FULL-WAVE ANALYSIS OF A FREQUENCY SELECTIVE SURFACES WITH FRACTAL-TYPE ELEMENTS

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ABSTRACT

It is shown the possibility of development of multifrequency frequency selective surfaces (FSS) by means of complicating of the shape of elements, for example, using elements with composite fractal shape. In the paper the method of integral equations is applied for the analysis of scattering characteristic of these gratings. In the paper the possibility of applying of FFS with elements of the composite shape at development of multifrequency FSS with reduced angular sensitivity on the basis of numerical experiment is shown. The obtained results can be used for choosing the most rational version of element shape of FSS at a solution of some problems in antenna engineering.

INTRODUCTION

The frequency selective structures usually apply to ensure operation on many frequencies of reflective type antennas with several feeds [1]. The multifrequency frequency selective gratings are usually multilayer structures. However, to operate on several frequencies frequency selective gratings it is not necessary should be multilayer structures. The constructions of antennas with radiators, which have the shape of fractals, are known. Such antennas can operate at once on several frequencies [2]. In a paper [3] the frequency selective structure, which is composed from the fractal elements, is represented. The elements of this frequency selective structure have the shape of Sierpinski gasket.

The purpose of the present work is the numerical analysis of scattering characteristics of frequency selective structures as gratings of metal plates and slots in the perforated screens, which have the fractal shape.

THEORY

The mathematical model foundation for the frequency selective structures is made in accordance with the concept of infinite periodic arrays. Such approach is reasonable because of consideration the multielement arrays with rather complicated element structure. An alternative way of modelling may be based on the basis of so called "element by element method" with taking into account mutual coupling between array elements. This way may become much more difficult because of necessity to solve large sized system of integral equations.

The frequency selective structure is excited by plane electromagnetic wave. This plane electromagnetic wave has linear polarization. We enter to Cartesian system of coordinates. We direct axis Oz along the normal vector by the plane, where printed elements of the frequency selective structure are located. We assume that these printed elements have arbitrary shape. The steps of array along axes Ox and Oy equal accordingly d_1 and d_2. The permittivity of substrate is