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GLORI (GLObal navigation satellite system Reflectometry Instrument): A New Airborne GNSS-R receiver for land surface applications

Erwan Motte, Mehrez Zribi, and Pascal Fanise
CESBIO, Toulouse, France (http://www.cesbio.ups-tlse.fr/)

GLORI (GLObal navigation satellite system Reflectometry Instrument) is a new receiver dedicated to the airborne measurement of surface parameters such as soil moisture and biomass above ground and sea state (wave height and direction) above oceans. The instrument is based on the PARIS concept [Martin-Neira, 1993] using both the direct and surface-reflected L-band signals from the GPS constellation as a multistatic radar source.

The receiver is based on one up-looking and one down-looking dual polarization hemispherical active antennas feeding a low-cost 4-channel SDR direct down-conversion receiver tuned to the GPS L1 frequency. The raw measurements are sampled at 16.368MHz and stored as 2-bit, IQ binary files. In post-processing, GPS acquisition and tracking are performed on the direct up-looking signal while the down-looking signal is processed blindly using tracking parameters from the direct signal. The obtained direct and reflected code-correlation waveforms are the basic observables for geophysical parameters inversion.

The instrument was designed to be installed aboard the ATR42 experimental aircraft from the French SAFIRE fleet as a permanent payload. The long term goal of the project is to provide real-time continuous surface information for every flight performed. The aircraft records attitude information through its Inertial Measurement Unit and a commercial GPS receiver records additional information such as estimated doppler and code phase, receiver location, satellites azimuth and elevation.

A series of test flights were performed over both the Toulouse and Gulf of Lion (Mediterranean Sea) regions during the period 17-21 Nov 2014 together with the KuROS radar [Hauser et al., 2014]. Using processing methods from the literature [Egido et al., 2014], preliminary results demonstrate the instrument sensitivity to both ground and ocean surface parameters estimation.

A dedicated scientific flight campaign is planned at the end of second quarter 2015 with collocated measurement of biomass and soil moisture ground truth in order to better characterize the instrument sensitivity to geophysical parameters. The instrument will be improved in the meanwhile including the optimization of data processing and the better integration of external data (GPS commercial receiver, Attitude) into the receiver.

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