Chapter 1

Introduction

Humans are continuously trying to search for life on planets other than the Earth of the Solar system. This has led to the emergence of the field for searching water/ice on celestial bodies. Not only this, they are also highly curious about knowing the facts behind the formation of the Solar system.

The curiosity of human towards the celestial bodies has led to the growth of the field known as "Remote Sensing". *Remote sensing is defined as obtaining information about any object without any physical contact with it* [1]. The object can be on Earth or may be on other celestial bodies of the universe. Radar (RAdio Detection And Ranging) is one of the important instruments used in remote sensing. During radar scan, it is observed that some of the celestial bodies having ice on their surface give very high radar albedo as compared to the North and South pole of the Earth. One amongst them is the Enceladus (moon of the Saturn) [2] [3]. This leads to a mystery, why are we getting high radar albedo from the Enceladus?

To understand this, we first have to understand the interaction of the electromagnetic waves with the random rough surfaces. The analysis of electromagnetic wave scattering from random rough surfaces has its roots in classical works of the previous two centuries. This field is highly important for remote sensing, communications, oceanography, optics and material science.

Early approaches for analysing the electromagnetic wave scattering from the random rough surfaces are based on asymptotic approximations like small-perturbation method (SPM) by Rice [4], Kirchoff or tangent plane approximation (KA), phase perturbation method (PPM), small-slope approximation (SSA), momentum transfer expansion (MTE), unified perturbation method (UPM) and the integral equation model (IEM) [5].

Due to a large number of applications, this was the field of interest continuously and lot of work was done in finding the domain of validity region for various analytical techniques, like for Kirchoff approximation by Thoros [6]. These methods are analytical, hence highly useful in understanding the physical insight of the interaction.