Код: 10889

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Zero-Pad Effects on Conditional Simulation and Application of Spatially-Varying Earthquake Motions

Дрезден, Германия, 2012 год

7 стр; формат: 23,5 x 16 см; библиографический список: 5 единиц

Realistic simulated ground motion are required for testing heath monitoring algorithms in connection with seismic excitations. To this end spatially-varying ground motions are important for long span structures such as bridges and pipelines. In conditional simulation of spatially-varying earthquake motions, a single earthquake motion time history at a site is known and a parametric coherency model is given. Spatially-varying earthquake motions at other sites are then simulated. To facilitate the use of the Fast Fourier Transform (FFT), dummy zero points must be added to the front and/or the end of the data. Investigating effects of zero-pad is important for simulating ground motions to be used for testing health monitoring techniques. However, neither comparison of zero-padded filtered data with non-zero pad filtered data nor explanation for effects of zero pads have been reported. The zero-pad effects on FFT of the input motion and also on the simulated motions are examined in this paper. When the input motion is a recorded acceleration time history, the Fourier amplitude spectra of the zero-padded input and simulated accelerations have lower peaks and higher resolution compared to the non zero-padded. The two phenomena are due to the contribution of the added data points and the conservation of the power energy when the data length is increased, respectively. The effects of zero pad on structural responses due to the simulated earthquake motions are also investigated by using a single degree of freedom model, where significant influence on the time history of structural responses at certain structural frequencies are observed.

Доклад. 6-я Европейская конференция по мониторингу технического состояния сооружений, 2012. Редакция Кристиана Боллера.

Ключевые слова:

Содержание