Disaster Prevention Research Center, Aichi Institute of Technology

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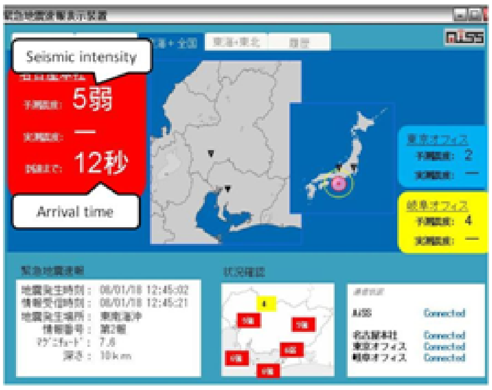
Outline

The earthquake disaster prevention consortium of Aichi Institute of Technology (AIT), i.e., the project on the development of technology for improving regional disaster prevention by use of application of earthquake information and construction of prevention base, was adopted by MEXT in 2004. As the research base of this project, the Disaster Prevention Research Center (DPREC) was established on April, 2005. DPREC has been activating as the leading research center in promoting high level education research in the central region of Japan.

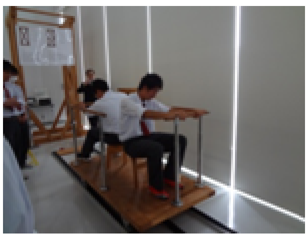
Features and research activities:



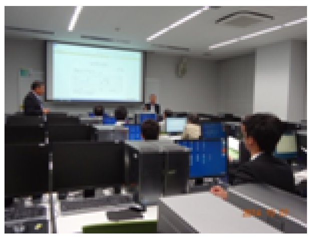
DPREC applies the Earthquake Early Warning (EEW) system from Japan Meteorological Agency (JMA) in the evacuation drill for students in the campus once a year. DPREC also issues the predicted instrumental seismic intensity and arrival time at each target site through the source parameters provided by JMA shortly after an earthquake occurs. DPREC distributes such information to as many as 100 enterprises to help them take evacuation measures, such as shutting down the gas, stopping the production equipment in the factory and elevators, and so on, before strong ground motions arrive. The right figure shows a terminal installed in one of the enterprises in the central region of Japan. In addition, DPREC adopts research activities in many aspects, including strong-motion observation, microtremor measurement, development of source model, site effect, vibration characteristics of high-rise buildings, international communication, on-site investigation (2008 Wenchuan earthquake, 2011 Tohoku earthquake), tsunami evacuation drill, detection of damaged buildings through satellite data, development of disaster response robot, etc.

Disaster prevention education:

DPREC opens its facilities to visitors from the enterprises, residents' community, and schools. DPREC implements the disaster prevention enlightening and education to approximate 1000 visitors every year. DPREC also provides fostering courses to those who are expected to activate as a leader when disaster happens. The level of course is designed for senior undergraduate and master.

Photos show the explanation about fault mechanism (left) and experience on the unidirectional shaking table (right).

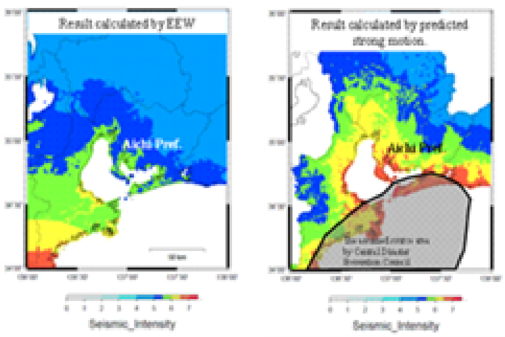



Photos show the members and lecturers of disaster prevention meisters and fostering course on the class

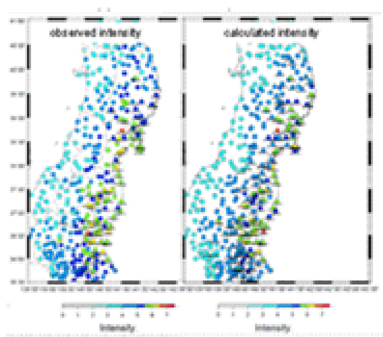
Research Achievements and Challenges

Upgrading the Earthquake Early Warning System for Great Earthquakes
Susumu Kurahashi

The present JMA Earthquake Early Warning (EEW) system may underestimate the seismic intensity for great earthquakes based on a point source assumption, as shown in Fig.1. We proposed a methodology for estimating the rupture extent from vertical PGA of P wave before main motions of S waves arrives when great earthquakes occur. The vertical PGAs at non-observation sites outside the rupture extent are calculated using the empirical attenuation-distance relationship of the vertical PGAs and shortest distances from sites to the source fault without requiring earthquake magnitude. The seismic intensities there are estimated using the empirical relationship between vertical PGA of P wave motions and seismic intensity. We applied this method to estimate the seismic intensity during the 2011 Tohoku earthquake. The calculated seismic intensities agreed well with the observed ones at stations around the epicenter and far from epicenter.



Comparison of calculated seismic intensity by EEW with that by predicted strong motions during the assumed Tonankai earthquake whose hypocenter is in the Shionomisaki-oki by Central Disaster Prevention Council (2003).



Comparison of the observed seismic intensity with the calculated ones during the 2011 Tohoku earthquake

Behavior Analysis of Evacuation Drill
Norimitsu Koike

Recent public estimation of tsunami damage has prompted the revision of existing evacuation plans in Japan. Our study aims to develop the model to find the useful information for evacuation plans by the evacuation drill.

(1)For visitors near the beach

It is important to establish countermeasures for visitors who are not acquainted with the risk of places near the beach. Our study evaluates the spatio-temporal evacuation behavior of visitors on how to flee from the beach to an evacuation shelter at an evacuation drill. Their evacuation behavior was tracked using mobile GPS devices and fixed-point video-recordings specifically. In addition, visitors' awareness of the risk was addressed through a questionnaire survey. Through those analyses, we found that guidance had an important effect on the visitors' evacuation behavior.

Example of GPS tracking (M. Morita, 2014)

(2)For fishing boats on the sea

There are two evacuation methods for the fishing boats on the sea. First is “Okidashi” which means evacuation through moving the boat to offshore at the deep water. Second is a quick landing. We evaluate the spatio-temporal evacuation behavior of fishermen at an evacuation drill. In addition, their awareness of the risk was addressed through the workshop and a questionnaire survey. Our goal is to develop the evacuation map including the evacuation shelter information and the evacuation time to decide whether taking “Okidashi” or a quick landing.

Detection of Damaged Buildings Using GeoEye-1 Imagery and Airborne Lidar Data
Yoshiyuki Yamamoto

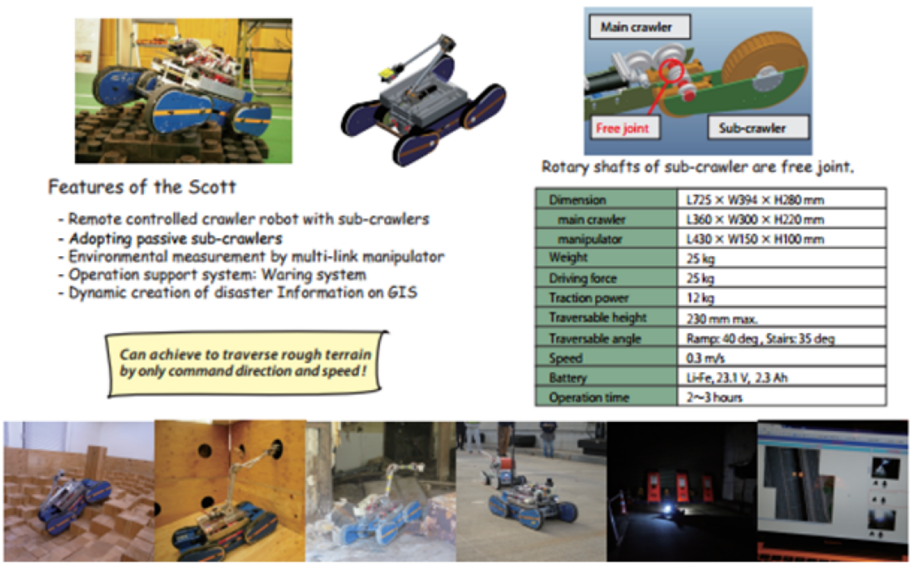
Accurate detection of damaged buildings can help government to initiate search and rescue specifically in the early post-disaster period. The purpose of this study was to develop a method to detect disaster-related damaged buildings using high-resolution optical satellite imagery, specifically GeoEye-1, and airborne lidar data. Three methods for creating a dataset used to detect damaged buildings were proposed: the Difference method (D-method), the Ratio method (R-method), and the Normalized Difference method (ND-method). The D-method was based on the difference in the value of the post-event imagery compared to that of the pre-event imagery. The R-method was based on the quotient of dividing the value of the pre-event imagery by that of the post-event imagery. The ND-method used a calculation formula that was similar to that used by the Normalized Difference Vegetation Index (NDVI). The experimental results indicated that the dataset created using the ND-method has a higher sensitivity than that of other methods.

(a) (b) (c) (d) (e)

Figure (a) and (b) show the false color pan-sharpened pre- and post-earthquake GeoEye-1 image, with 0.5 m spatial resolution, respectively. Figure (c) and (d) show the pre- and post-earthquake digital surface model (DSM) image, with 0.5 m spatial resolution, respectively. Figure (e) shows the detection result by the ND-method. The black areas signify the destroyed buildings, and the red areas the survived buildings.

Development of Disaster Response Robot
Masayuki Okugawa

The purpose of this study is the development of the robot technology in order to investigation in the disaster for the social infrastructure. A remote controlled robot "Scott" has been developed. Scott is a passive adaptive crawler robot and has the easy operability which does not depend on the skill. The data acquired from the robot are sequentially transferred to database server with acquisition time and positional information. Analysis of acquired data is possible in cooperation with an image processing program and numerical analysis program as needed.



Dimension	L725 × W394 × H280 mm
main crawler	L360 × W300 × H220 mm
manipulator	L430 × W150 × H100 mm
Weight	25 kg
Driving force	25 kg
Traction power	12 kg
Traversable height	230 mm max.
Traversable angle	Ramp: 40 deg , Stairs: 35 deg
Speed	0.3 m/s
Battery	Li-Fe, 23.1 V, 2.3 Ah
Operation time	2~3 hours