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TOYOHASHI
UNIVERSITY OF TECHNOLOGY

PRESS RELEASE

Source: Toyohashi University of Technology, Japan, Committee for Public Relations

Release Title: Using Machine Learning to Measure Building Earthquake Damage
Release Subtitle: Facilitating evacuation immediately following an earthquake and the continued use of buildings

Overview

The 2016 Kumamoto Earthquakes damaged municipal government office buildings, which was a large obstacle during evacuation and reconstruction. We need to develop technology that enables us to inspect municipal government offices, fire departments and other hub buildings for disaster control activities immediately after an earthquake occurs. The Earthquake Disaster Engineering Research Laboratory in Department of Architecture and Civil Engineering, Toyohashi University of Technology, has developed a method for instantaneously evaluating earthquake damage to a building from the readings of the building's seismometer using machine learning technology. All city government offices in the Higashi-Mikawa area are already equipped with seismometers and a system for sharing the results of damage assessments by email immediately after an earthquake has been established. Applying the machine learning technology that has been developed will enable faster, more accurate damage assessment.

Details

Municipal government offices, fire departments and other hubs for measures following an earthquake must be capable of assessing the building damage immediately after an earthquake to determine whether the building is able to continue to be used. To date, the methods for evaluating a building's condition after an earthquake have basically been limited to visual inspections from outside of the building because of the potential for an aftershock to cause the building to collapse. For this reason, it has been difficult to assess internal building damaged after a large earthquake. The research team has developed a technology for remotely assessing the condition of a building during an earthquake based on the readings from the building's seismometer. This method uses observation records stored on the Internet-cloud to analyze the response of the structural model of the building and based on these results, assess damage. However, a lot of time is necessary to ensure the damage assessment is highly accurate.

So, the research team developed a method for immediately assessing building damage using a machine learning technology without using a structural model of the building.

The method would remotely and immediately assess the level of earthquake damage (no damage, mild damage, moderate damage, severe damage, collapse) and whether the damaged building can continue to

be used (safe, caution needed, dangerous) from images of the wavelet spectra in the observation waveforms from the seismometer using the CNN (Convolutional Neural Network) machine learning method. Edisson Alberto Moscoso Alcantara, the lead author and doctoral student, explains damage assessments using the new method will be faster than the conventional method using a structural model of the building.

Development Background

"Machine learning technology is rapidly spreading across the field of earthquake preparedness. Previously, assessing damage to a building was dependent on human experience. In the future, this will be automatically handled by AI. The goal of the research is to establish a method for remotely assessing the condition of a building right after an earthquake without having to send someone to the site. At first, we worried that simply reading seismometer waveforms would not be able to assess the damage incurred. We learned that using the wavelet spectra enables damage assessments to be considerably accurate," says Professor Taiki Saito, the leader of the research team.

Future Outlook

The method for assessing earthquake damage developed by the research team may be applicable irrespective of the differences in buildings, such as the number of floors or the structure of the building. A real-time seismic testing system developed by Toyohashi University of Technology is already being used in city government office buildings in the Higashi-Mikawa area. Hopefully, the new method will enable faster and more accurate seismic diagnosis to improve local communities' ability to respond in a disaster.

Reference

Edisson Alberto Moscoso Alcantara, Michelle Diana Bong and Taiki Saito (2021). Structural Response Prediction for Damage Identification using Wavelet Spectra in Convolutional Neural Network. Sensors 2021, 21(20), 6795; https://doi.org/10.3390/s21206795

Further information

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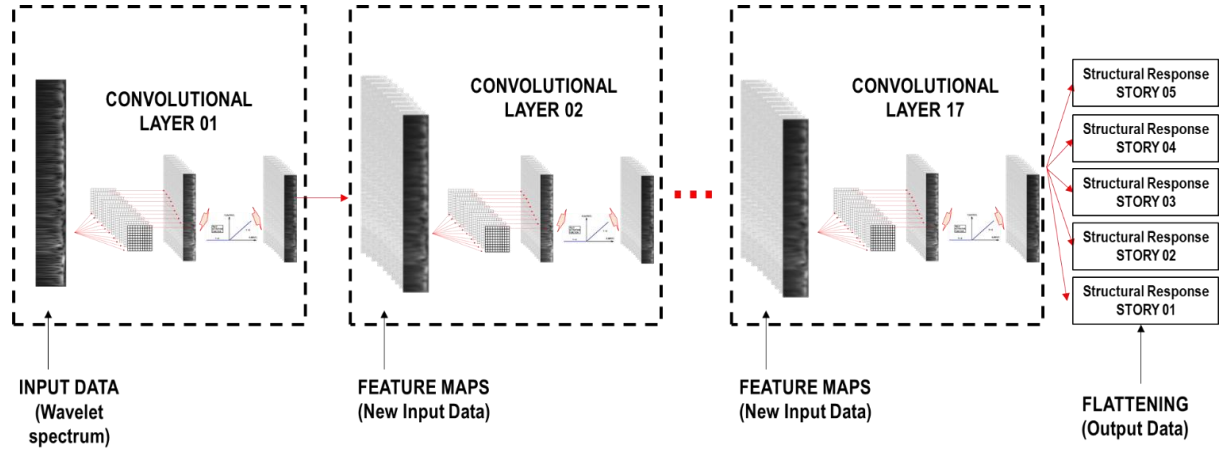
Toyohashi University of Technology founded in 1976 as a National University of Japan is a research institute in the fields of mechanical engineering, advanced electronics, information sciences, life sciences, and architecture.

Website: https://www.tut.ac.jp/english/

Figure1:



Title: Damage Assessment Flow Using CNN Machine Learning

Keywords: Solid electrolytes, Organic solvents, Batteries, Energy resources, Organic synthesis