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Extraction of Urban Building Damage Using Spectral, Height and Corner Information

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Abstract : Timely and accurate information on urban building damage caused by earthquake is important basis for disaster assessment and emergency relief. Very high resolution (VHR) remotely sensed imagery containing abundant fine-scale information offers a large quantity of data for detecting and assessing urban building damage in the aftermath of earthquake disasters. However, the accuracy obtained using spectral features alone is comparatively low, since building damage, intact buildings and pavements are spectrally similar. Therefore, it is of great significance to detect urban building damage effectively using multi-source data. Considering that in general height or geometric structure of buildings change dramatically in the devastated areas, a novel multi-stage urban building damage detection method, using bi-temporal spectral, height and corner information, was proposed in this study. The pre-event height information was generated using stereo VHR images acquired from two different satellites, while the post-event height information was produced from airborne LiDAR data. The corner information was extracted from pre- and post-event panchromatic images. The proposed method can be summarized as follows. To reduce the classification errors caused by spectral similarity and errors in extracting height information, ground surface, shadows, and vegetation were first extracted using the post-event VHR image and height data and were masked out. Two different types of building damage were then extracted from the remaining areas: the height difference between pre- and post-event was used for detecting building damage showing significant height change; the difference in the density of corners between pre- and post-event was used for extracting building damage showing drastic change in geometric structure. The initial building damage result was generated by combining above two building damage results. Finally, a post-processing procedure was adopted to refine the obtained initial result. The proposed method was quantitatively evaluated and compared to two existing methods in Port au Prince, Haiti, which was heavily hit by an earthquake in January 2010, using pre-event GeoEye-1 image, pre-event WorldView-2 image, post-event QuickBird image and post-event LiDAR data. The results showed that the method proposed in this study significantly outperformed the two comparative methods in terms of urban building damage extraction accuracy. The proposed method provides a fast and reliable method to detect urban building collapse, which is also applicable to relevant applications.

Keywords : building damage, corner, earthquake, height, very high resolution (VHR)
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