

A Study on Multiple Antenna Systems for Handheld Devices

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Many experiments have demonstrated that a substantial performance improvement may be obtained if multiple antennas are properly designed and are used in handheld devices. For example, the battery life, the data capacity, the gain and the coverage can be significantly enhanced due to the use of multiple antennas. In this presentation, we explore the possibility of using multiple antennas in handheld devices, which cover three frequency bands 1880MHz-1920MHz, 2300MHz-2400MHz, and 2540MHz-2620MHz. It is shown that four to eight small inverted-F antenna elements can be integrated to the handheld devices of standard dimensions to perform MIMO (multi-input multi-output) or beam steering function to boost the capacity or antenna gain respectively. For MIMO applications, the ECC(envelope correlation coefficient) and MEG(mean effective gain) are investigated and are used to evaluate the performance the MIMO systems with different antenna element designs and arrangements. For beam-steering application, the distribution of excitations for the antenna arrays are determined by optimizing the power transmission coefficient between the antenna array and a testing antenna placed in the desired direction in which radiation must be reinforced. The optimization process yields an eigenvalue equation, which gives the optimized distribution of excitations for the antenna arrays in the specified direction. The optimized distribution may be realized by various feeding techniques to achieve beam steering in either azimuth plane or elevation plane. A number of examples are expounded to illustrate the design procedure. Various prototypes of antenna arrays are developed, simulated and verified by measurements, to demonstrate the effectiveness of the multiple antenna designs for handheld devices.