VALIDATION OF AN EARTHQUAKE DAMAGE MAP FROM VHR OPTICAL IMAGES USING A GROUND SURVEY

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ABSTRACT

In this work we investigated the effects to man made structures and buildings caused by the December 26th, 2003, Bam (Iran) earthquake. The epicentre of the seism was nearby the ancient urban area of Bam and caused strong damage. The dataset was composed by pre- and post-earthquake QuickBird panchromatic images, with 60 cm geometric resolution. The very high resolution images acquired by QuickBird have been used to show the capability of this data to map damage at building scale by means of a segmentation approach. QuickBird took clear images of Bam on January 3, 2004, eight days after the event and on September 30, 2003, about three months before.

The use of very high resolution images from one side allows to detect very small details, while on the other hand buildings appear as rather complex structures difficult to be interpreted. Furthermore, they may be surrounded by scattering objects making less evident the contrast between the roofs and the ground, thus increasing the difficulties in the segmentation process. False alarm signals affecting the change detection process can be due to the shadows and their variations along the year. This implies that a single band is not enough to classify such complex environment. Moreover, when using panchromatic very high resolution (VHR) images, some objects/classes may have similar radiance, thus preventing their correct recognition using a single channel. Therefore, the extraction of other information such as shape of the objects or other geometrical information can be very useful when dealing with panchromatic images. To this aim, morphological operators have been applied to our image dataset. In particular, the Open and Close operators have been adopted. Using these operators with different windows size (spanning from 3x3 up to 125x125 pixels), a morphological profile for each object/class in the scene has been extracted from the original panchromatic images acquired before and after the earthquake. Hence, all the buildings within the urban area have been identified by means of a supervised classification approach, both in the pre-seismic and post-seismic image. After this building identification procedure at the resolution of the original Quickbird image, the damage level was computed within an area of the urban settlement (e.g., a district) by comparing pixel radiance belonging to the same building before and after the earthquake. The procedure has already been validate against a map identifying regions within the Bam city with comparable degree of damage.

In this work, we focus on the capability of the procedure to detect damage at single building scale, either total or partial. For this purpose, a validation process has been performed in order to compare the final high resolution damage map extracted from QuickBird images with a ground survey mapping the buildings totally or partially collapsed during the earthquake. The latter, reported by Hisada et al. (2004), is a local survey of seven areas related to seven Strong Motion Stations in Bam. A damage grade for each building within the areas has been assigned during the survey, according to the five level of the European Macroseismic Scale 1998 (EMS98). The comparison of the ground truth with our high resolution damage map was fairly satisfactory and allowed us to better tune the change detection algorithm devote to damage estimation from VHR images.

REFERENCES

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