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ANALYSIS OF THE BANDWIDTH OF RESONANT MICROSTRIP ANTENNAS ON ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

Microstrip antennas have sparked interest among researchers because of their many advantages over conventional antennas, such as low cost, light weight, conformal structure, low profile, reproducibility, realibility, ease in fabrication and integration with solid state devices.

Recently interest has developed in radiators etched on electrically thick substrates. The need for theoretical and experimental studies of microstrip antennas with electrically thick substrates is motivated by several major factors. Among these is the fact that microstrip antennas are currently being considered for use in millimeter wave systems. The substrates proposed for such applications often have high relative dielectric constants and, hence, appear electrically thick. The need for greater bandwidth is another major reason for studying thick substrate microstrip antennas. Consequently, this problem, particularly the bandwith aspect, has received considerable attention.

The complicated models used in calculating the bandwidth are based on an EM boundary problem, which leads to expression as an integral equation, using proper Green functions, either in the spectral domain or directly in the space domain, using moment methods. Without any initial assumption, the choice of test functions and the path integration appear to be more critical during the final, numerical solution. The best results can be obtained with the moment method, at the expense of a large computing time. However, using the cavity and transmission line models, the computation time is less than 2 seconds for a range of 60 frequencies, on a PC pentium/100 MHz computer. The cavity and transmission line models are also well suited for initial Computer Aided Design (CAD) tools and for a physical understanding of phenomena.

Artificial neural networks are known to provide simple and faster solutions than the complicated methods and techniques. The features of artificial neural networks such as ability and adaptability to learn, generalisation; less information requirements, fast real-time operation and ease of implementation have made them popular in recent years. This paper presents a new model based on the backpropagation multi layered perceptron network to find accurately the bandwidth of both electrically thin and thick rectangular microstrip antennas. This proposed neural model does not require the complicated Green's function methods and integral transformation techniques. The method can be used for a wide range of substrate thickness and permittivities, and is useful for the computer-aided design of microstrip antennas. The model only requires three parameters : W/λ_0, h and ε_r. The results obtained from this model are in excellent agreement with the results available in the literature even when $h(\varepsilon_r)^{1/2}/\lambda_0 = 0.15$. This method may find wide applications in high frequency printed antennas, specially at the millimeter-wave frequency range.

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