Design and Construction of a Microstrip–Patch Antenna Array with Arbitrary-Shaped Apertures Based on FDTD-MFIE Formulations

Edwin Koech Kipyegon

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ABSTRACT

This study used a hybrid of Finite-Difference Time-Domain (FDTD), which is one of the most popular techniques used for solving electromagnetic problems, and Magnetic Field Integral Equations (MFIE) to formulate and analyze a microstrip-patch antenna and its array. Each of these numerical methods has been used to simulate fields in microstrip-patch antennas but not a hybrid of the two. To capitalize on the strength of each (i.e. MFIE being best for modeling open spaces and FDTD for being able to model more than three different boundary problems) a hybrid of the two was used.

Finite-Difference Time-Domain was used to simulate the fields within the antenna and its radiations while the Magnetic Field Integral Equation (MFIE) was used to simulate the fields in the apertures, and then solved using Moment Methods (MOM). This is because the time-domain solutions have the advantages over frequency-domain solutions in that they provide wide bandwidth responses and are more accurate.

A procedure and computer code written in Visual Fortran programming language was developed to simulate and analyze the microstrip-patch antenna with irregular–shaped apertures with the aim of testing the effect of different apertures on microstrip-patch antenna characteristics

Microstrip-patch antennas with two different apertures (rectangular and square apertures) were constructed and their characteristic parameters such as radiation patterns, S-parameters and bandwidth were measured and compared with simulated results.