Estimation of fragilities by the modified intensity measures (IMs)

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Abstract

Fragility curves are commonly computed to estimate structural system performance. The most widespread procedure to estimate seismic fragility curves (FEMA P-58, 2012a) is based on scaling seismic accelerograms by a reference intensity measure (e.g. single/multiple ordinates of the pseudo-acceleration response spectrum or peak ground acceleration). Recently, it was shown that this methodology gives limited if any information on the structural seismic performance when the dependence between the intensity measure and the system demand parameter of interest (e.g. max inter-story displacement) is weak (Grigoriu M., 2016). Moreover, the dependence between these two variables (i.e. intensity measure and demand parameter) depends on the seismic direction, the intensity measure and the demand parameter considered (Ciano M. et al., 2018).
This paper presents a general solution to improve the accuracy in fragilities estimation when the dependence between the intensity measure and the demand parameter is weak and the widely used method in Performance-Based Earthquake Engineering (FEMA P-58, 2012a) does not give accurate results. This general solution is based on a modified version of the current intensity measure approach. In particular, once an intensity measure is chosen it is mapped in a suitable space where the demand parameter and the intensity measure are correlated. The modified version of the intensity measure is then used to scale acceleration time series and new fragility curves are estimated. The effectiveness of this approach is demonstrated for an actual multi-degree of freedom structural system.

References

Ciano, M., Gioffrè, M. and Grigoriu, M. On the accuracy of seismic fragilities for actual non-linear MDOF systems. *Proceedings of the CSM8 Eighth Conference on Computational Stochastic Mechanics*, Paros, 2018.

FEMA P-58. Performance Assessment of Buildings: Vol. 1–Methodology. *FEMA P-58*, 2012a.

Grigoriu, M. Do seismic intensity measures (IMs) measure up?. *Probabilistic Engineering Mechanics*, 46, 80-93, 2016.