Seismic Probabilistic Risk Assessment using MASTODON

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Abstract

Seismic risk assessment is routinely used to calculate the risk of accidents or unacceptable performance of safety-related nuclear structures including commercial nuclear power plants. Traditionally, seismic risk assessment has been performed using deterministic or pseudo-probabilistic approaches that do not provide adequate insight into the likely accident sequences in the fault trees, and may even result in conservative estimates of risk. Probabilistic approaches are possible, but are rarely used due to the lack of easy-to-use tools or the necessary expertise.

To enable a wider deployment of seismic probabilistic risk assessment (SPRA) the Facility Risk Group at Idaho National Laboratory is implementing the necessary tools for SPRA in the in-house finite-element and risk analysis code, MASTODON (Coleman *et al.*, 2017). These tools include automatic probabilistic and stochastic simulations, postprocessing of the results of these simulations to calculate seismic fragilities, and fault-tree and event-tree analysis to estimate system risk. MASTODON is an open-source code available to download on Github (github.com/idaholab/mastodon) and is built on the MOOSE framework (Gaston *et al.*, 2009), which enables highly-efficient parallelization of these simulations.

This talk demonstrates seismic probabilistic risk assessment of an idealized nuclear power plant with one safety system. The demonstration follows a time-based PRA approach (Huang *et al.*, 2008), starting with probabilistic seismic simulations in various intensity levels of the hazard curve, postprocessing the results of these simulations to calculate seismic fragilities, and fault tree analysis of the system to calculate the final seismic risk.

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