Mapping from Formosat-2 stereo images: digital elevation model validation and accuracy assessment

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Digital Elevation Model (DEM) generated from satellite stereo image data has been widely used in change detection of elevation, such as tracking the glacier movement, estimating the landslide volume, and mapping the surface topography. As the spatial resolution of satellite stereo image data is increasing, the generated DEM is expected to reveal more and more details of the topography. In addition, since the applications of rapid response are increasing, the time required to collect the satellite stereo image data is expected to get shortened as well. The successful operation of Formosat-2, launched on 21 May 2004, has enabled the collection of both high-spatial- (2 m) and high-temporal-resolution (daily) images. Together with its capability of pointing ±45 degrees to both along and across track directions, Formosat-2 is able to take stereo images for any scene in its coverage area. This provides an ideal source of stereo image data for rapidly generating a regional DEM to respond to the urgent needs in a timely manner.

This research describes the procedure of generating a DEM from Formosat-2 stereo image data. The mountainous region of the catchment of Tseng-Wen Reservoir (TWR) is selected as the study area, where the orthorectified aerial photos (50 cm) and their derived DEMs (5 m) are available. A total of 120 ground control points (GCPs) are uniformly collected from one aerial photo and identified on the corresponded Formosat-2 stereo images, with the intention to build the rational polynomial coefficients (RPCs) of Formosat-2 orbit. A series of sensitivity tests are performed to examine how the generated DEM is influenced by various factors, including RPCs, tie points and GCPs. The accuracy of the generated DEM is assessed and validated against the aerial DEM, ASTER DEM, and SRTM DEM. The results demonstrate that Formosat-2 stereo image data is ideal for rapidly generating a regional DEM to respond to the urgent needs in a timely manner.