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Author: Mr. Jorge Nicolas-Alvarez
Universitat Politecnica de Catalunya (UPC), Spain, jorge.nicolas@upc.edu

Mr. Xavier Carreño-Megias
Universitat Politecnica de Catalunya (UPC), Spain, xaviercarre@hotmail.com
Mr. Oriol Fusté
Universitat Politecnica de Catalunya (UPC), Spain, fuste.oriol@gmail.com
Prof. Albert Aguasca
Universitat Politecnica de Catalunya (UPC), Spain, aguasca@tsc.upc.edu
Prof. Antoni Broquetas
Universitat Politecnica de Catalunya (UPC), Spain, broquetas@tsc.upc.edu

INTERFEROMETRY-BASED ORBIT OBSERVATION FOR GEOSYNCHRONOUS SYNTHETIC APERTURE RADAR (GEOSAR) MISSIONS

Abstract

A major limitation of current Low Earth Orbit Synthetic Aperture Radars (LEOSAR) is related to their revisit time of several days or weeks. They cannot provide continuous monitoring over the same area. The introduction of the GEOsynchronous Synthetic Aperture Radar (GEOSAR) aims to provide permanent illumination of a wide zone of the planet. Potential applications that require continuous monitoring are for instance: flooding monitoring and forecasting, glacier motion and snow cover and mass monitoring, earthquakes, volcanoes and landslides forecasting, and subsidence monitoring. This work is performed in the context of the new ESA Earth Explorer pre-selected mission G-CLASS (Geosynchronous - Continental Land-Atmosphere Sensing System). G-CLASS is designed to help scientists unravel the details of the daily water cycle. Some of the main challenges come from processes which occur over periods of a few hours at a local, kilometre scale. For instance, prediction of local storms require the detailed observation of the local weather during the early stages. Monitoring of variations in the soil moisture, snow melting in mountains, river flows and water supplies would also benefit from the GEOSAR concept.

Microwave sensors are well-suited to measuring water since water liquid and vapour affect the observed signals. G-CLASS uses a single satellite with a synthetic aperture radar. The inherent limited motion of the spacecraft relative to Earth due to the GEO orbit allows forming a proper synthetic aperture. It can image almost anywhere across the continental visible from GEO. By choosing the orbit location carefully, imaging can be provided over most of Europe and Africa. The orbit determination of a GEOSAR is one of the main challenges of the mission. Still, previous studies show how the generic sub-wavelength tolerance requirement to build a well focused synthetic aperture can be substantially relaxed up to the sub-meter scale. The obtention of accurate orbit observables is the first step towards a proper orbit determination. Several techniques are reliable and perform well to this end. Among them, interferometry stands out since it can provide orbit observables coming from current satellites operating in GEO, serving as illuminators of opportunity. The experimental data resulting from our own ground interferometer built at the campus of the Universitat Politècnica de Catalunya in Barcelona are presented, serving as proof of concept for future GEOSAR missions such as G-CLASS.