New development of artificial record generation by wavelet theory

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Abstract. Nowadays it is very necessary to generate artificial accelerograms because of lack of adequate earthquake records and vast usage of time-history dynamic analysis to calculate responses of structures. According to the lack of natural records, the best choice is to use proper artificial earthquake records for the specified design zone. These records should be generated in a way that would contain seismic properties of a vast area and therefore could be applied as design records. The main objective of this paper is to present a new method based on wavelet theory to generate more artificial earthquake records, which are compatible with target spectrum. Wavelets are able to decompose time series to several levels that each level covers a specific range of frequencies. If an accelerogram is transformed by Fourier transform to frequency domain, then wavelets are considered as a transform in time-scale domain which frequency has been changed to scale in the recent domain. Since wavelet theory separates each signal, it is able to generate so many artificial records having the same target spectrum.

Key words: wavelet theory; artificial accelerogram; target spectrum; frequency content.

1. Introduction

Earthquake records highly depend on fault mechanism, rock properties, local soil condition, and other effects. It is important for us to record an earthquake record to apply in a dynamic analysis instead of a static analysis. 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 design operation.

Since earthquake is a random base phenomenon, it is impossible to detect clearly a possible future earthquake in specified location. Most studies have been conducted to identify some parameters such as magnitude, PGA, strong motion duration and so on. Yet, it seems difficult to predict properties of an earthquake which may happen with a certain probability of occurrence. In dynamic analysis, several proper records should be selected to be applied, preferably natural accelerogram records with

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