# Abstract

Microgrids, characterized by their decentralized and self-sustaining nature, are crucial in addressing energy management challenges in modern power systems. However, the growing inclusion of electric vehicles (EV) and other non-EV loads in microgrids introduces new complexities and demands efficient energy scheduling strategies. Demand response (DR) programs have emerged as effective tools for optimizing energy consumption and reducing peak demand. Simultaneously, reconfiguration methods offer opportunities for enhancing the performance and efficiency of distribution networks within microgrids.

This dissertation proposes an optimization model that addresses these challenges by incorporating a novel incentive-based DR program in reconfigurable microgrids. The DR program aims to maximize incentives offered to DR participants while maintaining fairness and ensuring uniform rewards and distress. By integrating the DR program into the energy management problem, the study aims to optimize generation costs, reduce energy demand, and enhance the overall efficiency of microgrid operation.

Furthermore, this work presents a novel two-stage heuristic approach for reconfiguring radial networks within the microgrid. The approach utilizes a sequential switch-opening strategy followed by a branch exchange method to achieve an optimal configuration with minimal computational time. A mathematical model based on bus-injection to branch-current matrix is developed to select switch pairs for the exchange operation that minimize power loss in the network. The effectiveness of this approach is tested on various models of distribution networks, ranging from 33-bus to 417-bus systems. The results demonstrate significant improvements in the runtime and the ability to achieve the best configuration of radial distribution networks.

Static models of grid-connected and off-grid microgrids, consisting of renewable energy sources, conventional generators, EV charging stations, and curtailable loads at different bus locations, are analyzed to evaluate the proposed optimization model. The results demonstrate improved efficiency, reduced energy dependency on external sources, and enhanced optimization of energy scheduling in microgrids. The findings contribute to advancing responsible and sustainable energy

consumption and production patterns in line with the United Nations' sustainable development goals.

**Keywords**: Demand response program, Distribution network reconfiguration, Energy management, Electric vehicles, Hong's (2m+1) point estimate method, Jaya optimization method, Microgrids.