Importance Sampling for Reliability Evaluation with Stochastic Computer Models

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Abstract: Importance sampling has been used to improve the efficiency of simulations where the simulation output is uniquely determined, given a fixed input. We extend the theory of importance sampling to estimate a system's reliability with stochastic simulations. Thanks to the advance of computing power, stochastic computer models are employed in many applications to represent a complex system behavior. In a stochastic computer model, a simulator generates stochastic outputs at the same input. Given a budget constraint on the total simulation replications, we develop a new approach that efficiently uses stochastic simulations with unknown output distribution. Specifically, we derive the optimal importance sampling density and allocation procedure that minimize the variance of an estimator. Application to a computationally intensive aeroelastic wind turbine simulation demonstrates the benefits of the proposed approach.

Bio: *Eunshin Byon* is an Assistant Professor in the Department of Industrial and Operations Engineering at the University of Michigan, Ann Arbor, USA. She received her Ph.D. degree in Industrial and Systems Engineering from the Texas A&M University, College Station, USA, and joined the University of Michigan in 2011. Dr. Byon's research interests include reliability evaluation and optimal control for stochastic systems, predictive modeling and data analytics. Her recent research focuses on structural load modeling, operation and maintenance (O&M) optimization, and condition monitoring in wind power systems.