Electric Power and Power Electronics Institute

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DISTRIBUTIONALLY ROBUST OPTIMIZATION FRAMEWORK FOR MODELING POWER SYSTEMS UNDER UNCERTAINTY

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Abstract

This seminar introduces a distributionally robust optimization (DRO) framework, which is capable of solving various power system problems considering uncertain renewable energy sources. The DRO model optimizes the expected total cost under the worst-case distribution over an ambiguity set. This ambiguity set is utilized to characterize the inexact probability distribution information of system uncertainties. The DRO approach should be more practical than the conventional scenario-based stochastic programming methods, because it does not require identifying the exact distribution of random variables. Meanwhile, results less conservative than the conventional robust optimization approaches can be achieved by exploiting some easily-assessed distributional characteristics. It has been shown in previous literature that the DRO formulation for two-stage or multi-stage problems is intractable to solve. Therefore, a linear decision rule approximation is proposed for better tractability. This decision rule function assumes that recourse decisions affinely depend on uncertain parameters and on auxiliary random variables introduced to capture the stochastic nature of system uncertainties. A few illustrative examples on unit commitment under uncertain wind power generation are provided to show that this decision rule technique provides a tight approximation to the original recourse problem, and system performance may be improved by integrating distribution information into the robust model.

Biography
Peng Xiong received the B. Eng. degree from Zhejiang University, Hangzhou, China, in June 2008. He then received the Ph. D. degree in electrical engineering at the National University of Singapore in 2013. Now he is a postdoctoral researcher in Texas A&M University, College Station, Texas, USA. His research interests are in the area of power system reliability and optimization.