GEOEYE-1 Satellite Stereo-Pair DEM Extraction Using Scale-Invariant Feature Transform on a Parallel Processing Platform

Ioannis Daliakopoulos (1) and Ioannis Tsanis (2,1)

(1) Technical University of Crete, Environmental Engineering Dept., Chania, Greece, (2) McMaster University, Department of Civil Engineering, Hamilton, Canada

A module for Digital Elevation Model (DEM) extraction from Very High Resolution (VHR) satellite stereo-pair imagery was developed. A procedure for parallel processing of cascading image tiles is used for handling the large datasets requirements of VHR satellite imagery. The Scale-Invariant Feature Transform (SIFT) algorithm is used to detect potentially homogeneous features in the members of the stereo-pair. The resulting feature pairs are filtered using the RANdom SAmple Consensus (RANSAC) algorithm by using a variable distance threshold. Finally, homogeneous pairs are converted to point cloud ground coordinates for DEM generation. The module is tested with a 0.5mx0.5m Geoeye-1 stereo-pair acquired over an area of 25sqkm in the island of Crete, Greece. A sensitivity analysis is performed to determine the optimum module parameterization. The criteria of average point spacing irregularity is introduced to evaluate the quality and assess the effective resolution of the produced DEMs. The resulting 1.5mx1.5m DEM has superior detail over the 2m and 5m DEMs used as reference and yields a Root Mean Square Error (RMSE) of about 1m compared to ground truth measurements.