REPEAT-PASS INTERFEROMETRY USING A FIXED-RECEIVER AND ERS-2/ENVISAT AS TRANSMITTERS OF OPPORTUNITY

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Introduction

In the last decades, Synthetic Aperture Radar (SAR) has been established as a standard tool for Earth Observation. Interferometric applications, such as InSAR or DInSAR, have developed into reliable techniques to generate Digital Elevation Models (DEM) and to monitor terrain deformations. While these techniques are reaching maturity for monostatic geometries, bistatic and multistatic configurations are arising as a new research field. A discussion of different bistatic and multistatic missions and experiments can be found in the literature [1, 2, 3, 4].

These kind of systems have some advantages above the monostatic ones. As an example, it is cheaper to implement a single transmitter and multiple receivers than to implement several transmitters and receiver modules. Also, in a multistatic system it is possible to extract more information about the scene by observing it from several different points of view at the same time. As a drawback, bistatic systems have to cope with a number of synchronization related challenges.

Bistatic system

The Remote Sensing Laboratory (RSLab) of the Universitat Politecnica de Catalunya (UPC) is developing bistatic systems that use commercial satellites as transmitters of opportunity, and on-ground fixed receivers. Currently a C-band receiver able to work with ESA's ERS2 and ENVISAT satellites named SABRINA (SAR Bistatic Receiver for Interferometric Applications) has been built and tested [5]. An X-band version of the system is being implemented.

Bistatic interferometric processing

A bistatic interferometric chain has been developed to process the interferometric data acquired by SABRINA. This processing chain has been applied to single pass interferometric data aquired by the system, producing a first Digital Elevation Model (DEM) of a portion of Barcelona. This DEM has been compared with a Digital Terrain Model (DTM) and with a DEM from the Shuttle Radar Topography Mission (SRTM) showing a good agreement [6].

Objective

This paper discusses the generation of Repeat-Pass interferometric data using SABRINA towards the obtention of differential products for urban subsidence monitoring. The first Bistatic SAR Repeat-Pass Interferometric data is going to be presented here.

Differential SAR Interferometry (DInSAR) is a very well known technique for the orbital monostatic systems and it has been reliable used to detect land motions with a millimeter per year precision. A bistatic geometry can be useful as a complement to the standard monostatic one. It can be interesting in areas where a typical monostatic orbital geometry presents strong foreshortening or layover and, thus, loss of resolution. Also, in the near future, by placing several receivers in different locations

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observing an scene and applying DInSAR technique to the multistatic interferometric data it will be possible to extract the 3D movement vector. Therefore, multistatic systems have a large potential in differential applications.

An adapted interferometric chain to process Repeat-Pass data will be discussed in this paper. This interferometric chain has into account that the satellite orbits are different for each pass. Some errors, which are cancelled in Single-Pass data due to they are common to both images, appear in the Repeat-Pass data. This paper will show how this errors can be solved.

The Repeat-Pass data presented in this paper will be acquired over an urban scenario. A campaign of measurements has been designed over Sallent, a small town in the North of Barcelona. This specific region presents strong terrain deformation phenomena, up to 3 cm per year, that can be observed with our sensors in a few months of monitoring. In addition, this area has been monitored with DGPS and also with a Ground-Based SAR [7]. Thus, ground truth data is available to validate the obtained results.

The terrain deformations observed by processing the data acquired with SABRINA will be presented in this paper. The data will be acquired using different passes of the ERS-2 and ENVISAT satellites. The obtained results will be compared with the existing ground truth.

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