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Title: Closed-form solutions for the spectral characteristics of the stochastic response of linear systems subjected to fully non-stationary excitations consistent with target seismic accelerograms

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Abstract

Strong motion earthquakes represent critical actions for buildings located in seismically active regions. The analysis of recorded accelerograms after earthquakes evidences that different earthquakes produce ground motions with different characteristics in terms of intensity, strong motion duration, and frequency content. It follows that, in order to guarantee a good performance of structures in seismic areas, it needs to adequately characterize the ground motion acceleration [1]. Moreover, it has been recognized that recorded accelerograms possess both temporal and spectral non-stationarities. Temporal non-stationarity refers the variation in the intensity of the ground motion in time, whereas the spectral non-stationarity refers to the time variation of the frequency content [2]. It follows that they can be view as samples of fully non-stationary zero-mean Gaussian processes.

Recently, the authors proposed a new model of the evolutionary power spectral density (EPSD) function of the zero mean Gaussian processes to generate artificial accelerograms, in such a way that a given target accelerogram can be considered as one of its own samples [3,4]. The EPSD function can simply be evaluate once the frequency of peaks, the zero level up crossings and the total energy of a target accelerogram are determined.

In this study the procedure co-authored by the senior author [5] is extended to evaluate the closed-form solution of the evolutionary frequency response function of classically and non-classically damped linear structural systems subjected to fully non-stationary excitations consistent with target seismic accelerograms. Then the time dependent spectral characteristics of the response are evaluated by means of an innovative approach based on a pole-residue operation in the complex.

References

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