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Machine learning based fast multi-layer liquefaction disaster assessment

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Abstract

Liquefaction is one kind of earthquake-induced disasters which may cause severe damages to roads, highways and buildings and consequently delay the disaster rescue and relief actions. A fast and reliable assessment of liquefaction disaster is thus of great importance for making disaster prevention plans beforehand and for planing rescue and relief activities right after earthquakes. However, this is still a great challenge task, because the computational cost of current existing liquefaction assessment methods is very high. For example, a 50 seconds simulation (5000 time steps) needs one hour with 1000 nodes in the Supercomputer K. In this paper, we proposed a machine learning based liquefaction disaster assessment method. Here, the assessment result can be given with high efficiency (few seconds or less) for emergency evacuation in an earthquake. Meanwhile, a multi-layer approach was also proposed. Firstly, the most dangerous area will be shown immediately by using convolutional neural network (CNN) model; followed by a high precision result, which is obtained by using fast Fourier transform and a special of soil (N values) coupled with a Light Gradient Boosting Machine (Light GBM) model. One more contribution is our visualization design, which can be used to let users know the dangerous area more intuitively. Finally, the effectiveness of our proposed method was demonstrated by assessing liquefaction from a large-scale earthquake simulation.

Keywords Liquefaction disaster assessment · Machine learning · Multi-layer

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