Session 7-2: Data and Parameter Estimation II

Session Chair: Deepak Rao, Entergy

PRA Parameter Estimation for NPPs in Japan (I) Parameter Estimation Overview (12153)
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PRA parameter estimation, especially safety-related component failure rate has been studied in Japan since 2009. Based on these experiences, new estimation methodology was discussed and planned to be applied for future parameter estimation. This methodology includes selection of new hyper-prior distribution and prior information to be used in hierarchical Bayesian estimation. Also, improvement of convergence in Markov Chain Monte Carlo calculation is discussed. This report presents overview of those investigations.

PRA Parameter Estimation for NPPs in Japan (II) Parameter Estimation Methodology (12114)
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This paper summarizes the enhancement of failure rate estimation methodology conducted by Japan Nuclear Safety Institute (JANSI). JANSI had developed the hierarchy Bayesian approach to estimate the generic and plant specific component failure rates at once. However, this approach had suffered from instability in estimating mean value of generic failure rate due to outliers and required many samples for reliable inference. To enhance the quality of component failure rate estimations, new hyper-prior distributions, a normal distribution for log-scale parameter and a Half-Cauchy distribution for shape parameter, were introduced. The performance of new hyper-prior distributions is compared with well-known hyper-prior distributions in various aspects.

PRA Parameter Estimation for NPPs in Japan (III) Parameter Estimation Experience (12148)
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These series papers summarize the validation of component failure rate estimation methodology conducted by Japan Nuclear Safety Institute (JANSI). To enhance the quality of the component failure rate, in the series paper (II) as discussed we developed the method of estimation of component failure rate with new hyper prior distribution, normal distribution for a logarithmic scale parameter ($\mu$) and the half-Cauchy distribution for shape parameter ($\sigma$). In this paper, we confirmed the quality of the new estimation method of component failure rate. To estimate the Japanese component failure rate, we selected US component failure modes as the prior information and set the prior distribution on the basis of the new estimation method. In addition, we estimated the posterior distribution by implementing Markov chain Monte Carlo calculation with the prior distribution and operating performance. As a result, we could obtain the converged posterior distributions for all of Japanese component failure rates.