Geophysical Research Abstracts
Vol. 20, EGU2018-4858, 2018
EGU General Assembly 2018

Preliminary study on high frequency ground motion simulation with soil nonlinearity from combining stochastic and equivalent linear method

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Soil nonlinearity problem remained an unsolved problem in many cases in the world. Previous studies tried to qualitatively and quantitatively identify it in large intensity earthquakes (Beresnev et al., 1995; Wen et al., 1995; Aguirre and Irikura, 1997; Wen et al., 2006; Noguchi and Sasatani, 2008). However, there's another important issue about to do the precisely ground motion prediction for engineering purpose. One of the effectively technique to deal with it was equivalent linear simulation technique (SHAKE, Schnabel et al., 1972), which could consider soil nonlinearity problem in geotechnical engineering filed. While velocity structure, geological material and suitable stress-strain curve were well investigated and constructed for shallow borehole system, linear and nonlinear ground motion simulations could be done from solving wave propagation equation but it had some limitations of deeper structure or multiple layers consideration. Meanwhile, site correction for stochastic ground motion simulation technique from empirical transfer function (ETF, Huang et al., 2017) had been verified could provide similar prediction level with traditional ground motion prediction equation (GMPE) and still carry physical meanings. Which means if the seismic parameters were well evaluated in the target region ETF method could provide accurately prediction but still needs to consider more about nonlinearity problems. Chen et al. (2017) tried to reconstruct nonlinear records based on combining stochastic simulation technique and H/V spectral ratio method (HVSR) for 2016 Meinong, Taiwan earthquake, but in general it's very hard to get HVSR with nonlinearity before the large earthquake. In this study, the advantages from both simulation techniques will be combined to solve nonlinear soil response from following procedure for Taipei basin, Taiwan. Firstly, stochastic simulation would be adjusted from ETF of B class station that would refer to basement rock motion (as imagination of engineering bedrock, EB). Detailed shallow velocity and material of structure above EB would be constructed next and validation of SHAKE process would be made from records of borehole seismograph. Finally, synthetic motion from first step would be treated as input motion from EB to compute high frequency ground motion simulation with nonlinearity.