

# **Issues and Challenges of Bayesian Inference in PHM: Prior, Data, or Lying**

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## **Abstract**

This talk is concerned with the issues and challenges of Bayesian statistical inference based decision making using disparate prior knowledge and extreme data. The effects of Bayesian inference due to rational and misspecified prior information as well as both extremely limited and abundant data are discussed. Taking system reliability analysis of complex engineering systems as examples, various Bayesian methods for system reliability analysis by effectively integrating various available sources of data and expert knowledge at both the subsystem and system levels are demonstrated. The talk also discusses the Bayesian melding method for integrating subsystem level priors with system level priors for both system and subsystem level reliability analysis. System reliability analysis results are compared between the Bayesian Melding method and the traditional approaches relying on system structure alone. Computational challenges for posterior inferences using the sophisticated Bayesian Melding method are addressed using Markov Chain Monte Carlo (MCMC) and adaptive Sampling Importance Resampling (SIR) methods. A variety of numerical examples with simulation results illustrate the applications of specific methods and provide insights for system reliability analysis using multilevel information.

## **Bio**

Professor Zhaojun “Steven” Li is with the Department of Industrial Engineering and Engineering Management at Western New England University in Springfield, MA, USA. Dr. Li’s research interests focus on Reliability, Quality, and Safety Engineering in Product Design, Systems Engineering and Its Applications in New Product Development, Diagnostics and Prognostics of Complex Engineered Systems, and Engineering Management. He earned his doctorate in Industrial Engineering from the University of Washington. Dr. Li has over 50 publications in journals and conference proceedings including IIE transactions, IEEE Transactions on Reliability, Reliability Engineering and System Safety, Quality Engineering, RAMS, ISERC, etc. He currently serves as Associate Editors for IEEE Transactions on Reliability and the International Journal of Performability Engineering. He has been actively serving on conference program committees and invited to give keynote speeches at international conferences. Prior to his career in academia, Dr Li has about 10 years’ industry experiences at both management and technical positions. His most recent industry position was a reliability team lead with Caterpillar Rail Division to support the company’s Tier 4 Locomotive New Four Stroke Engine and Gas-Diesel Dual Fuel Engine Development. He is an ASQ certified Reliability Engineer, and Caterpillar Six Sigma Black Belt.