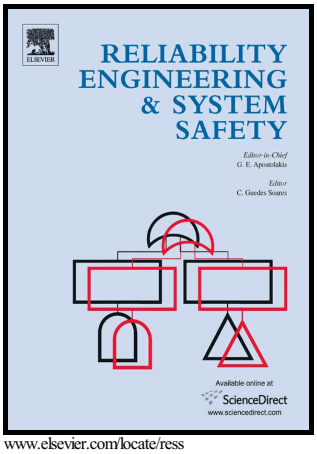


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# Epistemic and Aleatory Uncertainties in Integrated Deterministic and Probabilistic Safety Assessment: Tradeoff between Accuracy and Accident Simulations

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## ABSTRACT

The coupling of plant simulation models and stochastic models representing failure events in Dynamic Event Trees (DET) is a framework used to model the dynamic interactions among physical processes, equipment failures, and operator responses. The integration of physical and stochastic models may additionally enhance the treatment of uncertainties. Probabilistic Safety Assessments as currently implemented propagate the (epistemic) uncertainties in failure probabilities, rates, and frequencies; while the uncertainties in the physical model (parameters) are not propagated. The coupling of deterministic (physical) and probabilistic models in integrated simulations such as DET allows both types of uncertainties to be considered. However, integrated accident simulations with epistemic uncertainties will challenge even today's high performance computing infrastructure, especially for simulations of inherently complex nuclear or chemical plants. Conversely, intentionally limiting computations for practical reasons would compromise accuracy of results. This work investigates how to tradeoff accuracy and computations to quantify risk in light of both uncertainties and accident dynamics. A simple depleting tank problem that can be solved analytically is considered to examine the adequacy of a discrete DET approach. The results show that optimal allocation of computational resources between epistemic and aleatory calculations by means of convergence studies ensures accuracy within a limited budget.

**Keywords:** Epistemic and aleatory uncertainties, Dynamic PSA, Monte Carlo simulation, Dynamic Event Tree Analysis