Quick extraction of earthquake damage information from SAR intensity imagery

Yanfang Dong, Xiaoqing Wang, Aixia Dou, Long Wang, Xiang Ding, Yan Wang
Institute of Earthquake Science, China Earthquake Administration, P.O. Box 166, Beijing, 100036, P. R. China. dyfgis@163.cm

Abstract:

Rapidly collecting vital information for major disasters such as strong earthquake, flood and tsunami, has often helped emergency responders to assess losses more timely and efficiently, and to monitor progress in critical response and recovery operations. However, it is often difficult to obtain damage information due to communication disruption and traffic barrier happened with a strong earthquake. Remote sensing technology has had an enormous impact on quantifying post-disaster damage, monitoring recovery and reconstruction progress, especially high-resolution optical imagery and active sensors (e.g. synthetic aperture radar (SAR), and light detection and ranging (LIDAR)). Bad weather conditions after great earthquake usually hamper the usability of optical remote sensing, so all day and all weather SAR can provide useful information for quick damage assessment at an early stage when field survey for a large area is difficult. One main reason for this rapid progress has been the introduction of high-resolution, commercially-available satellite imagery, which has become readily accessible to the public. High-resolution SAR imageries of commercial satellites such as COSMO-SkyMed SAR, Terra SAR and Radarsat-2 SAR, have provide more powerful information of natural and/or man-made disasters at early stage.

Ms 8.0 Wenchuan earthquake, occurred on May 12th, 2008 in Sichuan province China, has caused great damages, including many kinds of geological disasters and widely distributed damaged buildings. Multi-source and multi-resolution airborne and satellite SAR imageries acquired for this event have played important roles in extracting damage information at early emergency stage. Change detection between ALOS PALSAR imageries acquired pre- and post-event revealed secondary geological disasters caused by this destructive earthquake, such as landslide, mud flood and barrier lakes, which helps responders quickly collect damage information from a large quake-hit area. In this study, ratio and differential methods, false color composition of multi-temporal imageries were used to

highlight geological disasters as stated above. Then supervised classification methods were implemented to change detection images and quantified the damage assessment.

In this study, Building damage in Dujiangyan city was also assessed based on 1 m spatial resolution Terra SAR intensity imagery. First, the backscattering mechanisms of damaged and undamaged buildings were analyzed. Double bounce mechanism is dominant in undamaged urban areas, but microwaves will be scattered in different directions with damaged buildings. The impact of the shape and orientation of buildings on backscattering measured by SAR was also discussed. Generally, the backscattering intensity determined after collapse is likely to be lowered compared to that obtained before the event. Second, selecting a sample block, statistically calculated the intensity in Terra SAR imagery for each damaged and undamaged building, and a threshold was defined to discriminate them. Third, a pre-event Quickbird imagery was used to extract GIS ancillary data of buildings and blocks. Fourth, the threshold defined in step 3 was used to classify the damaged and undamaged buildings from Terra SAR imagery, and building collapse ratio was calculated for each block. Finally, the accuracy of building damage extraction was validated by damage results obtained from aerial photographs and field survey.

This study focuses on approaches of quick damage information extraction from SAR intensity imagery of earthquake disaster. The results show that change detection is efficient for geological disaster extraction using medium spatial resolution SAR data, e.g. ALOS PALSAR imagery. However, high-resolution SAR data, e.g. 1 m Terra SAR imagery, can be used to discriminate damaged and undamaged buildings in urban areas. With the help of available GIS data or high resolution optical remote sensing data, the accuracy of building damage detection can be improved. The damage information obtained at early emergency stage can assist the field surveying and further damage assessment.

Key words: high-resolution SAR, Wenchuan earthquake, earthquake damage information extraction, building damage, change detection