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DATA-DRIVEN DECISION MAKING IN POWER SYSTEMS WITH PROBABILISTIC GUARANTEES: THEORY AND APPLICATIONS OF CHANCE-CONSTRAINED OPTIMIZATION

Xinbo Geng
Graduate Student at Texas A&M University at College Station, TX

Abstract

Uncertainties from deepening penetration of renewable energy resources have posed critical challenges to secure and reliable operation of the future grid. Among many stochastic and robust optimization methods proposed for decision making in uncertain environments, this paper focuses on chance-constrained optimization, which provides explicit probabilistic guarantees on the feasibility of optimal solutions. Although many methods to solve chance-constrained optimization have been proposed recently, there is a lack of comprehensive review and comparison of proposed methods. We first review three categories of existing methods to chance-constrained optimization: (1) scenario approach; (2) sample average approximation; and (3) robust optimization based methods. Data-driven methods, which do not assume any particular underlying distributions, are of particular interest. We then provide a comprehensive review on the applications of chance-constrained optimization in power systems. Finally, this paper provides a critical comparison of existing methods based on numerical simulations, which are conducted on standard power system test cases.

Biography

Xinbo Geng received the B.E. degree in electrical engineering from Tsinghua University, Beijing, China, in 2013. He received the Master of Science degree from Department of Electrical and Computer Engineering, Texas A&M University in 2015. He is currently working toward the Ph.D. degree at Texas A&M University. He interned at National Renewable Energy Lab (NREL) in 2016 and at ISO New England in 2017. He was a visiting student at University of California Berkeley and Massachusetts Institute of Technology in 2018. His research interests include stochastic optimization, data analytics in power systems and optimal power flow.