Antenna Arrangement Suitable for Self-Interference Reduction in Short Range Full-Duplex MIMO

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As mobile terminals such as smartphones have become widespread, the near field communications (NFC) have been commonly used. However, the further increase of the data rate in these systems is difficult because of the limited spectral resource. Therefore, a new communication scheme with higher spectral efficiency and capacity is needed for NFC application. Multiple-Input Multiple-Output (MIMO) scheme can attain the spectral efficiency in proportion to the number of antennas, however the number of antennas is limited for small terminals.

In this report, we propose an antenna arrangement suitable for In-Band Full-Duplex (IBFD) MIMO scheme in short range wireless communication. Since IBFD communication simultaneously transmits and receives the signals at the same frequency, it can double the spectral efficiency at maximum (J. Choi, et al., Computing and Networking in ACM, pp. 1-12, Sep. 2010). However, Signal to Interference plus Noise Ratio (SINR) deteriorates due to the strong Self-Interference (SI) because the terminal's transmitted signal is captured by its receiver. Therefore, SI is suppressed by using eigenmode-based beamforming. In the following, the performance of the proposed method is validated by numerical analysis.

Fig. 1 shows the antenna arrangement of the proposed method. This terminal is composed of four transmitting antenna elements and four receiving antenna elements. The uplink and downlink use the vertical and horizontal linear arrays, respectively, where two arrays use different polarizations each other and form a cross shaped array on the same plane. By setting the cross shape, the rank of the SI channel degenerates into two. Furthermore, the antenna element spacing which degenerates the rank to one is searched while keeping its geometry symmetric. The eigenvalues degenerate only in the SI channel, and the desired channel's rank is not necessarily reduced due to the spherical wave.

The proposed method is compared with antennas A and B. Antenna A consists of two parallel linear arrays with four antenna elements each, where the inter-array distance is 10 wavelengths and their polarizations are linear and orthogonal each other. Antenna B is a two-point fed linear array antenna using both vertical and horizontal polarized waves. Fig. 2 shows the achievable rate versus the communication distance. The proposed method has an achievable rate of 51.60 bits/s/Hz when d = 20 cm, and its achievable rate is always 20 bits/s/Hz higher than the antennas A and B. Therefore, the proposed method outperforms the other two antenna configurations in terms of the achievable rate.

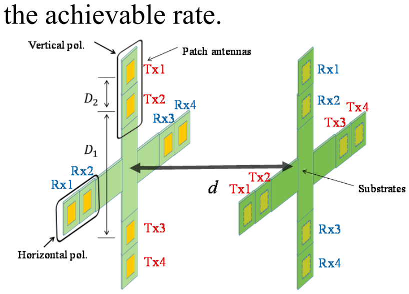

Figure 1. System model

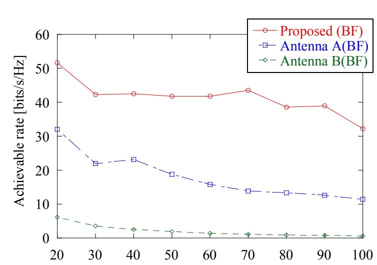

Figure 2. Achievable rate