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Soil amplification of seismic ground motions in soils with random properties

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The aim of this work is to evaluate, qualitatively and quantitatively, the effect of randomness in soil properties on seismic ground motions. More specifically, the ground motion propagation from bedrock to the surface is being investigated by considering the influence of the soil response on the seismic motion at the ground surface. To this end, the soil half-space was modeled through a detailed 2-D finite element model, where absorbing boundaries were employed at the edges of the domain, in order to simulate an infinite dimensional half-space and, thus, avoid any unrealistic wave reflection. Also, in order to achieve a more rational representation of the soil behavior, its mechanical properties, namely, the modulus of elasticity, the shear modulus and the Poisson ratio were considered to be of stochastic nature and were introduced as random variables in the numerical model. Concerning the ground motions, a set of artificially generated time-histories was used, which were obtained from the Spectral Representation method on evolutionary power-spectra, so as to effectively represent the non-stationary characteristics of the signal. In order to account for the uncertainty in the system parameters and ground motion input, Monte Carlo simulations were performed evaluating the change in the power-spectrum of the input ground motion and the power-spectrum of the response. This forms a basis for comparison and extraction of useful conclusions, regarding the soil amplification and its influence on seismic ground motions.
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