Tightening Quadratic Convex Relaxations for the AC Optimal Transmission Switching Problem

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Talk will take place from 1:00PM - 2:00PM through Zoom.

Abstract: The Alternating Current Optimal Transmission Switching (ACOTS) problem incorporates line switching decisions into the fundamental AC optimal power flow (ACOPF) problem. The advantages of the ACOTS problem are well-known in terms of reducing the operational cost and improving system reliability. ACOTS optimization models contain discrete variables and nonlinear structures, which make it difficult to solve. We derive strengthened quadratic convex (QC) relaxations for ACOTS by combining several methodologies recently developed in the ACOPF literature. First, we relax the ACOTS model with the QC relaxation, which has been empirically observed to be both tight and computationally efficient in approximating the ACOPF problem. Further, we tighten the QC relaxation by using strong linearization with extreme-point representation, and by adding several types of valid inequalities, with some of those inequalities being novel. In particular, we derive a novel kind of on/off cycle-based polynomial constraints, by taking advantage of the network structure. Those constraints are linearized with convex-hull representations. Our extensive numerical experiments on PGLib instances show that, compared with the standard method, our strengthening techniques are able to improve the bounds for ACOTS relaxations on a subset of the PGLib instances, with some of those improvements substantial.