Design and Evaluation of Dual Band MIMO Antennas.

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1. Background.

In the late 1990s, multiple-input multiple-output (MIMO) systems that utilize multiple antennas at both ends of the link were introduced. This enables the use of multiple spatial channels at the same frequency. Implementation of MIMO in mobile communication system necessitates at least two antennas in one terminal.

MIMO specific antenna design challenges are related to mutual coupling among antenna elements and degradation of antenna performance due to a user holding the mobile terminal. The number of antennas to be incorporated in today's mobile terminal is restricted by the size of the terminal. This is contrary to a less severe space limitation at the base station. Moreover, the performance of a MIMO system depends not only on the antenna performance, but also on the propagation environment. Therefore, a definitive and general conclusion on this subject has became major interest in antenna design community over the past few years.

2. Objectives of the thesis

The main objective of this thesis is to provide the dual band MIMO antenna and valuable insights for the small size and simple design of multi element antennas for wireless communication systems. The low profile unbalance fed inverted L antenna on finite conducting plane is investigated as antenna element of the dual band MIMO antenna.

Particularly, Equivalent circuit expression and the performance of inverted L antenna has been studied in the presence of the impedance matching.

A comparison with the base fed inverted F antenna have been investigated. The performance of unbalanced fed inverted L antenna such as the gain and return loss bandwidth are examined. Then, the comparison of the performance between the unbalanced fed inverted L antenna and unbalanced inverted F antenna has been examined to ensure which one is better to design the MIMO antenna.

The MIMO antenna composed two low profile inverted L antenna for 2.45 GHz on finite conducting plane have been investigated. The develop knowledge is used to reduce the mutual coupling between antenna elements and also the diversity performance is examined with investigating the correlation coefficient.

Finally, the dual band MIMO antenna composed low profile inverted L antennas for 2.45 and 5 GHz has been studied based on calculation and measurement data.

3. Contents and organization of the thesis

The main scientific results of this thesis are presented in articles [II] - [VI]. The thesis is divided into two parts. In the first part of the thesis, the expression of equivalent circuit of ultra low profile inverted L antenna in [II] and the characterization methods of ultra low profile unbalanced fed inverted L, base fed inverted F and unbalanced inverted F antennas performances are studied in, [III] and [IV].

The performances of the antennas with different type of inverted element are analyzed extensively. The investigations are focused on impedance matching, antenna gain and the return loss bandwidth at the design frequency of 2.45 GHz.

The second part of the thesis is dedicated to the design of MIMO antenna structures operating at the 2.45 GHz [V] and dual band MIMO antenna structures operating at 2.45 GHz and 5 GHz [VI]. The design and performance of the proposed MIMO antennas are investigated and using measurement examination and compared.

4. Scientific contributions

The scientific merit of the thesis is in the design, analysis, performance evaluation and design rules for MIMO antennas for wireless communication application. The highlights are:

1. The study of equivalent circuit of the ultra low profile unbalanced fed inverted L antenna is performed. The investigation on inverted L elements has been examined to obtain the impedance matching.

2. An empirical investigation on the impact of the height of inverted L and inverted F antenna, the conducting plane size and impedance matching. The evaluation is performed using calculation and measurement based on scattering parameters data.

3. Systematic analysis and evaluation on the performance of MIMO antenna composed of inverted L antennas are performed.

4. A simple design and good performance of dual band MIMO antenna has been realized. The proposed structure is operating at 2.45 GHz and 5 GHz bands.

5. The MoM of electromagnetic simulator WIPL-D

In the calculation the WIPL-D electromagnetic simulator based on Method of Moment is used.