Chapter 6

Conclusion

This thesis investigated the impact of optimal DGs placement and network reconfiguration in loss minimization and voltage profile together with voltage stability enhancement. Considering effective utilization of metaheuristic approaches in solving practical optimization problems of different fields, some of the metaheuristic approaches were used in this work for optimal placement of DGs and network reconfiguration. However, these metaheuristic approaches have their own limitations. Therefore, hybrid of two metaheuristic approaches were used to get best possible solution with these approaches (as demonstrated in this thesis through comparison of results of metaheuristic approaches considered individually with hybridization of two metaheuristic approaches for the test systems considered). The main contributions of the thesis and future research directions related to this work are presented below.

6.1 Summary of the Important Findings

- In Chapter-2, the hybrid metaheuristic approach Particle Swarm Optimization-Grey Wolf Optimization (PSO-GWO) is proposed for determining optimal location and size of multiple Type-1 DGs for loss minimization, voltage profile improvement and voltage stability enhancement. A multi-objective function comprising of weighted sum of power loss, voltage deviation of buses from desired value and voltage stability index was proposed. The optimal weighting factors were obtained using Genetic Algorithm (GA), whereas, the proposed multi-objective function was optimized using PSO-GWO algorithm with DG size and location taken as decision variables. Simulations were carried out in MATLAB environment on IEEE 33-bus radial distribution system. Simulation results show that proposed approach of multiple DG placement is more effective in loss minimization and voltage profile together with voltage stability enhancement compared to few other existing metaheuristic approaches.

- In Chapter-3, hybrid Particle Swarm Optimization-Gravitational Search Algorithm (PSO-GSA) has been proposed to determine optimal location and size of different types of DGs. Integration of different combination of Type-1, Type-2 and Type-3 DGs as well as their independent integration to grid has been suggested to minimize power loss and improve voltage profile. Case studies performed on two test systems show that proposed approach of DG placement is very effective in loss reduction and voltage profile improvement. Simulation results show that integration of combination of Type-1 and Type-2 DGs is most effective in loss reduction for both the systems, which is also most effective in control of voltage variations among buses for 69-bus radial distribution system. However, for 33-bus radial distribution system, combination of Type-2 and Type-3 is most effective in control of voltage variations. Power loss and voltage variations depend upon different factors such as R/X ratio of lines, connected loads with their locations. Thus, same combination of DGs may not be most suitable for two different systems as observed in case of voltage variations in two systems.

- Chapter-4 proposes a novel approach based on hybridization of PSO and Coral Reef Optimization (CRO) for optimal placement of distributed generators in distribution networks. Placement of Type-1, Type-2 and Type-3 DG were considered with their optimal location and size obtained by hybrid PSO-CRO algorithm. The idea behind this hybridization was to combine the high exploration capability of PSO and excellent exploitation proficiency of CRO. The effectiveness of proposed approach of DG placement was tested on 33-bus, 69-bus, and 118-bus radial distribution systems. Case studies performed on three test systems resulted in lowest power loss with proposed approach of DG placement compared to few other existing approaches. The DG size obtained by proposed approach was close to its mean value for 50 runs of algorithm. The proposed approach was shown to be computationally efficient, too, as computation time involved in running proposed algorithm of DG placement were much less compared to few other existing approaches. Proposed approach of DG placement resulted in significant enhancement in voltage profile of the network. Type-3 DG was found to be most effective in voltage profile improvement compared to DG of other two types for three test systems considered.

- The impact of various types of voltage dependent loads on real and reactive power loss, voltage profile and voltage stability of radial distribution network were studied through network reconfiguration using hybrid PSO-CRO approach in Chapter-5. The proposed approach was utilized to minimize power loss and bus voltage deviations from the reference value and maximize voltage stability margin under different types of voltage dependent loads. Case studies performed on 33-bus radial distribution system demonstrate the effectiveness of the proposed approach of network reconfiguration. Proposed approach of network reconfiguration through PSO-CRO algorithm is able to cause significant reduction in real and reactive power loss and considerable improvement in voltage profile as well as voltage stability margin of the system under all types of voltage dependent loads.

6.2 Future Scope

- This thesis has considered a single objective function of power loss minimization using PSO-CRO algorithm. The proposed hybrid PSO-CRO approach may be extended for optimal integration of Type-1, Type-2, and Type-3 DG considering multi-objective function such as combination of power loss, voltage deviations, and voltage stability margin. Reactive power loss minimization may also be considered in multi-objective function.

- The impact of various combination cases of Type-1, Type-2 and Type-3 DGs through optimal integration using PSO-CRO approach may be studied in future.

- Present work has considered placement of Type-1, Type-2, and Type-3 DGs along with their combinations using PSO-GSA algorithm. Optimal integration of Type-4 DG using proposed approach may be the scope left for future studies.

- This thesis work has considered network reconfiguration under voltage dependent loads using PSO-CRO algorithm, whereas, DG placement using this algorithm has concentrated on constant power loads, only. The work may be further extended in application of PSO-CRO algorithm in DG placement under different types of voltage dependent loads. Simultaneous reconfiguration and DGs placement under voltage dependent loads using PSO-CRO algorithm may also be explored in future research.

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