Analysis of a circular microstrip antenna on isotropic or uniaxially anisotropic substrate using neurospectral approach

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Abstract

Purpose – The paper aims to propose an artificial neural network (ANN) in conjunction with spectral domain formulation for fast and accurate determination of the resonant frequency and quality factor of circular microstrip antenna printed on isotropic or anisotropic substrate. This neurospectral approach reduces the problem complexity.

Design/methodology/approach – The moment method implemented in the spectral domain provides good accuracy but its computational cost is high due to the evaluation of the slowly decaying integrals and the iterative nature of the solution process. The paper introduces the electromagnetic knowledge combined with ANN in the analysis of circular microstrip antenna on isotropic or uniaxially anisotropic substrate to reduce the complexity of the spectral approach and to minimize the CPU time necessary to obtain the numerical results.

Findings – The resonant frequency results obtained from the neural model are in very good agreement with the experimental and theoretical results available in the literature. Finally, numerical results for the substrate anisotropy effect on the resonant frequency, quality factor and radiation pattern are also presented.

Originality/value – The paper develops fast and accurate model based on ANN technique to calculate the resonant frequencies and quality factors of circular microstrip antennas. ANN is used to model the relationship between the parameters of the microstrip antenna and the resonant frequencies and quality factors obtained from the spectral domain approach. This relatively simple model allows designers to predict accurately the resonant frequencies and quality factors for a given design without having to develop or run the spectral method codes themselves. The main advantages of the method are: less computing time than the spectral model, results with accuracy equivalent to that of full-wave models and cost effectiveness, since the client can use a simple PC for implementation. Another advantage of the proposed ANN model is that it takes into account the uniaxial anisotropy in the substrate without increasing the network size. This is done by combining ANN with electromagnetic knowledge.

Keywords CAD, Artificial neural networks, Anisotropy, Antenna, Boundary integral equation, Combination method

Paper type Research paper

I. Introduction

During the last three decades, a considerable number of papers have been published on the performance and applications of microstrip patch antennas. These patch antennas possess many desirable features, that make this type of antennas useful for many applications in radar and wireless communication systems. Various patch

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