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Generating the Strong Ground Motion based on the First Oncoming Signals using Artificial Neural Network

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ABSTRACT

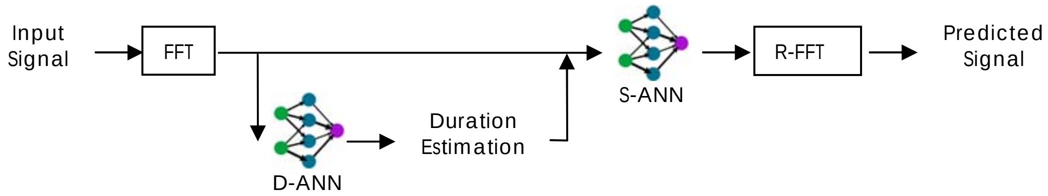
Nowadays is approved that there are meaningful relationships between the first signals of the oncoming earthquake and it's Magnitude, duration and PGA. Numerous empirical relationships were be derived to model this dependency, which be used in earthquake alerting and employed in pipeline and train shot down systems. In spite of the empirical relationships, which are just able to predict some parameters of earthquake signal, sometimes we need to make a qualitative prognosis, which is able to show the oscillation of seismic wave as a time series.

The aim of this study is to develop a methodology for selecting and training neural network that are capable of generating strong motion for input of beginning earthquake signals. Here we are going to asses the qualitative relations between the first signals and the whole content of coming earthquake wave.

For the reason that the Strong ground motion process is a non-homogenous process, which contains different wave types with different propagation features, the process is developed separately for different wave phases (P, S and Coda wave).

The elements of proposed model are Fast Fourier (FFT) and Reverse Fourier Transform (R-FFT) and artificial neural networks (ANN) (as shown in schematic figure). A feed-forward 2 layers ANN with different structures (number of nodes in hidden layer) will be used to detect the more comprehensive form of the network. The first seconds after oncoming each wave phases are apply to system as input signal. The feed forward ANN was trained to make the duration estimation of the each seismic wave phase (called D-ANN). The input data for the ANN are the both real and imaginary part of FFT. Because of reversibility of Fourier transform it can be used without any manipulation in original data set. The second ANN is placed to simulate the ground motion signal (called S-ANN).

16 training data set are randomly collected from 20 horizontal ground motion accelerograms (10 earthquake records). To reach the reasonable results, all training and test data sets have some similar characteristics such as soil type (in our case shear wave velocity bigger than 750 m/s), hypocentral distance (near field records, distance between 14 and 34 km) and magnitude range (6<Mw<7.5).



Schematic figure of the Artificial Neural Network based earthquake prognose system

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