

Urban and suburb change detection using multitemporal polarimetric SAR images

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ABSTRACT

The objective of this research is to examine the effectiveness of polarimetric indicators obtained from polarimetric synthetic aperture radar (PolSAR) data acquired by Advanced Land Observing Satellite (ALOS) Phased Array type L-band Synthetic Aperture Radar (PALSAR), for urban and suburb change detection in two Asian cities namely Osaka and Ho Chi Min City. Numerous indicators can be generated from several stages of processing with full PolSAR images. Therefore, it is possible to use several indicators obtained from PolSAR images for changed detection that always makes confusion at the time of application. Thus, a systematic analysis was done with the considered set of polarimetric indicators for the changed detection in an urban and suburb area to obtain the best set of polarimetric indicators. In this study five set of polarimetric indicators generated from full PolSAR images namely amplitudes of three polarimetric components (HH, HV and VV), diagonal elements of coherency matrix (T11, T22, T33), three scattering components (surface, double and volume scattering), rotation of coherency matrix to minimize the effects of cross polarized (HV) component (T11, T22, T33 after minimizing of cross component effect), and three scattering components obtained from the rotation of coherency matrix (surface, double and volume scattering after minimization of cross component effect) were selected.

To compare the PolSAR images from different dates, a changed image was developed using normalized difference ratio operator for each individual indicators that gives the relative change in two images. And a histogram fitting thresholding algorithm was implemented to automatically classify the change images into three classes: changed with increased intensity, changed with decreased intensity and unchanged. Similarly, we tested for the best result integration method for the different indicators in each set of polarimetric indicator to achieve the best performance. A union operation of the detected changed from each indicators in every set depicts the better performance than using the total power by summing up the power of each indicators in each set. Thus, the union operation was done to obtain final changes from each set of polarimetric indicators. Diagonal elements of coherency matrix and three component decomposition after minimizing the effects of cross component achieved the best results and both have very similar level of accuracy. Both of them are able to detect above 90% of changed area correctly in both cities. However, to reduce the processing time and complexity the diagonal elements of coherency matrix after minimizing the effects of cross component would be recommended for the urban changed detection.

Keywords: Change detection, PolSAR, coherency matrix, urban area, polarimetric indicators