Comparison of SIFT and SURF based DEM extraction approaches on a GEOEYE-1 satellite stereo-pair

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 (tsanis@hydromech.gr)

A MATLAB module for Digital Elevation Model (DEM) extraction from Very High Resolution (VHR) satellite stereo-pair imagery is used to compare the efficiency of two well established feature detection and description algorithms. A procedure for parallel processing of cascading image tiles is used for handling the large datasets requirements of VHR satellite imagery. Scale-Invariant Feature Transform (SIFT) and Speeded Up Robust Features (SURF) algorithms are used to detect potentially tentative feature matches 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, tentative feature matches are converted to point cloud ground coordinates for DEM generation. A 0.5 m × 0.5 m Geoeye-1 stereo-pair acquired over an area of 25 km2 in the island of Crete, Greece is used as input for the module. The resulting 2 m × 2 m DEMs has superior detail over previously developed 2 m and 5 m DEMs that are used as reference, and yields a Root Mean Square Error (RMSE) of about 1 m compared to ground truth measurements. Results suggest that SURF's superior runtime performance outweighs the slightly better feature quality attained with SIFT.