in a realistic situation was used to monitor the overall system's performance.