

Verification of damage detection methods utilizing the image analyzing method with orthographic projection photographs of the Kumamoto earthquake

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As a damage detection method for aftermath of natural disasters, an aerial photographic interpretation and an image analyzing is important. In case of the 2016 Kumamoto earthquake, a number of aerial photos have acquired by airplane at April 15th, 19th and 20th, in adjacent to damage-concentrated areas such as Mashiki-town, East region of Kumamoto city, and Nishihara-village. These photos records the situation of damaged buildings, in each aftermath of the M6.5 foreshock occurred at April 14th and the M7.3 main-shock occurred at April 16th. By utilizing these images, we have classified damage levels of buildings into 4 grades, then separated structures into Wood or non-Wood mainly based on the shape of buildings, and divided the building age by comparing with different age of aerial photos of the National Land Image Information published by Geospatial Information Authority of Japan (GSI). Then we input these information into the GIS polygons, utilizing the Fundamental Geospatial data published by GSI. In this study, we conducted the following image analyzing methods with these aerial photos and GIS data, then verified the relation between each indices constructed by image analyses and building damage levels based on visual judgement.

First, we developed Digital Surface Model (DSM) with resolution of 50 cm, by method of the stereo matching with aerial photos which have taken at April 15th and 20th. Besides, we have acquired airborne laser scanning data from GSI, and constructed DSM data with resolution of 50cm. Then we calculated differences with each DSMs, and extracted differences into each polygons of building, after that, we have developed the building height difference data in each cases aftermath of the foreshock and aftermath of the main-shock. By comparing building height difference data with building damage levels, we have confirmed that heavy damaged buildings show apparently DSM height differences. The result shows that the height difference is available for detecting destroyed houses.

Secondly, we have extracted the Blue Sheet polygon data, by utilizing aerial photos taken at April 15th, 19th and 20th, with the area segmentation method and the threshold method utilizing the HSV color space. Then compared area ratios of the Blue Sheet covered area with each building polygons. As a consequence, we have confirmed that buildings which have moderate or slight damage levels show significant values of Blue Sheet polygon area ratio.

Additionally, we have performed texture analyses with the aerial photo taken at April 20th by use of Laplacian filters, as a result, we have confirmed that standard deviations of brightness values are correlate with building damage levels.

Finally, we have conducted edge analyses with the aerial photo taken at April 20th, then organized GIS data of building edges, and compared area ratios of building age polygons with damage levels of each polygons. As a result, in case of heavy destroyed buildings, area ratios in each edge of buildings shows small value.

As explained above, the difference of DSM and the segmentation of the Blue Sheet area is available for damage detection. Furthermore, texture analyses and edge analyses can be effective if combined with another damage detecting indices such as DSM.

For next step, we are going to develop the image analyzing method for detecting damages of the buildings by joining multiple indices. Additionally, by combining with other damage detecting methods such as the Machine Learning, it would actualize more immediate and more accurate damage detection than current conditions.

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