EGU24-18444, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-18444
EGU General Assembly 2024

Rapid Computation of Physics-Based Ground Motions in the Spectral Domain using Neural Networks

Fatme Ramadan, Bill Fry, and **Tarje Nissen-Meyer**

Physics-based simulations of earthquake ground motions prove invaluable, particularly in regions where strong ground motion recordings remain scarce. However, the computational demands associated with these simulations limit their applicability in tasks that necessitate large-scale computations of a wide range of possible earthquake scenarios, such as those required in physics-based probabilistic seismic hazard analyses. To address this challenge, we propose a neural-network approach that enables the rapid computation of earthquake ground motions in the spectral domain, alleviating a significant portion of the computational burden. To illustrate our approach, we generate a database of ground motion simulations in the San Francisco Bay Area using AxiSEM3D, a 3D seismic wave simulator. The database includes 30 double-couple sources with varying depths and horizontal locations. Our simulations explicitly incorporate the effects of topography and viscoelastic attenuation and are accurate up to frequencies of 0.5 Hz. Preliminary results demonstrate that the trained neural network almost instantaneously produces estimates of peak ground displacements as well as displacement waveforms in the spectral domain that align closely with those obtained from the wave propagation simulations. Our approach also extends to predicting ground motions for 'unsimulated' source locations, ultimately providing a comprehensive resolution of the source space in our chosen physical domain. This advancement paves the way for a cost-effective simulation of numerous seismic sources, and enhances the feasibility of physics-based probabilistic seismic hazard analyses.