Distributionally Robust Optimization on Power System Operations and Resilience

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Abstract: The power grid disruptions caused by extreme weather, although rare, can bring catastrophic impacts to the power industry and the society in general. The evaluation and mitigation of disruption-related risks and impacts are often computationally prohibitive due to the complexity of the power system, uncertainty of weather conditions, and the combinatorial nature of component failures. In addition, the intermittent nature of renewable energy brings another challenge for the independent system operators to maintain a reliable power system. In this talk, we propose distributionally robust optimization models to assist power system operations and enhance the power system resilience in face of uncertain renewable energy output and extreme weather conditions. The proposed approach integrates statistical and optimization methods to derive innovative decision-making under uncertainty models for unit commitment problems. In our approach, we consider the cases where the true probability distribution of random parameters is ambiguous, i.e., difficult to accurately estimate. Instead of assigning a (fixed) probability estimate for the random parameter such as renewable energy output or system component failure, we consider a set of probability distributions (termed the ambiguity set) by taking advantage of data information. Our approach considers all possible distributions in the ambiguity set, and is hence distributionally robust. Meanwhile, it can benefit from available data and become less conservative than the robust optimization approaches.

Bio: Dr. Chaoyue Zhao is currently an Assistant Professor in Department of Industrial Engineering and Management in Oklahoma State University. She received her Ph.D. in Industrial and Systems Engineering from the University of Florida in 2014 and her B.S. degree in Department of Mathematics from the Fudan University, China, in 2010. She has collaborated with Sandia and Argonne National Labs for her research and worked at Pacific Gas & Electric Company for one year. Her research interests include distributionally robust optimization, stochastic optimization, and robust optimization, with their applications on power system planning, scheduling, resilience and risk assessment. Her research is funded by multiple Federal agencies such as NSF, UTC, and Argonne National Laboratory.