Increasing Channel Capacity of an Ultra Wideband MIMO system using Co-located Vector Antennas

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Since the allocation of a 7.5 GHz (3.1-10.6 GHz) spectrum for Ultra Wideband communications, novel compact antenna designs for this frequency range have received considerable attention. It is known that using multiple antennas at the transmitter and the receiver, implementing what is traditionally known as a Multiple Input Multiple Output (MIMO) system, leads to increased channel capacity as compared to a single antenna. These antennas usually take the form of a linear array with elements spaced half a wavelength apart. Recently, it has been shown that co-located antennas, or vector antennas, can provide the same capacity increase as compared to a linear array of antennas (Konanur et al, *IEEE Trans. Microwave Theory and Techniques*, **53**, 1837-1844, June 2005).This paper describes the design of a vector antenna for an Ultra-Wideband MIMO system consisting of a loop-like antenna and two orthogonal bowtie antennas. The antennas operate in the frequency range 4-8.5 GHz and are fabricated on a single substrate with a relative permittivity of 2.6. Mutual coupling between the antennas was found to be less than -20dB over the frequency range 4-8.5 GHz. Time domain measurements show that the antennas have a linear phase response over the above mentioned frequency range, which indicates that these antennas are suitable for Ultra Wideband systems.

The UWB system was used in a transmitter-receiver configuration to evaluate the capacity of the channel. The environment consisted of scatterers placed randomly in the far field of the antennas. A Vector Network Analyzer was used to measure the S-parameter S_{12} between the transmitter and receiver and, by cycling through every possible combination of transmit-receive antenna element, 3x3 channel matrices were computed. Results show that spectral efficiency of the vector antenna system approaches that of the traditional spatial array. This demonstrates that vector antennas can be used in place of spatial arrays where compact multi-antenna systems are needed.