The standard optimal power flow (OPF) problem is an economic dispatch (ED) problem combined with transmission constraints, which are based on a static topology. However, topology control (TC) has been proposed in the past as a corrective mechanism to relieve overloads and voltage violations. Even though the benefits of TC are presented by several research works in the past, the computational complexity associated with TC has been a major deterrent to its implementation. The proposed work develops heuristics for TC and investigates its potential to improve the computational time for TC for various applications. The objective is to develop computationally light methods to harness the flexibility of the grid to derive maximum benefits to the system in terms of reliability.

One of the goals of this research is to develop a tool that will be capable of providing TC actions in a minimal time-frame, which can be readily adopted by the industry for real-time corrective applications.

A DC based heuristic, i.e., a greedy algorithm, is developed and applied to improve the computational time for the TC problem while still maintaining the ability to find quality
solutions. In the greedy algorithm, an expression is derived, which indicates the impact on the objective for a marginal change in the state of a transmission line. This expression is used to generate a priority list with potential candidate lines for switching, which may provide huge improvements to the system. The advantage of this method is that it is a fast heuristic as compared to using mixed integer programming (MIP) approach.

Alternatively, AC based heuristics are developed for TC problem and tested on actual data from PJM, ERCOT and TVA. AC based N-1 contingency analysis is performed to identify the contingencies that cause network violations. Simple proximity based heuristics are developed and the fast decoupled power flow is solved iteratively to identify the top five TC actions, which provide reduction in violations. Time domain simulations are performed to ensure that the TC actions do not cause system instability. Simulation results show significant reductions in violations in the system by the application of the TC heuristics.