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K N Toosi University of Technology
Faculty of Electrical Engineering
Center of Excellence in Computation and Characterization of Devices and Subsystems

The Second Iranian Conference on Engineering Electromagnetics (ICEEM 2014), Jan. 8-9, 2014

Iranian Scientific Society of Engineering Electromagnetics

A New Approach for Transient Scattering of Infinite Conducting Cylinders – TE Case

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ABSTRACT— A new numerical method is presented to solve the Time Domain Electric Field Integral Equation (TD-EFIE) for a two-dimensional conducting scatterer in free space illuminated by a TE-polarized Gaussian plane wave. In a time domain Method of Moments formulation (TD-MoM) of the problem, the free space two dimensional Green's function, the rectangular temporal basis function and the triangular spatial basis function are used. By employing Galerkin's method in spatial domain and point matching in time domain, it is shown that the time convolution integrals and self-terms involved in the formulation can be evaluated analytically to increase the accuracy and the stability of the proposed technique. This possesses the advantage of a simple implementation. Numerical examples are demonstrating the accuracy and efficiency of the proposed method.

Keywords: time-domain electric field integral equation (TD-EFIE); time-domain method of moment (TD-MoM); two-dimensional geometries; two-dimentional Green's Function

I. INTRODUCTION

The transient scattering of electromagnetic waves by a perfectly conducting cylinder in free space is important in applications such as broad-band response of dielectric or conducting targets, target identification through short-pulse radar, scattering from biological media, and electromagnetic compatibility (EMC) [1, 2].The state of the art in scattering of electromagnetic waves has been reviewed by several authors in [3].

The earlier work in time domain to compute the transient electromagnetic scattering by a perfectly conducting cylinder, based on approximation methods for early time and late time, has been discussed by several authors in [4] and [5], respectively. Nowadays, a well-known approach is to use an integral equation (IE) having either the electric field or the magnetic field as unknown (EFIE or MFIE, respectively), solved by the time-domain method of moments (TD-MoM). First time, Bennett and Weeks [6] used the free space two-dimensional Green's function and calculated the transient currents on conducting cylinders with arbitrary cross section by means of a numerical solution of the time-domain magnetic field integral equation (TD-MFIE), in which the scattered field at each space-time point is obtained by the so-called marching-on-in-time method (MOT). Later, a computationally efficient method, namely the implicit solution scheme, was applied to transverse electric (TE) incidence onto two-dimensional conducting cylinders, both for EFIE and MFIE [7]. The solution method was simple, accurate, and stable. However, TD-MoM methods suffer from late-time instability and high computational complexity, which severely limits their application to practical, real-world problems. Many schemes