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RAPID BUILDING DAMAGE MAPPING BY OPTICAL SATELLITE IMAGES

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Earthquakes are widely regarded as major disastrous natural events claiming large numbers of lives and economical losses every year in Iran or other hazard prone countries. As a repeated experience, in every decade, some major such events have affected seriously urban settings in Iran. Rapid damage mapping associated to the early phase of post-event will help in managing search and rescue operations, resource allocations and preliminary economic loss estimation. Earthquake rapid damage mapping in disaster management phases using remote sensing technology is feasible and has been regarded as powerful technique for semi-automatic or automatic building extraction and damage mapping in urban areas.

In November 12, 2017, a strong earthquake (Mw 7.3) occurred on the Iran-Iraq border. In this event, the province of Kermanshah was the most affected area with the city of Sarpol-e Zahab being the hardest-hit zone. For this study, the Chinese TRIPLESAT_2 and SV1 satellite data sets were acquired for both before and after the event. The object-based image analysis has been sought where a building mask map was utilized for extracting textural contents from all building footprints from all images. The building mask has been created as a layer from Google Earth images (Figure 1). A ground truth data is necessary in order to train the ANN and in order to evaluate the outcome of the algorithm. This data can be derived according to a manual process or using an already existing damage data. Since the ground truth information and the survey data of the study area was not available, ground truth and reference damage map was prepared according visual interpretation post-earthquake satellite image .the buildings were classified into two classes of "Changed" or "Unchanged" (Figure 2).

Figure 1. Building mask extracted from optical image.

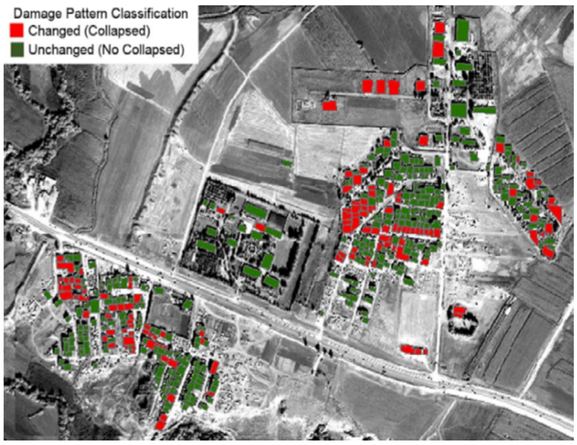

Figure 2. Reference damage map associated to post-earthquake satellite image.

The flowchart depicted on Figure 3 describes the steps involved in the object-oriented semi-automated methodology used in this research for citywide damage mapping.

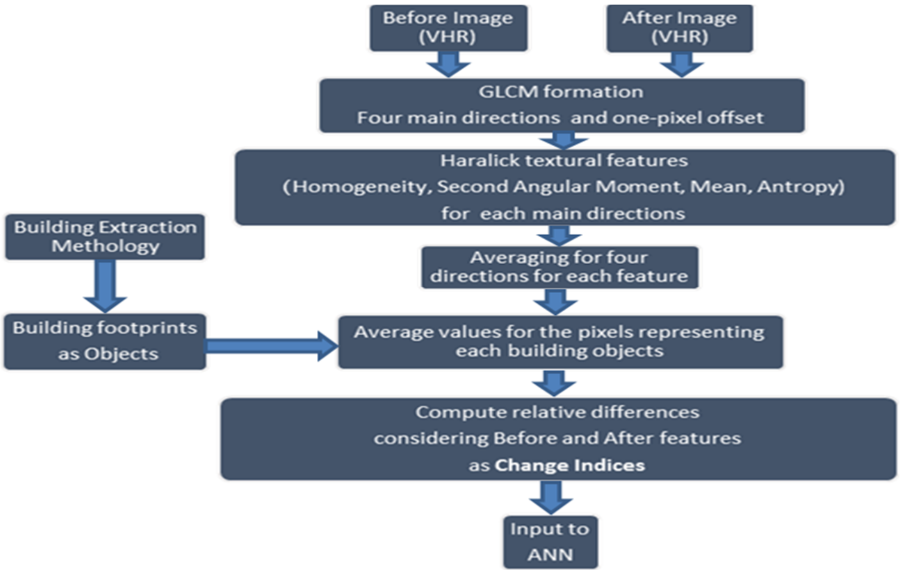

Figure 3. Flowchart of the proposed method.

Both pre-event and post-event data were utilized and the damage detection algorithm reflects the changes. The input change indices are set as the relative differences (from pre_ and post_ data) of the seven Haralick textural features per individual building objects. In addition to these features, the statistical correlation values have been also computed for each individual objects (building property layout) considering both before and after satellite images having in mind that a higher values would reflect no detectable changes and vice versa. A total of 130 buildings were chosen randomly as the train data set from the reference ground truth data for damaged or undamaged buildings. Accordingly, a tailored ANN algorithm was employed for creating the entire damage map for the region. To assess the accuracy of the classification, a confusion matrix has been created based on the reference data and the model result showing an overall accuracy of 72% and a user accuracy of 84% for undamaged buildings. Figure 4 depicts a damage map where the red polygons show drastic changes and the green polygons represent non-detectable changes.

Figure 4. ANN's damage mapping using both pre-event and post-event images.

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