Theme: SAR Tomography

Synthetic Aperture Radar Tomography using pairs of crossing-track interferometric acquisitions

Background

One of the unique aspects of radar-based remote sensing is the potential to penetrate through semi-transparent media (such as forest canopies, ice and snow, or even the ground) and to retrieve information of sub-surface features. The most direct and powerful approach is Synthetic Aperture Radar Tomography (TomoSAR), which can be understood as a generalization of SAR Interferometry. For that, usually a number of images need to be acquired from slightly different positions and coherently combined. A drawback of this approach is that it requires a typically large set of acquisitions, which are not easy to obtain using a space-borne platform. Moreover, it typically requires that the scene remains coherent (*frozen*) during the entire time-span of the acquisitions. An alternative approach uses a time series of single-pass interferograms, as those provided by the TanDEM-X missions. This approach lays at the core of several proposed mission concepts, in particular the SAOCOM Companion Satellite mission, currently being pursued by the European Space Agency, and the Tandem-L mission proposed by the German Aerospace Center (DLR).

Research Objectives

In this M.S. thesis we want to investigate and consolidate an alternative approach that uses a single pair of interferometric acquisitions under crossing tracks. In particular, data acquired over a forest by DLR's F-SAR airborne system at L-band will be used to image the vertical structure of the forest. Preliminary (quick and dirty) results were already produced and presented, so that it is expected that as output of this thesis, a peer reviewed paper should be published.

Aside from consolidating TomoSAR based on crossing tracks acquisitions, the work should help prepare an experimental framework with which the potentials and limitations of the aforementioned mission concepts.
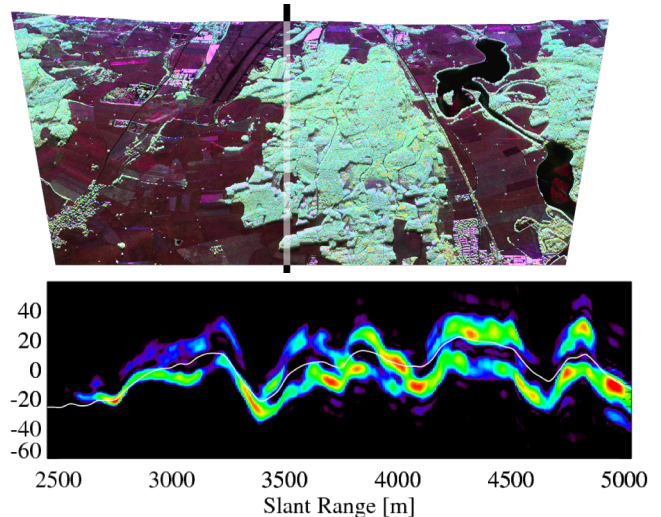

Figure 1 F-SAR image of a forest in Kaufbeuren (RGB colors represent a Pauli decomposition of the different polarimetric channels), and vertical slice generated using crossing-track TomoSAR. The two layers seen correspond to the ground and the canpy, respectively.

Interferometry under non parallel tracks is an interesting generalization of parallel track interferometry, which will expose the student to fine subtleties of InSAR, which are typically ignored.

Student Profile

Candidate students should preferably have some prior knowledge about Synthetic Aperture Radar and SAR Interferometry, and have an interest in signal theory. The project requires the implementation of some signal processing algorithms in a high level programming language.

Advisor and Information

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