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Name : AHMAD SANUSI BIN CHE COB

Title : DETECTION OF BUILDING FEATURES IN INTERFEROMETRIC SYNTHETIC APERTURE RADAR DATASETS

Supervisor : ASSOC. PROF. DR. MOHAMMAD HALMI KAMARUDDIN (MS)
ASSOC. PROF. SR. DR. JUAZER RIZAL ABDUL HAMID (CS)

Building features are the main components of geospatial data which are constantly required for many applications in this ever changing world. Producing and consistently updating building layers have been the functions of many mapping organisations in the world including Malaysia. In this regard, The Department of Survey and Mapping Malaysia (JUPEM) has faced an uphill task to frequently establish the building layers throughout the country where persistence cloud cover has always been the big issue. An alternative solution would be to utilize Synthetic Aperture Radar Interferometry (InSAR) technology which is widely known to have the penetration capabilities through cloud cover to perform such task. This study investigates the potential of using interferometric SAR datasets products namely unwrapped phase images and digital surface models (DSM) as the main input for building features detection strategy of built up area in Tanjung Malim district, State of Perak in Peninsular Malaysia. The objectives of the research are to improve the method of building features extraction from InSAR dataset by using shape and size of structure elements and to combine the extracted building features with the generated DSM height models to create 3D building model. The last objective is to make an assessment of 3D building features model which are derived from interferometric products with Photogrammetric-based DSM (PhotoDSM) and the digitised vector map data from JUPEM. In the first part, the study adopted commercial off the shelf (COTS) software Erdas Imagine 2011 and Fast Fourier Transformation-based IDL program to obtain digital surface model without the availability of ground control points (GCP) and secondly for building footprint detection, image filtering technique of ENVI and IDL involving convolution and morphological operation were used. Both models were finally combined to form a 3D building model of the study area. It has been found that the generation of DSM is possible with InSAR technique even when the temporal resolution of repeat-pass datasets is large (99 days apart). More importantly, it was found that the baseline distance factor is highly significant in order to produce desirable DSM results and must strictly adhere to ESA guidelines. High level of coherence values between two images that constitute interferometric pairs was found to be insignificant when generating interferometric SAR products. For the 2nd objective, building features detection method using unwrapped phase image has been proposed and tested based on image processing technique of IDL and ENVI. It was found that the detectable buildings masks of different threshold values and the reference digitised vector map from JUPEM have correlation values of more than 0.6 for five tested files. This shows that there is a strong relationship between the size of kernel and shapes with the success rate of detecting building features in unwrapped phase image datasets which needs further analysis in the future. The accuracies of InSAR-based DSM were found to be between 5 to 10 meters for built-up areas and in the region of 10 to 20 meters for areas covered by vegetation and forest. The values were found to be consistent with the values of 1.41 meters for 32 transect locations of buildings in the whole study area. This shows that InSAR-based DSM produces comparatively better building heights than vegetation or forest features heights. Although the results have shown that the potential of detecting buildings by the proposed method is very high and can be further improved with more research on structure elements development, the 3D model was found to be still insufficient to characterize small buildings in built-up areas of urban township like Tanjung Malim.