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Estimation of Fragility Curves Using Proposed Ground Motion Selection and Scaling Procedure

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Abstract : Reliable and accurate prediction of nonlinear structural response requires specification of appropriate earthquake ground motions to be used in nonlinear time history analysis. The current research has mainly focused on selection and manipulation of real earthquake records that can be seen as the most critical step in the performance based seismic design and assessment of the structures. Utilizing amplitude scaled ground motions that matches with the target spectra is commonly used technique for the estimation of nonlinear structural response. Representative ground motion ensembles are selected to match target spectrum such as scenario-based spectrum derived from ground motion prediction equations, Uniform Hazard Spectrum (UHS), Conditional Mean Spectrum (CMS) or Conditional Spectrum (CS). Different sets of criteria exist among those developed methodologies to select and scale ground motions with the objective of obtaining robust estimation of the structural performance. This study presents ground motion selection and scaling procedure that considers the spectral variability at target demand with the level of ground motion dispersion. The proposed methodology provides a set of ground motions whose response spectra match target median and corresponding variance within a specified period interval. The efficient and simple algorithm is used to assemble the ground motion sets. The scaling stage is based on the minimization of the error between scaled median and the target spectra where the dispersion of the earthquake shaking is preserved along the period interval. The impact of the spectral variability on nonlinear response distribution is investigated at the level of inelastic single degree of freedom systems. In order to see the effect of different selection and scaling methodologies on fragility curve estimations, results are compared with those obtained by CMS-based scaling methodology. The variability in fragility curves due to the consideration of dispersion in ground motion selection process is also examined.

Keywords : ground motion selection, scaling, uncertainty, fragility curve
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