Application of wavelet multiresolution analysis and artificial intelligence for generation of artificial earthquake accelerograms

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Abstract. This paper suggests the use of wavelet multiresolution analysis (WMRA) and neural network for generation of artificial earthquake accelerograms from target spectrum. This procedure uses the learning capabilities of radial basis function (RBF) neural network to expand the knowledge of the inverse mapping from response spectrum to earthquake accelerogram. In the first step, WMRA is used to decompose earthquake accelerograms to several levels that each level covers a special range of frequencies, and then for every level a RBF neural network is trained to learn to relate the response spectrum to wavelet coefficients. Finally the generated accelerogram using inverse discrete wavelet transform is obtained. An example is presented to demonstrate the effectiveness of the method.

Keywords: artificial accelerogram; wavelet transform; RBF neural network; target spectrum.

1. Introduction

For seismic design of structures, a dynamic analysis, either response spectrum or time- history analysis is often required. The major imperfect of response spectrum analysis in seismic design of structures lies in its debility to provide temporal information of the structural responses. Such information is sometimes necessary in achieving a satisfactory design. In many cases, house equipment is sensitive to floor vibrations during an earthquake. It is sometimes necessary to develop response of the floor. In addition, when designing critical or major structures such as power plants, dams, and high-rise buildings, the final design is usually based on the complete time-history analysis. To provide input excitations to structural models for sites with no strong ground motion data, it is necessary to generate artificial accelerograms (Fan and Ahmadi 1990).

The best accelerogram is one, which has compatible characteristics with desired area. Therefore, it is difficult or may be impossible in some cases to choose a proper record for a design area, because the recorded and processed accelerograms of the design location are few. Besides, other location records do not satisfy the geo-seismic characteristics on desired location. In this case, artificial earthquakes that are statistically generated based on desired properties are very useful for analysis or

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