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SAR Tomography Applications for SAOCOM-CS

Advanced SAR processing for data calibration and tomographic imaging

EXECUTIVE SUMMARY

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Picture:

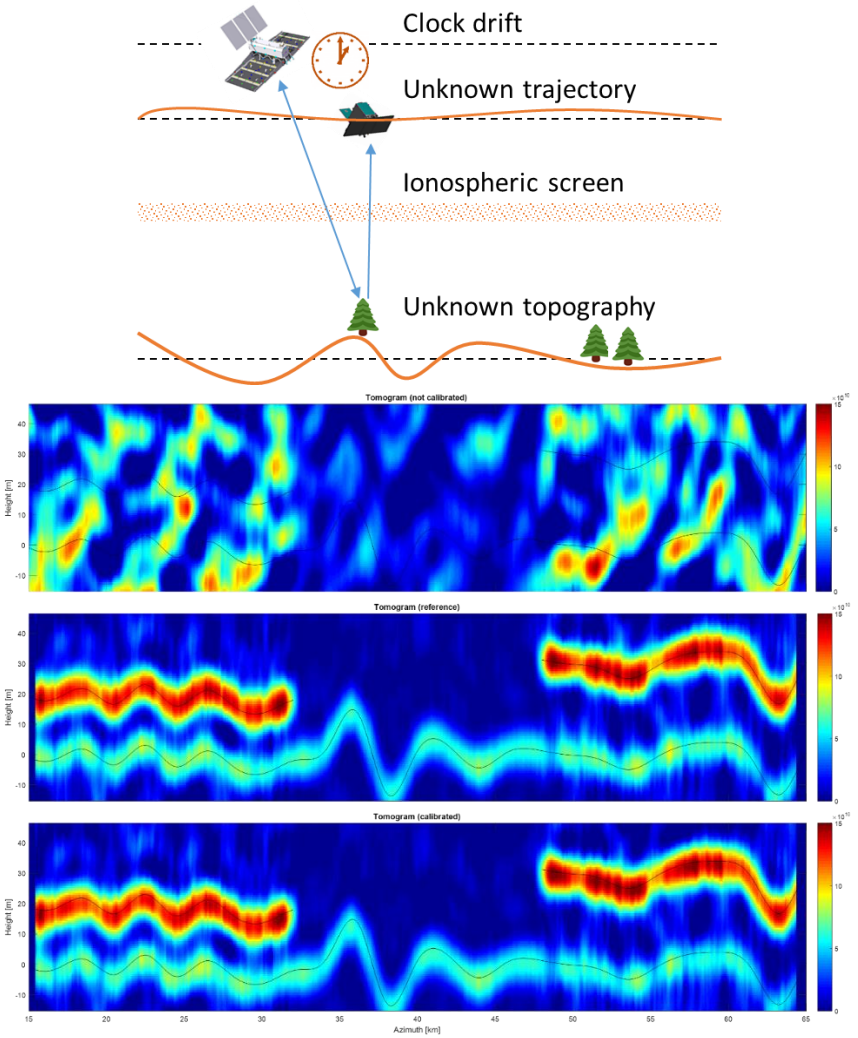

Figure 1: Phase correction results on tomography. The tomograms were estimated from the bistatic images with: uncompensated phases (upper) reference phases (mid) and calibrated phase (lower).

Motivation:

Please describe briefly here the scope of the survey / research goal of the pilot, as applicable (max: 40 words)

Non-cooperative bistatic SAR missions such as SAOCOM-CS promise to greatly enhance the science return of existing missions at a low cost.

In this study, we addressed major technological challenges associated with the implementation of such missions, such as phase calibration and tomographic focusing.

Methodology:

Please describe here briefly the background of the study and the methods applied to develop the research (max: 150 words).

The research methodology was as follows:

1. Phase perturbations that affect SAOCOM-CS acquisitions are modeled and simulated. A novel calibration algorithm is proposed. Particular emphasis is put on perturbations that arise by the onboard clocks drift between platforms as well as ionospheric-induced phase screens.

2. the phase calibration algorithm is tested on end-to-end simulations (from RAW data up to the 3D tomographic focusing) of bistatic SAR images over synthetic scenarios, which realistically incorporate the phase perturbations into the acquired images.

3. end–to-end simulation results based on simulated SAOCOM-CS data derived from airborne campaigns over a boreal forest (BioSAR 2) and an Alpine glacier (AlpTomoSAR) are shown regarding tomographic products generation.

4. Advanced tomographic processing techniques are discussed which contemplate the peculiarities of the mission, considering polarimetric and non-polarimetric data acquisitions, scenarios and revisit times.

Results:

Please list here a brief description of the most significant results obtained during the study (max: 4 items).

Relevant study results:

1. Development of an interferometric model that accounts for clock drift, ionosphere, and residual topographic errors
2. Development of a comprehensive phase calibration technique to correct for the aforementioned residual phase terms
3. Performance assessment through numerical simulations
4. Development of super-resolution algorithms for bistatic tomographic imaging

Publications:

Please list here the complete references to the papers published or submitted for publication during the study in agreement with ESA. Example:

1. Mario Azcueta and Stefano Tebaldini, “Signal Analysis and Advanced Processing Techniques for Incoherent SAR Tomography”, oral presentation at PolInSAR 2017, ESA/ESRIN, 2017
2. Mario Azcueta and Stefano Tebaldini, “SAOCOM-CS BISTATIC PHASE CALIBRATION AND TOMOGRAPHIC PERFORMANCE ANALYSIS”, IGARSS 2017, Fort Worth, 2017

3. Laurent Ferro-Famil, Yue Huang, Stefano Tebaldini, Mario Azcueta, “Assesment of SAOCOM-CS data processing for the characterization of forested areas using polarimetric SAR tomography”, IGARSS 2017, Fort Worth, 2017
4. Mario Azcueta and Stefano Tebaldini, “Non-cooperative bistatic SAR clock drift compensation for tomographic acquisitions”, MDPI Journal of Remote Sensing, under review

A full TGRS paper is currently in preparation

Highlights:

Please put here a more extended description of one particularly relevant result obtained or any further/ongoing work (max: 80 words).

We deem that this work has demonstrated the feasibility of 3D Tomographic imaging using data from a non-cooperative bistatic spaceborne SAR such as SAOCOM-CS. In particular, the results show that residual phase terms associated with clock drifts, ionosphere, and residual topography can be successfully corrected by using proper processing techniques that operate directly on the Radar data, in the absence of external information and reference targets.