ABSTRACT

Cavity model used for analysing regular shape microstrip patch antennas is generalised to useful arbitrary shape microstrip patch antennas. Segmentation and multiport connection methods are used to determine the electric field distribution in the patch. Once the electric field distribution is known, cavity model is used to evaluate antenna characteristics like input impedance, radiation patterns, etc,. The new technique is verified by applying it to linearly polarised, circularly polarised and microstrip series array antennas. The antennas discussed are : rectangular ring, H-shaped patch, square ring, crossed rectangular patch and resonant and non-resonant series arrays of rectangular microstrip patches. In all the cases theoretical results obtained using Generalised Cavity Model (GCM), are compared with the measured values. The agreement is found to be good.

Rectangular ring and H-shaped patch antennas are found to be good alternatives to commonly used rectangular patch antenna. Rectangular ring antenna has more impedance bandwidth because of lower Q, whereas the size of the H-shaped patch antenna is about half that of rectangular patch because of loaded transmission line configuration. Therefore, H-shaped patch can substitute for UHF applications where the size of the antenna is relatively large. Impedance bandwidth is related through Q_o to axial ratio bandwidth for circularly polarised patch antennas. A simple

empirical expression for axial ratio bandwidth is reported. Square ring antenna is found to have larger axial ratio bandwidth than square patch, square patch with corners chopped, square patch with a diagonal slot and crossed rectangular patch antennas. The crossed rectangular patch has larger size than square patch and therefore it is well suited at millimeter wave frequencies for the given tolerance.

The proposed technique appears to be more efficient and/or accurate compared to the existing numerical techniques for analysing microstrip patch antennas. Unlike other techniques, feed reactance does not have to be modelled separately. It is built into the analysis and takes into account the patch geometry, feed location and dielectric constant of the substrate. However, the technique has inherent limitations of cavity model. Suggestions for the removal of these limitations are given.

Application of the Generalised Cavity Model to the analysis of waveguides with arbitrary cross-sections, with or without dielectric fillings, is suggested. New patch shapes are indicated. Optimization of antennas using the proposed technique is outlined.