Name: Millie Sikdar, Department of Electrical & Computer Eng.

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ABSTRACT

The sensitivity of microwave scattering to both dielectric and geometric characteristics of natural surfaces makes radar remote sensing one of most promising techniques for estimating soil moisture content. The potential of using polarimetric Synthetic Aperture Radar (SAR) for soil moisture estimation is investigated in this thesis.

Soil moisture estimation has been an area of significant interest due to its widespread applications in the estimation and modelling of various large-scale ecological processes. Many approaches based on experimental observations or theoretical reasoning have been developed for soil moisture retrieval from SAR systems. Among the major models developed, the empirical model proposed by Dubois et al. in 1995 proves to be a good choice, because of its wide applicability and simplicity of implementation.

One of the challenges presented by the Dubois Model as well as other originally developed models is their ineffectiveness in accurately estimating the soil moisture content in vegetated regions. In this thesis, this concern is addressed and a methodology for incorporating a suitable vegetation index into the existing Dubois Model is proposed.

The Water Cloud Model is used to introduce the vegetation correction into the backscattering coefficients, which are then used in the inversion model to yield better estimation results. The vegetation index used requires the prior knowledge of several ground-measurable vegetation parameters. In order to sustain the true essence of "remote sensing", an approach for minimizing the need for ground measurements, by remotely estimating the vegetation parameters, is also suggested.

The proposed algorithm applied to three different data sets – SIR-C, AIRSAR and Convair-580, and its accuracy is evaluated based on the correlation and RMSE between the radar-based estimates and the published ground truth. The results show that soil moisture estimation accuracy can be improved by the addition of the vegetation correction into the model.