Data-Driven Security-Constrained OPF

In this paper we unify electricity market operations with power system security considerations. Using data-driven techniques, we address both small signal stability and steady-state security, derive tractable decision rules in the form of line flow limits, and incorporate the resulting constraints in market clearing algorithms. Our goal is to minimize redispatching actions, and instead allow the market to determine the most cost-efficient dispatch while considering all security constraints. To maintain tractability of our approach we perform our security assessment offline, examining large datasets, both from measurements and simulations, in order to determine stable and unstable operating regions. With the help of decision trees, we transform this information to linear decision rules for line flow constraints. We propose conditional line transfer limits, which can accurately capture security considerations, while being less conservative than current approaches. Our approach can be scalable for large systems, accounts explicitly for power system security, and enables the electricity market to identify a cost-efficient dispatch avoiding redispatching actions. We demonstrate the performance of our method in a case study.