NEW METHODS AND TOOLS FOR SEISMIC PSA SYSTEM ANALYIS: SCRAM++

Project News | 5 November 2024

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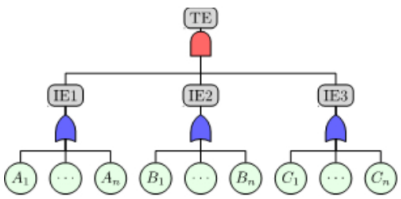
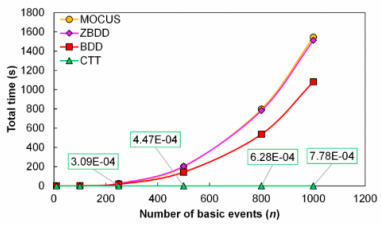
The nuclear industry increasingly employs Probabilistic Risk Assessment (PRA) to enhance safety during routine operations and mitigate external hazards. PRA addresses uncertainties and complex interconnections within nuclear power plants, serving as a crucial tool in risk-informed decision-making. External hazard PRA involves hazard assessment, fragility assessment, and system analysis, which utilises Event Tree Analysis (ETA) and Fault Tree Analysis (FTA) to calculate system failure probabilities from component-level failures. Nuclear plant fault trees are complex, containing numerous basic events (BEs) and intermediate events (IEs) linked by logic gates. Analysing large, interdependent fault trees demands significant computational and storage resources. Existing FTA algorithms, such as cut set-based (MOCUS), Boolean function-based (BDD and ZBDD), and Bayesian network-based methods, have limitations including approximation errors, inefficiency in large fault tree analysis, and high storage requirements.

In response to these challenges, researchers at NC State University have developed a novel FTA algorithm based on compressed truth tables (CTT) to provide exact system failure probability calculations, offering enhanced computational efficiency for specific fault tree scenarios. To leverage the CTT algorithm, a unified platform named SCRAM++ is created, integrating the CTT algorithm into the open-source software package, SCRAM. This development enables more efficient and accurate fault tree analysis, addressing the limitations of existing algorithms. The comparison of CTT with other algorithms in SCRAM demonstrates the advancements achieved with this new approach.





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