FIRST ASSESSMENT OF THE PERMANENT SCATTERER LINEAR DISPLACEMENT MODEL IN AIRBORNE INSAR TIME-SERIES

Karlus A. Câmara de Macedo

OrbiSat Remote Sensing
Av. Shishima Hifumi, 2911
São José dos Campos - SP, Brazil
karlus.macedo@orbisat.com.br

Rolf Scheiber, Alberto Moreira

German Aerospace Center
Microwaves and Radar Institute
Wessling, Germany
(rolf.scheiber;alberto.moreira)@dlr.de

1. EXTENDED ABSTRACT (PROPOSED FOR ORAL SESSION)

The permanent scatterer (PS) technique is an advanced D-InSAR method that has proven to have a remarkable potential for mapping ground deformation [1]. The PS technique is based on the detection of phase-stable scatterers and terrain movement estimation by time-series analysis of a SAR data set of typically 30 or more images. Another advanced D-InSAR method is the small baseline technique [2, 3, 4].

The PS technique has been up to now only used for spaceborne D-InSAR, due to the large amount of time-periodic data available along the years, and due to the stable trajectory described by the spaceborne platforms. Differently, large sequences of time-periodic airborne SAR images are not available and airborne data are often corrupted by phase errors due to flight deviations from the nominal track.

Analysing the archive of the E-SAR data from 1995 until 2005, one set of 14 airborne SAR images at L-band acquired at same day every 20 minutes, over Oberpfaffenhofen area, was identified as feasible for a first airborne (high-resolution) time-series analysis. With this data set the feasibility analysis for detection of permanent scatteres in a reduced set of airborne SAR images was performed [5]. Using this same data set, we continue our work on airborne PS and present for the first time the estimation results for the target displacement and DEM errors from selected PSs.

In particular, this paper shows that for reliable PS based estimations it is necessary to compensate accurately the motion errors so that the remaining phase errors can be modelled as white noise. The paper will analyse the PS results before and after applying a complete Motion Compensation (MoComp) strategy with the Precise Topography-and Aperture dependent MoComp (PTA) and the Weighted Phase Curvature Autofocus (WPCA) algorithms to mitigate phase errors due to flight deviations from the nominal track [6, 7]. The results demonstrate the need of proper residual motion compensation before applying advanced D-InSAR techniques in order to obtain suitable results with airborne data.

The displacement velocity and the DEM errors associated to each individual PS is found by maximizing the linear displacement model (periodogram) as described in [8]. We assume that in the airborne case there are no phase errors due to atmosphere [9] and the motion errors were properly removed after PTA-WPCA processing.

Due to the small number of images in our data set (14 images), the final number of reliable PS is not enough to form a dense grid of estimations and to enable an analysis of a wide area. In this paper the displacement velocity and DEM error results and the conclusions will be on a PS basis. Target structures related to some chosen reliable PS will be shown by photos and the corresponding periodograms highlighted.

Despite the lack of a large data set, the results show that airborne (high-resolution) PS-InSAR is reliable. Due to the greater flexibility of airborne platforms, airborne PS has the potential to become a complementary tool to the already established spaceborne PS analysis, e.g. for the monitoring of fast deformations on short-time scales. Airborne systems can be deployed according to the needs and specifications of the D-InSAR experiment or mission (time and geometry) and they may operate in several frequency bands.

2. REFERENCES

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