Simulation-Based Reliability Evaluation Under Large Uncertainties

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Abstract: Thanks to advanced computing and modeling technologies, computer simulations are becoming more widely used for the reliability evaluation of complex systems under large uncertainties. Yet, as computer models represent physical systems more accurately, increasing computational costs become new challenges in analyzing system reliability. Furthermore, due to large uncertainties represented by millions of random variables in simulations, existing variance reduction techniques often fail to provide computationally efficient methods for estimating the reliability of stochastic systems. These challenges call for new analysis and modeling approaches to provide efficient solutions. This talk presents (a) a variance reduction technique for stochastic computer models, called stochastic importance sampling, which saves computational time significantly without compromising the accuracy of reliability estimation, (b) an uncertainty quantification approach using an asymptotically valid confidence interval, and (c) a simulation automation method where a new information criterion is devised to adaptively guide simulation process using online stream of simulation data. Implementation results, using a computationally intensive wind turbine simulator developed by the U.S. National Renewable Energy Laboratory, demonstrate the benefits of the proposed approaches. This presentation will also discuss the ongoing and future research.

Bio: *Youngjun Choe* is a Ph.D. candidate of Industrial and Operations Engineering at the University of Michigan, Ann Arbor. He received bachelor's degrees (summa cum laude) in Physics and Management Science from the Korea Advanced Institute of Science and Technology (KAIST). His research interests include data analytics, stochastic simulations, and modeling and analysis of sustainable energy systems. Youngjun's current research focuses on reliability evaluation of complex systems under large uncertainties, which typically requires large-scale computing. One of his papers was selected by the journal's editor-in-chief for the Technometrics invited session in 2015 INFORMS Annual Meeting. His other recognitions include 2015 Best Refereed Paper Finalist (from Quality, Statistics and Reliability Section of INFORMS) and 2015 Mary G. and Joseph Natrella Scholarship (from Quality and Productivity Section of American Statistical Association). He is a member of ASQ, IEEE, IIE, and INFORMS.

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