Scattering from Plasma Coated Cylinders and Spheres: Conducting and Dielectric Cases

Surendra Singh*[(1)], John R. Roadcap [(2)], and Kausik Chatterjee[(3)]
(1) The University of Tulsa, Tulsa, OK, 74104, http://www.utulsa.edu
(2) Air Force Research Laboratory, Kirtland AFB, NM 87117
(3) Space Dynamics Laboratory, 1695 North Research Parkway, North Logan, UT 84341
(3) Electromagnetic Communication Laboratory, Pennsylvania State University, University Park, PA 16802

In the domain of computational electromagnetics, one of the main areas of interest and research has been the study of electromagnetic scattering from conducting and dielectric structures. These structures may be land-based or airborne platforms. The size of the structure determines what numerical method or methods can be effectively employed to solve for the quantities of interest. Of course, one of the main quantities of interest is the radar cross section (RCS). This pursuit of the computation of RCS has resulted in a multitude of numerical algorithms to address the computational challenges brought forth by the complex nature of the problem.

In the realm of numerical methods, the most popular is the method of moments in which an integral equation is solved to determine induced current on the structure due to an incident electromagnetic wave. For higher frequencies or electrically-large structures, it is more appropriate to use high frequency methods such as Geometric Theory of Diffraction (GTD). Apart from these two techniques, the use of finite differences to solve the time domain Maxwell's equations has become quite popular. In some cases, we can apply traditional techniques such as series expansion to solve for scattering parameters which lead to the computation of RCS.

In this work, we start with treating simple two-dimensional (2D) conducting or dielectric cylindrical geometries coated with multiple plasma layers to study the propagation and scattering characteristics while varying plasma parameters such as thickness, plasma frequency and plasma electron density. This treatment is then extended to 3-D bodies such as a conducting or a dielectric sphere covered with multiple plasma layers. Numerical results for a singly- or doubly- coated cylinder or sphere will be shown to match with published results. Additional results for multi-layered cases will also be provided.