AN EXPERIMENTAL DESIGN FOR A STATISTICAL COMPARISON BETWEEN PULSED AND CONTINUOUS WAVE RADAR SYSTEMS

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CHAPTER I

INTRODUCTION

The problem of scattering of electromagnetic or accoustic waves from a rough surface is of interest in a number of different fields. In particular, the problem occurs in the sensing of reflected radar waves from rough ground or from the sea. The prediction and interpretation of radar reflections obtained from various terrain types is important in designing radar mapping systems and radio altimeters.

Experimental studies in the past few years have examined the presence of the depolarized* or cross-polarized component of the electromagnetic waves that are back-scattered from rough surfaces. The back-scatter phenomena is considered important because it is thought that if the scattering phenomena can be explained theoretically and experimental results correlated with the theory, then depolarized backscatter information can be used to make analytical predictions concerning the terrain or other scattering medium, which is not present in the direct-polarized backscatter.

Previous Work

Most of the existing rough surface scattering theories are based on the Kirchoff method, geometric optics method, or small perturbation

*When the polarization of backscattered electromagnetic wave is in quadrature to that of transmitted wave then it is known as cross-polarized backscatter. It is known as direct-polarized backscatter when the transmitted and backscattered electromagnetic waves have the same polarization.

method. Summaries of these methods as well as extensive bibliographies on the scattering theories can be found in the works of Fung [1] and Janza [2]. Although these theories have had limited success in explaining the direct-polarized scatter from rough surfaces, they fail to explain the depolarized scatter measured in experimental studies. Trowbridge and Reitz [3] have presented a new ray model for the reflection of electromagnetic radiation from the interface of a randomly rough target surface in contact with air. This derivation considers the surface to be composed of microareas not only randomly oriented but also randomly curved. But again, no attempt has been made to account for the presence of the depolarized component of electromagnetic wave backscattered from a rough surface.

A few authors have recently published papers suggesting that the depolarized scatter does not originate at the surface but from scattering within the volume of the reflecting medium [4,5]. Intuitively, this approach seems to explain the differences between theoretical predictions and actual experimental measurements. The scattering theories assume a homogeneous scattering medium and only those reflections which take place at the surface are considered. On the other hand, most natural targets such as earth terrain are inhomogeneous. Thus, the possibility of volume scattering exists.

Hoekstra and Spanogle [6] measured the radar backscatter from snow and ice surfaces at frequencies of 10 and 35 GHZ. They observed that the backscatter was dependent on temperature, and that the effect was small for vertically polarized radiation*, but considerable for

*The transmitted wave was also vertically polarized.