

TanDEM-X: Scientific Contributions

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Abstract

In this paper new and innovative techniques during the commissioning phase of TanDEM-X will be presented that are firstly demonstrated on a satellite platform. The focus is on the secondary goals of TanDEM-X that are assigned for the third year of the mission time life due to the tight schedule for the acquisition of the highly accurate global digital elevation model. Therefore, a variety of scientific experiments are planned to be performed already during the commissioning phase. The first experiments are related to bistatic processing, Polarimetric SAR Interferometry, double differential SAR Interferometry, decorrelation measurements, superresolution and velocity measurements. The data quality and the results obtained will be validated and are discussed.

1 Introduction

TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurements) is an innovative spaceborne radar interferometer that is based on two TerraSAR-X radar satellites flying in close formation. The primary objective of the TanDEM-X mission is the generation of a consistent global digital elevation model (DEM) with an unprecedented accuracy, which is surpassing the new HREGP specification defined by NIMA, US.

Beyond that, TanDEM-X provides a highly reconfigurable platform for the demonstration of new radar imaging techniques and applications [1]. Both satellites will then act as a large single-pass radar interferometer with the opportunity for flexible baseline selection. This enables the acquisition of highly accurate cross- and along-track interferograms without the inherent accuracy limitations imposed by repeat-pass interferometry due to temporal decorrelation and atmospheric disturbances.

This paper is focusing on the innovative secondary goals of TanDEM-X and their demonstration during the commissioning phase in space. The key elements are the bistatic data acquisition employing an innovative phase synchronization link, a novel satellite formation flying concept allowing for the collection of bistatic data with short along-track baselines, as well as the use of new interferometric modes for system verification and DEM calibration. Beside this new modes as along-track SAR interferometry, polarimetric SAR interferometry (Pol-InSAR), digital beamforming, superresolution etc will be performed for the demonstration of innovative technology but also to use it as a tool for the development of new applications products.

2 Operating Modes

Interferometric data acquisitions with the TanDEM-X satellite formation can be achieved in three cooperative modes: Bistatic, Pursuit Monostatic, and Alternating Bistatic. The three cooperative modes may further be combined with different TerraSAR-X and TanDEM-X SAR imaging modes like Stripmap, ScanSAR, and Spotlight, the last mode being in sliding spotlight acquisition geometry. However, only the bistatic mode will be used for the acquisition of standard TanDEM-X DEM products, while others may be used for system calibration, validation and verification as well as for the acquisition of non-operational experimental data [1]. During the commissioning phase several modes will be operated and validated.

3. Scientific Experiments

The first scientific experiments will be conducted during the Commissioning Phase (CP) of TanDEM-X which is scheduled to long 5 months after launch. The CP is divided into three phases and starts with the LEOP and goes over to the monostatic phase where the two satellites will be brought closer (a maximum long baseline of approximately 20km will be available). Then TanDEM-X is going over to the bistatic phase (a baseline of 500 m is available). During the different phases several scientific experiments will be performed related to new and innovative techniques. Several experiments will be conducted related to different topic/themes as for example:

- Polarimetric SAR Interferometry
- Decorrelation Analysis
- Bistatic Processing
- Velocity Measurements
- Superresolution
- Deformation

References

- [1] Krieger, Gerhard und Moreira, Alberto und Fiedler, Hauke und Hajnsek, Irena und Werner, Marian und Younis, Marwan und Zink, Manfred (2007) [*TanDEM-X: A Satellite Formation for High Resolution SAR Interferometry*](#). IEEE Transactions on Geoscience and Remote Sensing , 45 (11) , Seiten 3317-3341. IEEE . DOI: 10.1109/TGRS.2007.900693.
- [2] S. Baumgartner, G. Krieger and K.-H. Bethke, "A Large Along-Track Baseline Approach for Ground Moving Target Indication Using TanDEM-X," Proceedings of International Radar Symposium (IRS), Cologne, Germany, 2007.