CHAPTER-10
CONCLUDING REMARKS

The thesis has presented experimental and computed results carried out on the electromagnetically coupled shorted microstrip antennas and their arrays. Resonant frequencies, input impedance, impedance bandwidth and radiation characteristics, both as an isolated element and in an array environment, have been studied. The resonant properties of electromagnetically coupled shorted patch structures have been computed based on the method of moments and verified experimentally. The performance obtained indicate that electromagnetically coupled (stacking position) shorted microstrip antenna could advantageously replace other types of antennas in many applications.

The detailed experimental results and design considerations on the novel electromagnetically coupled shorted microstrip antennas structures optimized for its electrical characteristics, exhibit a broadband behaviour of the antenna with low cross-polarisation levels and better directivity as compared to a single shorted patch radiator. The impedance bandwidth obtained as high as 11% with very good return loss characteristics, for a proper (an optimized) spacing between two patches. The structures have been studied with two types of configurations, normal and inverted. The inverted type is of practical interest in that it additionally incorporates the top parasitic layer itself as a protective radome. The following inferences may of practical interest:

1. As a result of the availability of more number of design parameters, the two-layer EMC shorted microstrip antenna does offer a very good combination of pattern and bandwidth characteristics with an optimum choice of air gap between patches and also radius of the feed probe and shorting post.

2. As compared to the single layer shorted patch antennas and annular ring coupled (horizontal coupling) shorted microstrip antennas. The two-layer EMC shorted microstrip antennas exhibit a better return loss characteristics over a large bandwidth.

3. With a large control on its input impedance characteristics, by choice of the various parameters of the layered structure, the two layer EMCP antenna may be optimized for its input match as well as bandwidth, to form an ideal antenna element in an array configuration.
4. It has also been shown that there is no drastic changes in the characteristics of the odd combination coupling (as shown in chapter-7) with the shorted patches as compared to the annular ring/square ring coupled shorted circular square microstrip antenna.

Experiments carried out on linear array of two-layer EMC shorted microstrip antenna exhibited similar performances as that of EMC shorted microstrip antenna element. High gain and good pattern shape with side lobe as well as cross-polarisation levels of the order of -11 dB have been realized. The following are the results of practical interest on the application of two-layer EMC shorted microstrip antenna exhibited similar performances as that of EMC shorted microstrip antenna element. High gain and good pattern shape with side lobe as well as cross-polarisation levels of the order of -11 dB have been realized.

The following are the results of practical interest on the application of two-layer EMC shorted microstrip antenna array.

1. The two-layer EMC shorted microstrip antenna array provides a very good combination of pattern and bandwidth characteristics with the use of optimized two-layer EMC shorted microstrip antenna elements. The impedance bandwidth more than 10% may be realized with a good return loss and pattern characteristics.

FUTURE WORK

Exhaustive study have been presented in this thesis, on probe-fed EMC shorted microstrip antennas and their arrays, investigating their resonant impedance pattern characteristics. Although practical realization of broadband microstrip antennas and arrays with a very good pattern and impedance matching characteristics is tractable, as shown in this thesis, the future work lies in several different areas of the problem. Other microstrip patch geometries and feeding techniques may be investigated. The theoretical investigations leading to closed form design formulas and procedures for EMC shorted structures, are needed for ease of realizing such antennas with less of rigorous experimentation.