REPORT JULY 03

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Report:

The mathematical and optical engineering principles involved in the creation of 3D photogrammetric surface images have been thoroughly described.Cartosat-1 or IRS P5 (Indian Remote Sensing Satellite) is a state-of-the-art remote sensing satellite developed and launched by ISRO (May 5, 2005). It has been designed for terrain modeling and large-scale mapping applications. This High-resolution stereo data has great potential to produce high quality DEM.The high resolution Cartosat-1 stereo image data is capable of providing significant impact in topographic mapping and watershed applications. The Objective of the present study is to generate high resolution DEM (10 m and 30m) and ortho-rectified image through Cartosat-1 stereo pair, quality evaluation in different elevation strata, generation of terrain parameters. Aglar watershed inTehri-Garhwal and Dehradun district has been used as the test site. The present study reveals that DEM generated (10 m and 30 m) using the CARTOSAT-1 stereo pair is of high quality. The derived terrain parameters like slope, aspect,drainage, watershed boundaries etc., are also of good quality. A comparison of the DEM and the parameter derived from it reveals significant improvement in

the quality as compared to the freely available DEM in internet.A Digital Elevation Model (DEM) is a digital representation of ground surface topography or terrain. It is also widely known as Digital Terrain Model (DTM)(Hirano et al., 2003; Trisakti and Carolita, 2005). Digital Elevation Models(DEMs) play an important role in Earth surface deformation studies: eruptive events, gravitative instabilities, landslides and glacier evolution,geomorphological variations and crustal deformations can be detected and evaluated by means of multi-temporal DEM comparisons (Kaab and Funk,

1999; Honda and Nagai, 2002). There are various data sources for DEM e.g.aerial photographs, satellite images, cartographic maps and measured terrestrial

points. Photogrammetric technique is an appropriate solution for obtaining theDEM of large areas. DEM data can easily be obtained using stereo images through photogrammetric methods. Cartosat-1 satellite is dedicated to stereoviewing and its dataproducts are utilized for various terrain modeling applications. This stereo capability assists in three dimensional point determination and enables generation of detailed DigitalElevation Model (DEM)(Crespi et al.,

2008).

The satellite is placed in the PolarSun Synchronous orbit of 618 km from Earth. It has a payload consisting of two cameras, one near nadir looking Aft (band A) and the other forward lookingFore (band F) with a tilt of -5 degree and +26 degree providing the real time stereo data along the track. These cameras are mounted with a fixed geometry which helps in collecting stereo coverage of the terrain at a fixed B/H ratio of0.62 (Gianinetto, 2009). The swath covered by these high resolution PAN cameras are 30 km and their spatial resolution is 2.5 meters. The stereo data from this satellite along with the Rational Polynomial Coefficients (RPC) can be used to generate DEM. The Rational Polynomial Coefficient (RPC) file contains the third order polynomial coefficients that relate the image to the object space considering the imaging sensor geometry (Grodecki and Dial, 2003).CARTOSAT-1 is designed for cartography applications (Kocaman et al., 2008).

Cartosat-1 data have also been used in several other fields namely, natural hazards assessment and estimation of hydrological parameters (Kumar et al.,2006; Gianinetto, 2009). A DEM contains sufficient information to determine terrain characteristics and general patterns of drainage and watersheds. The test site for the current studies Aglar river watershed, which is located in lowerHimalayan part of the Tehri-Garhwal and Dehradun districts of Uttarakhand andthe area is also known for frequent landslide and is erosion prone.