Abstract:

The aim of this thesis is to understand the main difficulties and challenges for effective operation and protection of the microgrid networks and increase the microgrid resilience. In this work the optimal size of the DGs has been identified for the microgrid systems under economic and reliable operation, different methods such as islanding and fault detection are developed to ensure the safety of the microgrid and the voltage quality issues are handled by controlling the DG operation. Firstly, optimal photovoltaic, wind, biomass, and battery-based grid integrated microgrid system is developed using multi-objective artificial cooperative search algorithm (MOACS) to minimize annual life cycle costing (ALCC) and loss of power supply probability (LPSP). The battery based energy storage system (ESS) is chosen to provide backup power supply for at least 30 minutes during peak load condition and the probability density functions (PDFs) are utilized to characterize the variable nature of the RE sources. Later on a fault detection technique has been developed based on the phase change in the positive sequence current for the grid tied IIDG dominated microgrid system under different fault and operating conditions. Different types of DGs are considered and also various load power factors are assumed to make the system more practical. Further, islanding detection in the microgrid has been addressed by developing the novel approach by using the Lissajous patterns of the local voltage and current signals. The islanding detection method is validated under all IEEE standards with different operating conditions including real time hardware in loop testing. Later on optimization based multi objective control strategy is developed for the IIDGs in the microgrid to compensate the voltage unbalance at the load buses by supplying the negative sequence quantities by the IIDGs. Further, the control strategy is improved and a flexible multi objective control strategy has been developed to address the multiple objectives simultaneously.