Current density analysis for conducting surfaces

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Abstract

This study presents a comprehensive analysis of current density distribution on conducting surfaces, with particular emphasis on the electromagnetic behavior under various excitation conditions. Employing both analytical methods and full-wave numerical simulations, the research investigates how surface geometry, material properties, and boundary conditions influence the resulting current densities.

Keywords: Current density; Analysis; Conducting surfaces.

1. Introduction

The analysis of current density on conducting surfaces is fundamental in understanding the behavior of electromagnetic fields in a variety of engineering applications. In high-frequency circuits, antennas, waveguides, and shielding enclosures, the distribution of current density directly influences performance parameters such as radiation efficiency, impedance matching, and electromagnetic compatibility. Precise characterization of these currents is essential for optimizing designs, minimizing losses, and reducing undesired interference.

2. Current density analysis over conducting surfaces

Current density, defined as the amount of electric charge flowing per unit area of a conductor, is governed by Maxwell's equations and strongly depends on material properties, frequency, and surface geometry. Traditional analytical approaches, such as the application of boundary conditions and Green's functions, provide valuable insights for simple geometries. However, for complex structures, full-wave numerical simulations, including the Finite Element Method (FEM) and Method of Moments (MoM), offer a more accurate and comprehensive analysis.

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