Abstract

This dissertation has been devoted to the rigorous modal analysis of multilayer HDRA excited by four different feeds namely the microstrip-slot feed, the waveguide slot feed, the coaxial probe feed, and the conformal strip feed. The analysis is carried out using the Green's function and the Method of Moments (MoM) approach. The theoretical results have been verified by experiments.

The exact Green's function of the *N*-layer HDRA resting on an infinite ground plane and excited by magnetic and electric point sources has been derived. The unknown constants in the Green's function are evaluated using a matrix formulation. The characteristics equations of the *TE* and *TM* modes of the *N*-layer HDRA have been obtained in the matrix form, from which the resonant frequencies of the *TE* and *TM* modes can be obtained.

In addition, a novel and efficient computation technique named as "Product of Two Double Integrations" for the evaluation of input impedance of the slot-fed and the co-axial probe fed HDRA has been demonstrated. It has been shown that the overall computation time needed to obtain the input impedance of the microstrip slot coupled HDRA and co-axial probe coupled HDRA can be reduced by a factor of 37 and 100 respectively. The time reduction factor of about 319 has been obtained for centre-probe fed HDRA with Product of Two Single Integrations technique.

Thereafter, the analysis of the three-layer HDRA excited by the above-mentioned four feeds for wide band operation is presented. For the microstrip slot fed three-layer HDRA the wide impedance bandwidth is achieved by using a three-layer HDRA topology with unity permittivity in the second layer. Also, the parametric variation of the second and third layer permittivities for realization of maximum bandwidth is discussed. The maximum impedance bandwidth is also justified using source free Q factor curves. In addition, the modal analysis of the three-layer HDRA is presented.

Thereafter similar analysis has been carried out for waveguide slot feed, co-axial probe feed and conformal strip feed to the three-layer HDRA. The efficient algorithm has been used to determine the return loss, input impedance, radiation pattern and mode efficiency of the antennas.