

Sparse Modeling to Estimate Spatial Distribution of Ground Motion Required for Rapid Prediction of Structural Damages

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A rapid prediction of structural damages due to a large earthquake is important to prevent secondary disasters. The first step of the prediction is to estimate ground motion at a targeted construction from observed seismic data, and the second step is to predict structural damage using the estimated ground motion. An accurate damage prediction requires ground motions with spatially-high resolution although the spatial density of constructions is much higher than that of seismometers in urban area. We have been developing a statistical method to model such ground motions using seismograms obtained by a seismometer array. Our target is Tokyo metropolitan area in which seismogram of MeSO-net (Metropolitan Seismic Observation network) is available.

Mizusako[2013, graduation thesis] proposed a method based on the Taylor expansion, and applied it to MeSO-net data when the Great East Japan Earthquake occurred. This method was found never to account for ground motions higher than 0.15 Hz, which was insufficient when considering that the eigenfrequency of constructions is usually between 1-10 Hz. Mizusako[2013] determined the partial differential coefficients, which appear in the Taylor expansion, from five nearest observatories with a truncation of the first order, but a better selection of a truncation of order and a group of observatories, which is hereinafter called " cluster " , could more accurately explain ground motions higher than 0.15 Hz.

We propose an algorithm based on sparse modeling that automatically and objectively determine the truncation of order and the size of the cluster. Our algorithm adopts the lasso, which is able to select dominant partial differential coefficients owing to the L1-norm regularization term. Moreover, the group lasso is implemented on our algorithm in order to select the coefficients of the same order associated with different components. We will report initial results obtained by the proposed method, comparing with the results of Mizusako[2013].

Keywords: Sparse modeling, lasso, urban disaster, MeSO-net