Applications of Convex Restriction Techniques to Electric Power System Optimization Problems

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Abstract:

Power system optimization problems are constrained by the so-called "power flow" equations which relate the voltages and power injections. Due to the nonlinearity of these equations, power system optimization problems are nonconvex, resulting in a variety of algorithmic and theoretical challenges. Over the last decade, the research community has developed many new techniques for convexifying the nonconvexities associated with the power flow equations. These techniques can be categorized as approximations, relaxations (convex outer approximations of the feasible space), and restrictions (convex inner approximations of the feasible space). After briefly overviewing each of these categories of techniques, this presentation details recent progress in the development of convex restrictions of power system optimization problems. This presentation then describes two algorithms that use convex restrictions to 1) compute paths between operating points such that all points on the paths are feasible with respect to both the power flow equations and the operational constraints, and 2) solve robust optimization problems that ensure constraint satisfaction despite uncertain perturbations from renewable generators.

This is joint work with Dongchan Lee, Line Roald, and Kostya Turitsyn.

Bio:

Daniel Molzahn is an assistant professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. Daniel also holds an appointment as a computational engineer in the Energy Systems Division at Argonne National Laboratory. Daniel was a Dow postdoctoral fellow at the University of Michigan. He completed the B.S., M.S., and Ph.D. degrees in Electrical Engineering and the Masters of Public Affairs degree from the University of Wisconsin–Madison, where he was a National Science Foundation Graduate Research Fellow. His research interests are in the application of optimization techniques to electric power systems.