INVESTIGATIONS ON MICROSTRIP ANTENNAS COVERED WITH A DIELECTRIC LAYER USING GENETIC ALGORITHM

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ABSTRACT

Microstrip antennas have found widespread applications for microwave and millimeter wave systems. Microstrip antennas have been employed in airborne and spacecraft systems because of their low profile and conformal nature. Many of these applications require a dielectric cover over the radiating element to provide protection against heat, physical damage, and the environment. When a microstrip antenna is covered with a dielectric layer (superstrate), its properties like resonance frequency, gain are changed which may seriously degrade the system performance. Therefore, in order to introduce appropriate correctness in the design of the antenna, it is important to determine the effect of dielectric layer on these antenna parameters.

This paper describes the use of Genetic Algorithm to optimize the resonance frequency and gain of a rectangular microstrip antenna covered with a dielectric layer. Genetic Algorithm is a class of search techniques that use the mechanisms of natural selection and genetics to conduct a global search of the solution space. In the design and syntheses of antennas, the goal is to find a radiating structure that meets performance criteria that may be gain, input impedance, beam width or a combination of any of the above parameters. Optimization of microstrip antennas using genetic algorithm involves four parameters, that is, length, width and thickness of the patch and the relative dielectric permittivity of the dielectric substrate. In addition to these four parameters, for the optimization of a microstrip antenna covered with a dielectric layer, there are another two parameters which are thickness and dielectric constant of the dielectric cover layer. The rectangular microstrip antenna was modeled using the cavity method of analysis and the fitness functions to optimize the gain and resonance frequency were obtained. The antenna was assumed to be operating in the fundamental TM10 mode. The variations of resonance frequency and gain of a rectangular microstrip antenna covered with a dielectric layer were observed. It is found that the resonance frequency is decreasing on increasing the thickness of the substrate. The gain, in the case of ice layer on the patch, was found to increase monotonically for the thickness of the layer up to 100 mm. In the case of microstrip antenna covered with a superstrate of dielectric constant of 79, an increase in the gain was observed up to the thickness of 4 mm., after which the gain falls off. Therefore, there is an optimum thickness of the dielectric cover layer for obtaining the maximum gain.