[AGM] Hybrid Learning Assisted Optimization Methods for Uncertainty Management and Corrective Control

Los Alamos Team: **Sidhant Misra** and Marc Vuffray
Timeline: FY2020 – FY2022

Challenge:

Preventive and corrective controls are necessary for uncertainty management and to ensure safe and economic operations under uncertainty. An adjustable robust optimization (ARO) formulation built around the optimal power flow that incorporates preventive and corrective controls can produce the most efficient control actions and dispatch set points. However, due to significant computational burden, currently a limited number of preventive measures such as N-1 security, and corrective measures such as AGC and AVR are incorporated into optimal power flow formulations, and as such these formulations are already quite challenging.

Technical Approach:

This project has developed learning assisted optimization techniques for efficient and reliable uncertainty management and decision making at faster time scales. By leveraging recent advances in machine learning, the data available from load and uncertainty forecasts, from routinely solved optimal power flow and, synthetic data generated from offline computations has been used to inform and significantly boost current and new optimization tools used in operations. This provides a flexible and comprehensive optimal power flow (OPF) based ARO framework that incorporates preventive and corrective actions and accommodates current and potential future practices. The methods leverage recent advances in active-set learning for constrained optimization to identify critical constraints and thus reduce complexity. These learning tools are used for generating advanced non-linear corrective control policies for more efficient utilization of available corrective control resources by utilities.

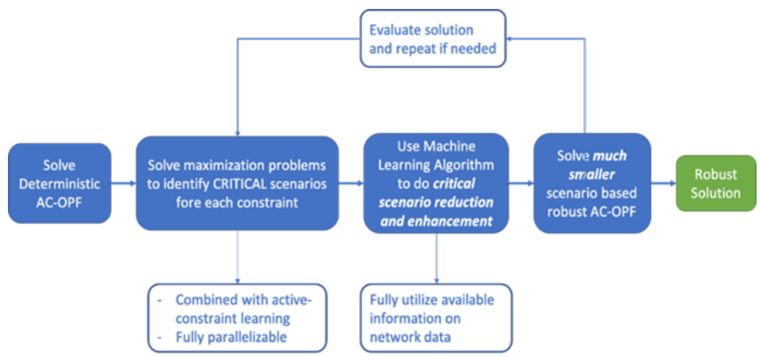

Figure 5-3: Data-driven scenario selection and enhancement algorithm process flow.

Impact:

Given that most power system tools for determining generator dispatch incorporate limited requirements on reliability and resilience, this approach supports a wider suite of security constraints to be incorporated in formulations like optimal power flow and account for system response during extreme conditions such as preventive actions and corrective control actions. This limits reliance on ad-hoc policies and reduces the need to resort to expensive emergency controls and improve economic efficiency.