# Earthquake Damage Detection of Urban Structures using Aerial Photographs

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Abstract

Remotely sensed imagery data from satellites and airborne platforms have become important tools to assess vulnerability of urban areas and to grasp damage distribution due to large earthquakes. The platforms and sensors of remote sensing should be selected considering the area to cover, the urgency, the weather and the time conditions, and the resolution of images. In this study, visual damage inspection for two recent large earthquakes was conducted for expressways and wooden houses using aerial photographs and satellite images.

In the Niigata-ken Chuetsu earthquake, which occurred on October 23, 2004, severe and minor damages were found in the expressway network. The expressways had been in the traffic regulation because of the damages caused by this earthquake for about a month. The spatial distribution of JMA (Japan Meteorological Agency) seismic intensity was estimated based on Kriging technique (Fig. 1) to reveal the relationship between the damage of expressways caused by the 2004 Niigataken-Chuetsu earthquake and the seismic intensity. The areas where the expressway suffered from many damages were subjected to severe ground motion whose JMA seismic intensity was larger than 6.0. The major and minor damages of expressways can be detected using aerial photographs. The capability of high-resolution optical satellite images for the purpose of visual damage detection was also evaluated in this study (Fig. 2).

On March 20, 2005, the Fukuoka-ken Seiho-Oki earthquake occurred. An island named Genkai-jima island, which is located near the epicenter, suffered from severe damages, and all inhabitants had to evacuate from the island. The field survey to investigate the damage level of each wooden house was conducted by the authors. The visual damage inspection for wooden houses in this island was conducted using a vertical aerial photograph (Fig. 3). The result of visual damage inspection was verified based on field photos and diagonal aerial photographs (Fig. 4), and our photo interpretation seems to give reasonable accuracy.

In this study, visual damage interpretation of expressways and wooden houses for two recent large earthquake was conducted using aerial photographs and satellite images. The result of photo interpretation was compared with the ground truth data, and our visual damage inspection seems to give reasonable accuracy. The remote sensing technology can be used for the detection of damage because of large earthquakes. Combining the spatial distribution of seismic intensity with the remotely sensed image, proper emergency response to earthquake disaster can be conducted.

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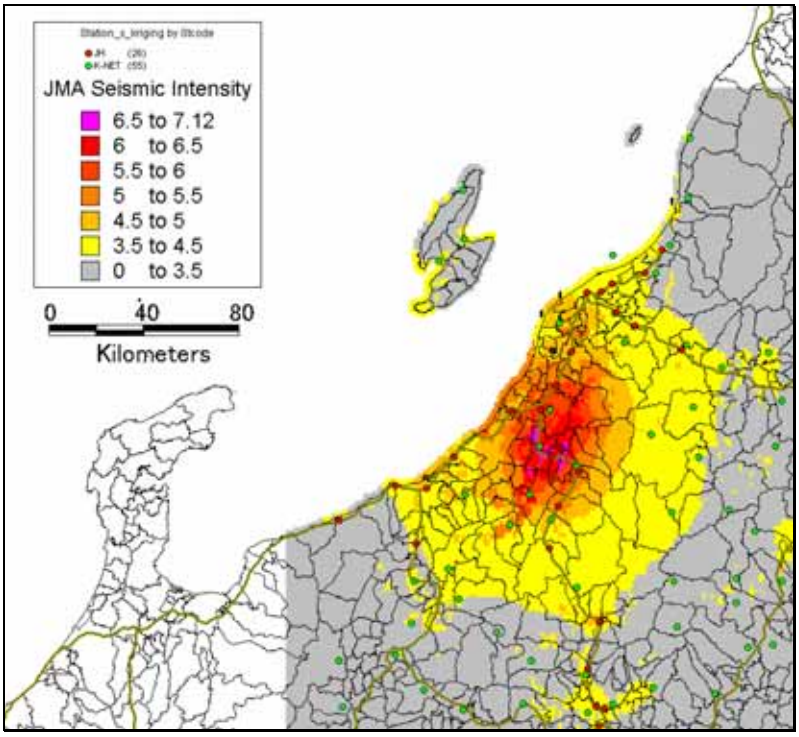


Fig. 1 Estimated distribution of JMA seismic intensity in the Niigata-ken Chuetsu earthquake

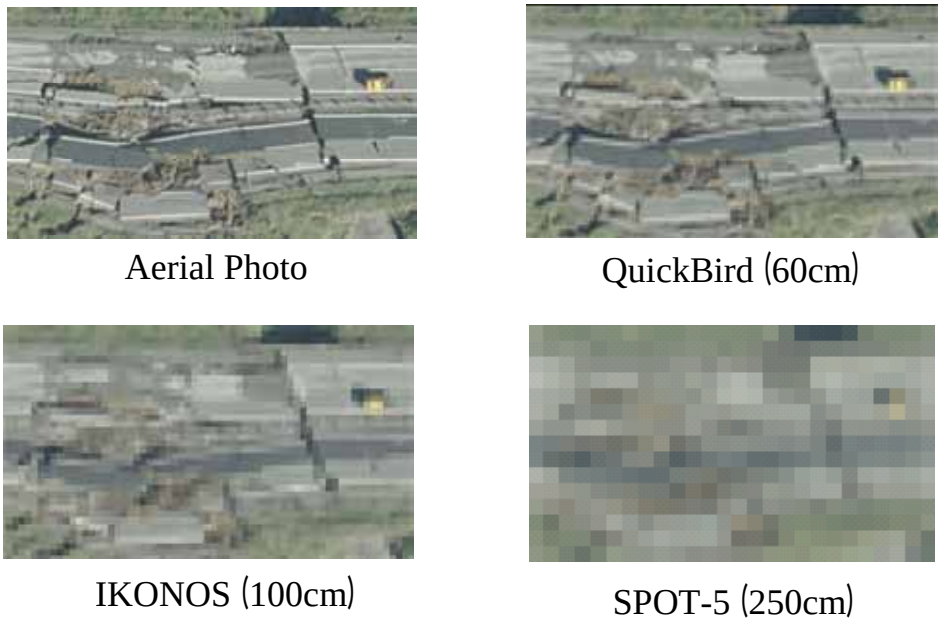


Fig. 2 Visual damage detection based on images with various resolutions (214.5 kp)


Fig. 3 Result of visual damage inspection of Genkai-jima island using a vertical aerial photograph

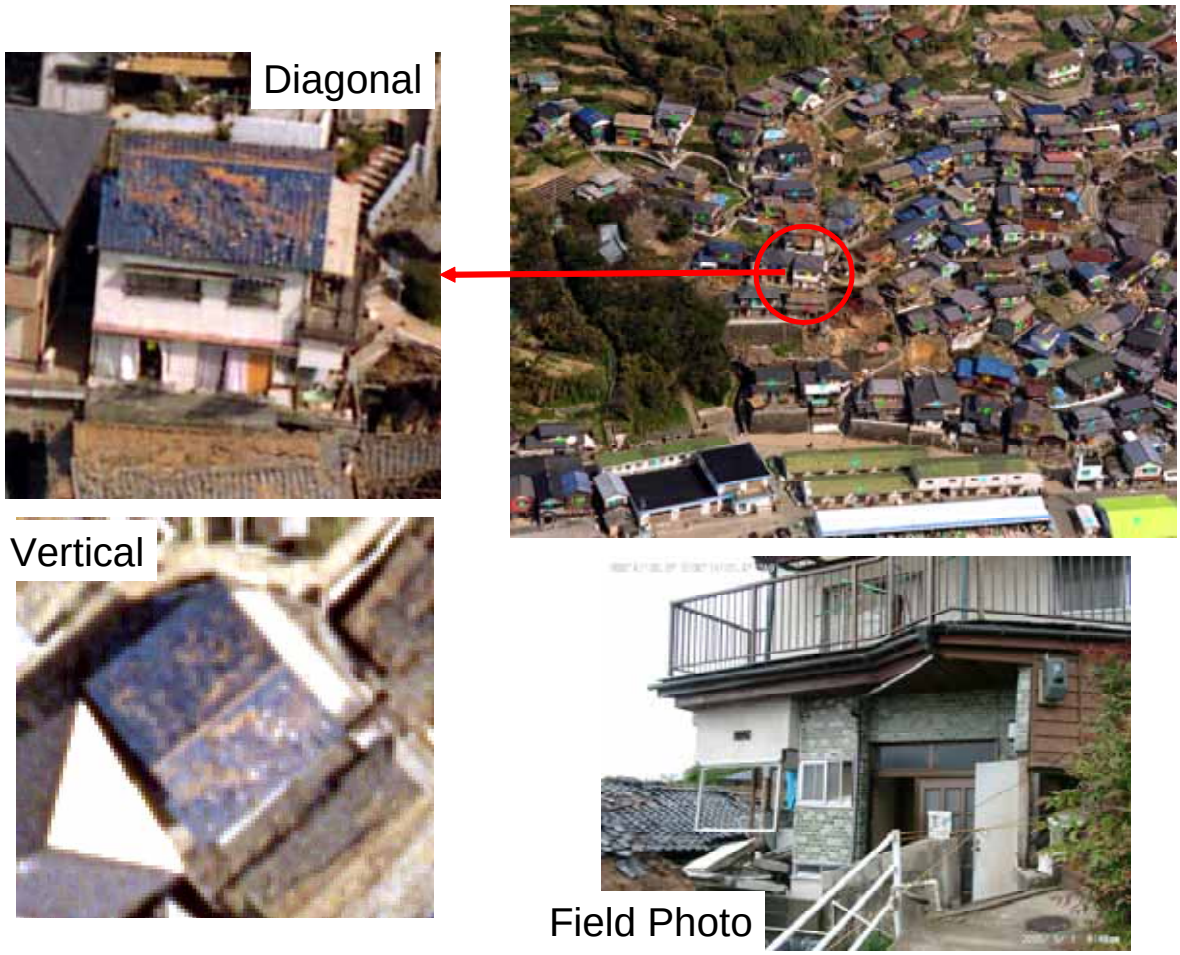


Fig. 4 Verification of visual damage detection using vertical aerial photograph based on diagonal aerial photograph and field photo