SOIL MOISTURE RETRIEVAL USING GNSS-R: VEGETATION EFFECTS

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1. INTRODUCTION

GNSS-R techniques are currently being used for remote sensing purposes retrieving geophysical parameters over different types of surfaces. Over the ocean, sea state information can be retrieved to improve the ocean salinity retrieval [1-4]. Furthermore, over land these techniques can also be used to retrieve soil moisture [5-6]. This paper presents the theoretical and experimental results of using Global Navigation Satellite Signals Reflections (GNSS-R) to retrieve soil moisture when vegetation is present. The particular technique being applied in this study is the Interference Pattern Technique [7] that measures the interference pattern (IP) of the GPS direct and reflected signals, after reflecting over the surface.

2. THEORETICAL ASPECTS

In the first part of the paper, the theoretical aspects of the Interference Pattern Technique applied over a vegetation scenario will be presented. In order to consider the vegetation effects it is necessary to introduce an electromagnetic model capable to describe the behavior of the reflected signals when they impinge over the ensemble surface + vegetation. A software package developed at the Universitat Politècnica de Catalunya [8-9], is used to compute all the interactions between the signal and the scenario elements (soil + vegetation). Originally, this tool was conceived to simulate the polarimetric emission of vegetation and it is now used to model the scattering of the GPS signals in the ensemble soil + vegetation. The vegetation is modeled using L-systems and trunk, branches, leaves and fruits have their particular scattering models.

A full set of simulations has been performed considering different vegetation heights, roughness, and soil moisture values, producing a wide range of reflectivities. The IP technique is then analyzed theoretically to find ways to perform the soil moisture retrieval under the presence of vegetation.

3. EXPERIMENTAL FIELD CAMPAIGN

The second part of the paper presents the experimental measurements carried out to prove the theoretical model developed. The IP GPS Reflectometer [7] was deployed in field campaign over a wheat field since February to October 2008, in Palau d'Anglesola (Lleida, Spain), covering different growth stages of the wheat, from no vegetation up to 60 - 65 cm vegetation height, including the dry up process of the wheat (fig.1).

(a) (b) (c) (d)

Figure 3. Different growth stages of the wheat: (a) 23rd February, 2008, (b) 25th April, 2008, (c)12th June, 2008 and (d) 25th June, 2008.

4. CONCLUSIONS

These measurements will be compared to the theoretical results, and conclusions will be extracted about the use of the GPS IP technique to retrieve soil moisture in presence of the vegetation, taking into account the different parameters that influence the measurements, as roughness and vegetation height.

5. REFERENCES

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