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Research Summary: AY2019

Limit State Estimation Based on Subset Simulation Method

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【Background】

Estimation of the limit state or reliability of a structure considering the uncertainties exit in structural system is an important issue for structural health monitoring and structural design. By a pioneer work conducted by Prof. Au and Beck, the Subset methods which is an advanced MCMC prove to be an efficient method to estimate rare events. The basic idea of Subset is splitting target small probability events into multiple high probability events, then the probability of small events can be obtained by multiplying several high conditional probabilities. Thus, it is a good choice to use Subset method to analyze the reliability of a specific complex system.

【Objective】

Due to the fact that many uncertainties exit in structural system, such as the strength of concrete and bars, it becomes difficult to obtain the information of the structure limit state because the calculation is time consuming, especially when it comes to nonlinear stage. Thus, we'd like to explore the uncertainties of a structure yield points which can be reflected by its corresponding equivalent stiffness of a single degree of freedom system and also to estimate the probability of exceedance of the yield points by Subset method.

【Approach】

FEM is carried out to model a specific reinforced concrete structure. The uncertainties of concrete can be modeled by different random parameters. By conducting pushover analysis, the yield states of the structure under different pairs of parameters can be obtained. The concrete process are as following: According to the basic idea of subset, firstly we generated 1000 samples of different parameters , so 1000 different yield points can be obtained, then by choosing the intermediate threshold of yield points adaptively, the conditional samples can be generated under different subset levels, and finally the target rare event of yield points can be reached.

【Results】

Subset simulation method is efficient to estimate rare events and to obtain the limit state of a complex nonlinear structure system.