Incorporating Uncertainty in Ground Motion into Damage Estimation Calculations

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It is well known that a ground motion prediction equation produces not just a point estimate but a variation around this point estimate. This variation in ground motion is given by a standard deviation and ground motions can be said to be lognormally distributed. When estimating the damage to a property from an earthquake, for a given fixed ground motion intensity of say 0.5g there would be a variation in damage modelled. Therefore, there are two properties varying – the intensity of the earthquake and the vulnerability of the structure. Typically, combining the two probability distributions would be computationally expensive and possibly unrealistic if a large number of locations were being modelled. This paper seeks to investigate theoretically how the two distributions can be combined to give a single probability distribution of damage and we also investigate methods which allow this computation to be speeded up through approximations. Finally the change in mean damage amount and standard deviation after accounting for uncertainty in the ground motion (as opposed to using a point estimate) is also investigated.