ISSN 1064-2269, Journal of Communications Technology and Electronics, 2014, Vol. 59, No. 11, pp. 1128–1134. © Pleiades Publishing, Inc., 2014.

ELECTRODYNAMICS AND WAVE PROPAGATION

Calculation of Electromagnetic Waves Scattering by Non-Homogeneous Surface Impedance Using Moment Method[1]

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Received March 08, 2014

Abstract—In this paper, using the method of moments to calculate the current density and mono-static and bi-static radar cross section of an unlimited strip by a non-homogeneous impedance. Here, incident wave is a plane wave. To authenticate the method, using the iterative method to solve the integral equations is engaged. Simulation results show that the surface with non-homogeneous impedance has reduced or increase in potential for bi- and mono-static radar cross section in certain azimuth.

DOI: 10.1134/S1064226914110102

INTRODUCTION

Before the advent of computers with high speed, scholars of field and wave were concentrating their efforts on modeling and approximation for electromagnetic problems in a way that working with the formulas derived from the analytical relations will not require high computational volume. In other word, if you needed to get unknown coefficients of equations by iterative method, you must use modeling of problem and approximation theory in a way which the minimum number of iterations achieve the highest possible accuracy. Results of such research depend largely on the skill of the researcher on how to use mathematics in solving the problem [1].

Nowadays, with the development of computers, researchers of fields and waves are trying to use methods that simplify the formulation of the problems, but they have high computational volume. Numerical methods are considered part of this category, and there are many practical problems that need to be analyzed in this way.

One of the most powerful of these methods is the moment method. Moment; general process for solving the non-homogeneous equation is that its operator could be a differential, integral or a combination of both.

One of the problems of interest in recent years in the field of electromagnetism is calculation of scattering from non-homogeneous media. Analysis of non-homogeneous permeability and permittivity for conventional materials and complexes has been done in different ways in the past [2, 3]. But non-homogeneous surface impedance is a topic that is rarely discussed. In reference [4], unlimited surface with non-homogeneous impedance has been studied by perturbation method which the method is implemented based on Fourier transform. The problem with this method is that by increasing the order of approximation greatly increases the complexity of relationships. Another drawback of this method is that its application for limited surface (strip) is difficult. Hence the need to develop alternative methods for analyzing this problem seems necessary. Using moment method has advantages over other numerical methods such as simple formulation, implementation and speed. The equation describing the problem is an integral equation of the second kind of Fredholm. The problem formulation is presented in this paper first. Then results for strip conductors have been acknowledged. In the next part various non-homogeneous impedance profiles has been used. Then For each of these profiles, Surface current density, mono- and bi-static radar cross section has been obtained. For the verification of computer programs for non-homogeneous impedance, the iterative method is used to solve the integral equation. The iterative method will be divergent when the impedance is too small. Thus, the iterative technique is used for initial authentication of moment code.

Surface impedance changes can be achieved by changing the material's surface, forming alloys ingredient changes. Changes in the temperature along the surface are of another way to realization of non-homogeneous surface impedance because temperature changes cause changes in specific thermal conductance surface ingredient. For example, the temperature on the surface of a cube whose beginning and end are connected to two different heat source tempera-

[1] The article is published in the original.