Identification Of Uniform Hazard Time Histories for Seismic Design

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Summary

This paper focuses on the identification of groups of uniform hazard (acceleration) time-histories for Performance Based Seismic Design applications. In detail, on the basis of a peculiar Probabilistic Seismic Hazard Analysis, the characteristics that a group of earthquake inputs must possess in order to be associated to a given exceedance probability are obtained. The proposed procedure takes advantage of the information carried by the "epsilon" parameter, and is rooted on a separate treatment of the aleatory variability and the epistemic uncertainty considered in the hazard analysis. The analytical developments allow to identify a condition for the spectral ordinates ("spectral cloud") of the acceleration time histories, which is valid for a number of structural periods at once, and to quantify (in terms of coefficient of variation of the spectral ordinates) the randomness associated to the epistemic uncertainty (error in the spectral acceleration prediction law).

Keywords: Probabilistic Seismic Hazard Analysis, Performance Based Seismic Design; procedure; analytical developments.

1. Introduction

Within a Performance Based Seismic Design framework, in order to evaluate the seismic performance of a given structure in probabilistic terms, it is fundamental to associate a probability of occurrence/exceedance with a given structural response parameter, often referred to as "Engineering Demand Parameter" (*EDP*). This is carried out by means of numerical non-linear dynamic analyses which make use, as seismic input(s), of properly chosen groups of accelerograms characterised by given hazard. These groups have been referred in scientific literature [2] to as "earthquake bins" (Giovenale *et al.*, 2004) and, for sake of clarity, will be herein referred to as "groups of uniform hazard time-histories". The choice of the uniform hazard time-histories is deeply rooted upon their probabilistic identification. However, the hazard level cannot be directly associated to the time-histories, whilst it can be associated, by means of Probabilistic Seismic Hazard Analyses (PSHA), to earthquake "intensity measures" (*IM*s), which consist of scalar or vector-valued combinations of selected ground motion parameters (*GMP*s) associable to a given probability of exceedance. In recent years, many research works have focused on the identification of the optimal *IM* for the identification of groups of uniform hazard time-histories. Among all possible and commonly used *IM*s, the spectral acceleration, $S_A\left(T_j\right)$, at a specified period T_j, has been recently suggested as optimal (Baker and Cornell, 2006). With reference to the $S_A\left(T_j\right)$, the uniform hazard spectrum has been obtained and widely used for the identification of groups of uniform hazard time-histories. However, due to its intrinsic properties, such use of the uniform

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