A brief study of two-dimensional electromagnetic scattering

Saeed Hatamzadeh [*,1], Zahra Masouri [2]

[1] *Department of Electrical Engineering, Islamshahr Branch, Islamic Azad University (IAU), Tehran, Iran*
[2] *Department of Mathematics, Islamshahr Branch, Islamic Azad University (IAU), Tehran, Iran*

Abstract

This paper presents a concise yet insightful study of two-dimensional (2D) electromagnetic scattering phenomena, with a focus on canonical structures such as infinitely long cylinders and dielectric slabs. The investigation examines the interaction between incident electromagnetic waves and 2D geometries, analyzing both the scattered field characteristics and the influence of material and geometric parameters.

Keywords: Brief study; Two-dimensional; Electromagnetic scattering.

1. Introduction

Electromagnetic scattering is a fundamental topic in the field of electromagnetics, with applications spanning radar detection, antenna analysis, remote sensing, and wireless communication. While full three-dimensional scattering problems are often complex and computationally intensive, two-dimensional (2D) models provide a more tractable framework for gaining physical insight and validating numerical methods. A 2D scattering problem typically assumes an infinite extent in one direction.

2. Study of two-dimensional electromagnetic scattering

Classic 2D scattering scenarios involve plane wave illumination of infinitely long cylindrical objects, dielectric rods, or layered structures. These configurations, though idealized, capture key features of wave-material interaction and are widely used as benchmarks in electromagnetic theory. In such cases, analytical techniques like separation of variables and modal expansions can be effectively employed to solve for the scattered fields, allowing for the derivation of closed-form expressions for parameters like radar cross section (RCS) and far-field patterns.

[*]Corresponding author
E-mail addresses: saeed@hatamzadeh.ir (S. Hatamzadeh); nmasouri@yahoo.com (Z. Masouri)

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