Progress on Topographic Measurement

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Project 5297 (Topographic Measurement) focuses on topographic mapping and deformation measurements with X-, C-, and L-band SAR data. InSAR data is used to measure the elevation in glacier areas, as well as deformations caused by slow landslides, urban subsidence, and deformation of large infrastructure elements over different test sites in China. In 2010 the following topics have been investigated:

1. Topographic mapping is done with InSAR and stereo radargrammetry in difficult areas. Mt. Qilian in China's Gansu province is one test area with almost 20 ASAR scenes collected under the Dragon II program. The results are compared to the results from our experiment with COSMO-SkyMed, TerraSAR-X, and ALOS PALSAR in the same test area.
Stereo radargrammetry is an interesting alternative to InSAR for DEM generation in difficult terrain, mainly due to the fact that stereo radargrammetry is less sensitive to temporal decorrelation than InSAR. An object-space based approach using the Rational Polynomial Coefficients (RPC) model for geocoding (see also below), is tested. We experiment with new techniques for the determination of homologous points using Mutual Information and derived methods.

2. The Three Gorges Area is strongly affected by landslides. But it is also a difficult area for deformation measurement with InSAR because of the dense vegetation cover and the steep mountains. X- and C-band InSAR suffers severely from temporal and geometric decorrelation. With the L-band ALOS PALSAR data, more stable deformation measurements with D-InSAR is possible and we can show the detection of landslide movement in L-band SAR is feasible even in this difficult terrain.

3. For urban subsidence monitoring we focus on Shanghai. Using 48 ASAR images acquired from October 2007 until February 2010, the deformation of seawalls near Shanghai has been measured. The seawall in the Nanhui district seems to suffer severely from subsidence. In another study, 20 TerraSAR-X stripmap mode images acquired from April 2008 to January 2010 are used to monitor the deformation of a few large-scale man-made infrastructures within the urban area of Shanghai. Benefiting from the high resolution imaging capability of TerraSAR-X, we can detect much more stable point-like scatterers from the same building than with medium resolution ASAR data, and unprecedented detailed deformation pattern can be revealed.

4. SAR image geocoding with the RPC model provides a computational efficient way for geocoding SAR images. We have shown that the RPC model is suitable for high-precision spaceborne SAR geocoding. The determination of the 78 unknown coefficients is the key problem. It requires the solution of an ill-posed system of linear equations. Using a hybrid solution, a fast and stable method for the determination of the unknown coefficients has been implemented and widely tested. The RPC model is also an important basis for the topographic mapping using stereo radargrammetry, because the high geocoding efficiency allows for more efficient radargrammetric methods.