

Probabilistic State Estimation: A Foundation for Distributed Energy Management?

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Abstract. Probabilistic load flow analysis was promoted by Borkowska already in the early 1970s. However, least squares techniques, which are not fully probabilistic, remain dominant when it comes to power system state estimation. But there is an increasing awareness of the role of probabilities and uncertainty in electrical power systems. This is due, in part, to the growing penetration of renewable energy production, which is much less predictable than most traditional energy production technologies. Fortunately, there has recently been much fundamental and algorithmic progress on probabilistic graphical models as a way to decompose high-dimensional probability distributions. While this work has largely taken place in fields such as artificial intelligence, information theory, machine learning, signal processing, and statistics, these models are starting to be applied in and adapted to power systems, including in state estimation. The working hypothesis explored in this talk is that the transition from centralized to distributed energy management introduces additional uncertainties, and can thus potentially benefit from the same or similar probabilistic techniques to those developed thus far. Based on this hypothesis, we discuss challenges and opportunities related to distributed energy management grounded in previous work on probabilistic graphical models, and in particular Bayesian networks. Our main focus is on probabilistic state estimation and its potential role in distributed energy management.

Bio. Dr. Ole J. Mengshoel is an Associate Research Professor in the Dept. of Electrical and Computer Engineering at CMU Silicon Valley. His current research focuses on reasoning, diagnosis, decision support, and machine learning under uncertainty - often using probabilistic graphical models including Bayesian networks. Additional research interests include electrical power systems, resource allocation and scheduling in real-time systems, intelligent user interfaces, information assurance, evolutionary algorithms, and knowledge engineering. Dr. Mengshoel has managed and provided hands-on leadership in a wide range of research and development projects. Working with organizations such as Boeing, NASA, Rockwell Automation, and Rockwell Collins, he has successfully developed new technologies and software that have or are being matured and transitioned into the aerospace, defense, finance, education, electronic commerce, and manufacturing sectors. Dr. Mengshoel has published over 50 articles and papers in journals and conferences, and holds 4 U.S. patents. He has a Ph.D. in Computer Science from the University of Illinois, Urbana-Champaign. His undergraduate degree is in Computer Science from the Norwegian Institute of Technology, Norway (now NTNU). Prior to joining CMU, he was a research scientist in the Knowledge-Based Systems Group at SINTEF (Scandinavia's largest independent research organization), in the Decision Sciences Group at Rockwell Scientific (now Teledyne Scientific and Imaging), and a senior scientist/research area lead at USRA/RIACS (a research organization that supports NASA).