Antenna Location Effects on the Capacity of MIMO DSRC Channels

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Dedicated Short Range Communication (DSRC) [1], an automotive communication protocol, is popular for its potential application like Lane Changing Warning (LCW), Forward Collision Warning (FCW) in ensuring traffic safety and reducing traffic accidents. The major challenge in developing such application to provide a 360 degrees view of traffic status is to overcome the hurdle provided by the obstacles in form of buildings (in intersection), heavy vehicles (in case of overtaking), generally categorized as Non-Line-of-Sight (NLOS) scenarios [2]. In this work, we have used a vehicle as an obstacle between two other vehicles (at the transmitting and receiving ends). Antennas were placed at various locations on the vehicles' bodies. A total of 15 transmitters and receivers were spread out on the rear, center and front of two vehicles. The two vehicles were separated by two different distances: 10 meters and 15 meters, and the obstacle vehicle was positioned at the center, between these vehicles. This multiple antenna system was studied at two different locations. One location was in the area of College of Engineering and Mines, University of North Dakota, and the other was in the area around Walmart in Grand Forks, ND. Commercial simulation software, Wireless InSite® from Remcom Inc. [3], was utilized. Initially, the response of each receiver with respect to each transmitter was analyzed depending on the received power. By adopting the concept of Multiple Input and Multiple Output (MIMO) [4-5], different combination of transmitters and receivers were used to evaluate the channel capacity of a vehicle-to-vehicle (V2V) communication system in respect to antenna position [6]. These NLOS cases were compared to Line-of-Sight (LOS) cases (studied previously in [6]) when the obstacle vehicle was removed from the transmitting and receiving vehicle. The obtained capacities values were then compared with the capacity for a MIMO Rayleigh fading channel [7]. Furthermore, the impact of inclusion of phase of the received signal on channel capacity equation was studied.

References

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