LAND RETRIEVALS:
THE SMIGOL-REFLECTOMETER AND THE INTERFERENCE PATTERN TECHNIQUE

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INTRODUCTION

- GNSS-R techniques are being used in many remote sensing applications: altimetry and sea state retrievals over ocean , soil moisture retrievals over land, ice age or altimetry retrievals over ice.
- The Interference Pattern Technique (IPT) [1, 2, 3] is a suitable GNSS-R technique to perform land geophysical parameters retrieval from static locations.
- This work is a summary for the SMIGOL-Reflectometer applications in different field experiments: [2, 3, 4].
  - Bare soil field [2]: Topography and soil moisture retrieval.
  - Wheat & Barley [3] and Maize [4] fields: Topography, soil moisture and vegetation height retrieval.

THE SMIGOL-REFLECTOMETER AND THE INTERFERENCE PATTERN TECHNIQUE

- Soil Moisture Interference-pattern GNSS Observations at L-band Reflectometer (Fig. 1) works in L1 GPS band (1.57542 GHz).
- Vertical polarization antenna pointing to the horizon.
- Received signal results of the interference between direct and reflected GPS signals over the observed area (Fig. 2).
- Different retrievals are performed: topography, vegetation height and soil moisture

Figure 1. SMIGOL-Reflectometer present state.

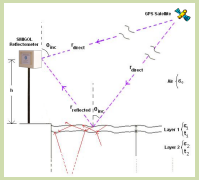
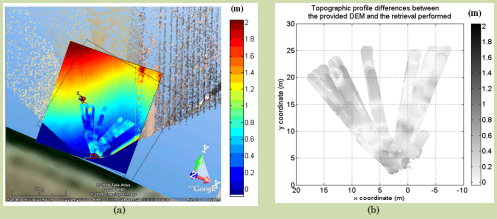


Figure 2. Interference Pattern Technique sketch

LAND GEOPHYSICAL PARAMETERS RETRIEVAL

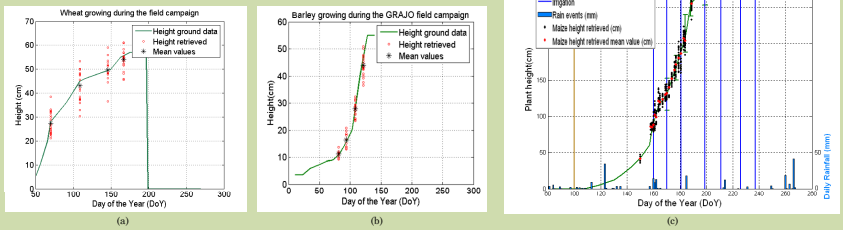
TOPOGRAPHY RETRIEVAL



(a) (b)

Figure 3. Topography retrieval performed over a barley field at REMEDHUS (Zamora) SMOS CAL/VAL SITE, 2009. (a) Topography retrieval performed by the SMIGOL-Reflectometer superimposed to the field DEM and (b) difference between the DEM and the retrieved topographical profile map.

VEGETATION HEIGHT RETRIEVAL



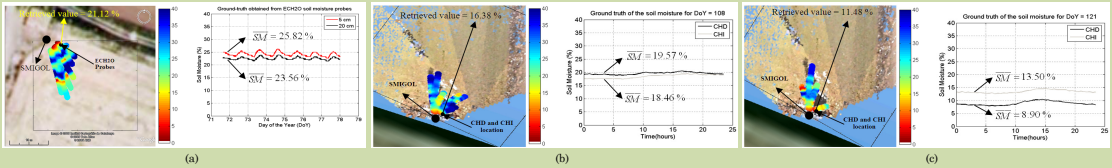
(a) (b) (c)

Figure 4. Maize plant height retrieval achieved by processing the SMIGOL-Reflectometer measurements over (a) a wheat field (Palau d'Anglesola, Lleida, 2008), (b) a barley field (Vadillo de la Guareña, Zamora, 2009) and (c) a maize field (Palau d'Anglesola, Lleida, 2010).

SOIL MOISTURE RETRIEVAL

WHEAT AND BARLEY FIELD

- Inter-comparison between soil moisture ground-truth and SMIGOL-Reflectometer measurements performed (Fig. 5).
- 3 different soil moisture levels have been tested.

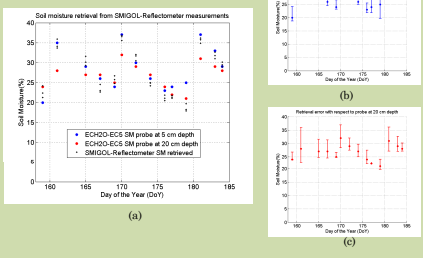


(a) (b) (c)

Figure 5. Soil moisture retrieval achieved by processing the SMIGOL-Reflectometer measurements (left) and ground truth values (righ) for (a) a wheat field (Palau d'Anglesola, Lleida, 2008), (b) a barley field (Vadillo de la Guareña, Zamora, 2009) and (c) a barley field (Palau d'Anglesola, Lleida, 2010)

MAIZE FIELD

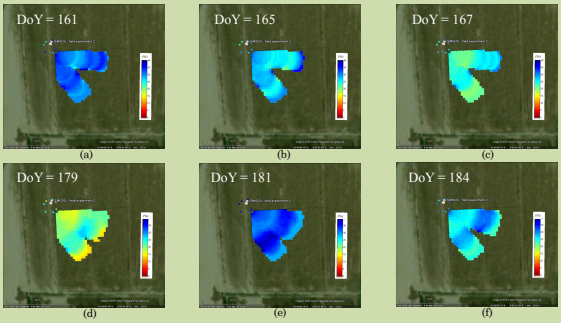
- Inter-comparison between soil moisture ground-truth and SMIGOL-Reflectometer measurements performed (Fig. 6):
  - Errors ≤ 8 % in all cases (Figs. 6b and 6c)
  - SMIGOL measurements closer to 5 cm depth probe when field is irrigated, but
  - SMIGOL measurements closer to 20 cm depth probe when field is drying.
- Figure 7 soil moisture maps processed at same hour in different days.
  - The evolution from irrigation to dryer state is clear.



(a)

(b) (c)

Figure 6. Soil moisture retrieval analysis: (a) Comparison between soil moisture retrieved and measured at 5 cm and 20 cm depth, (b) error respect to 5 cm depth probe, and (c) error respect 20 cm depth probe.



(a) (b) (c) (d) (e) (f)

Figure 7. Soil moisture retrieved maps for DoY: (a) 161 (field is firstly irrigated), (b) 165 (4 days after first irrigation), (c) 167 (6 days after first irrigation) , (d) 179 (9 days after second irrigation) , (e) 181 (third irrigation), and (f) 184 (3 days after third irrigation)

CONCLUSIONS

The SMIGOL-Reflectometer and the Interference Pattern Technique provide good results in the retrieval of the following parameters:
- Topography retrieval
- Vegetation height retrieval
- Soil moisture retrieval

References

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