Novel Multi-Band MIMO Antenna Designs for Laptop Applications

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Modern Multiple-Input Multiple-Output (MIMO) mobile terminals demand miniaturized antennas as array elements. Recent requirements also demands that the MIMO systems operate at multi frequency bands. This invited paper based on our previous work discusses some of our recent developments in designing MIMO antennas for laptop applications. Specifically, a tri-band MIMO antenna and a dual band back-to-back E-shaped antenna will be examined. The tri-band operates in the frequency bands of 2.4 GHz, 5.25 GHz, and 5.8 GHz and the dual-band E-shaped antenna operates at the frequency bands of 2.4 GHz and 5.2 GHz. Both the single element version and four element versions of these designs have been studied.

Based on a Printed Inverted "F" Antenna (PIFA) concept, the tri-band antenna has been designed and evaluated. The mechanism of the design has been reported in one of our recent papers. The current distribution on the antenna at different frequencies reveals that the PIFA generates the lowest resonant frequency. In order to create the second resonant frequency, a J-shaped slot is inserted in the PIFA. Basically this J-shaped slot divides the original PIFA into two PIFAs that are connected in parallel. This element has already been integrated into two- and four-element MIMO arrangements. Simulations and measurement results will be shown to demonstrate the performance of this MIMO antenna.

It appears that the laptop manufacturers tend to move away from the plug-in cards into integrated solutions. A back-to-back E-shaped patch antenna has recently been designed to be integrated inside a laptop's screen rim. The design uses the TFT panel acting as a ground plane. The antenna is formed by two identical front and back patch sections connected by a narrow strip. A dual band behavior is achieved using uniquely designed E-shaped patches and a connection strip. The antenna element embraces the ground plane edge and can be integrated inside the plastic rim of a 3mm laptop display. As was recently shown in spite of integration with a large ground plane, the designed back-to-back E-shaped patch antenna has a quasi-omnidirectional total gain pattern in the horizontal plane This desirable feature is due to the patch and ground plane front-back symmetry. As part of our investigation both the single and four element back-to-back E-shaped antennas are placed within the TFT panel and attached to a real laptop's keyboard base. Both simulations and spherical near-field measurements of the antenna radiation patterns have been performed for different antenna locations and laptop opening angles.