CHAPTER 7

CONCLUSION

7.1 CONCLUSION

In this work an EBFA based approach is proposed to determine the suitable type of FACTS devices, its optimal size and location. The conventional OPF problem is reframed to incorporate FACTS devices. The generation cost of power plants and the investment cost of FACTS devices are also included in the objective function to evaluate the system performance. The newly framed objective function was solved using three evolutionary algorithms namely Genetic Algorithm (GA), Bacterial Foraging Algorithm (BFA) and proposed Enhanced Bacterial Foraging Algorithm (EBFA). The algorithms are tested for IEEE 30 bus system under different loading conditions. The efficacy of the algorithm was evaluated based on computation time, convergence characteristics and accuracy of the solution. From the comparative results, it is found that the proposed algorithm is robust and suitable for sizing and location of FACTS devices. The proposed algorithm can be extended for higher bus system.

An attempt has been made to solve OPF problem including FACTS devices with hybrid Gravitational Search Algorithm. Even though excellent advancements have been made in classical methods, they suffer with the following disadvantages:

- In most cases, mathematical formulations have to be simplified to get the solutions because of the extremely limited capability to solve real-world large-scale power system problems.
• They are weak in handling qualitative constraints.
• They have poor convergence, may get stuck at local optimum,
• They can find only a single optimized solution in a single simulation run,
• They become too slow if number of variables are large and
• They are computationally expensive for solution of a large system.

Whereas, the major advantage of the GSA is that it is relatively versatile for handling various qualitative constraints. It can find multiple optimal solutions in single simulation run. So they are quite suitable in solving multi objective optimization problems. In most cases, GSA can find the global optimum solution. The advantages of GSA methods are: It only uses the values of the objective function and less likely to get trapped at a local optimum. Lower computational time is an advantage. The more advantages of GA are adaptability to change, ability to generate good enough solutions and rapid convergence. GSA is used to solve multi objective generation scheduling, optimal reactive power dispatch and to minimize total cost of power generation. Application of Gravitational search algorithm approach to solve OPF problem with and without FACTS devices under variable loading conditions has been explored and tested. The results presented in work are obtained for IEEE 30 bus test system.

When FACTS device is introduced in a system the losses decrease thus increasing the generated active power (MW) in the system. Since, cost is directly dependent on the active power of a system. Thus, when power increases, cost also increases. It is thus shown that FACTS device do not provide significant cost saving since cost depends mainly on the active power. However, it can increase the controllability and flexibility of the system; it
can provide wider operating margin and improved voltage stability with higher reserve capacity.

A hybrid GSA method was presented to solve the OPF problem of power system with FACTS devices. The proposed method introduces the injected power model of FACTS devices into a conventional AC optimal power flow problem to exploit the new characteristic of FACTS devices. Case studies on modified IEEE test system show the potential for application of GSA to determine the control parameter of the power flow controls with FACTS. It can be shown that the FACTS device cannot reduce the generation cost (i.e. it is not a cost saving device) compared with normal system OPF. However, it can increase the controllability and feasibility of the system and provide wider operating margin and higher voltage stability with higher reserve capacity. In this method, GSA effectively finds the optimal setting of the control parameters using the conventional OPF method. It also shows that the GSA was suitable to deal with non-smooth, non-continuous, non-differentiable and non-convex problem, such as the optimal power flow problem with FACTS devices.

Finally, in this work, Modified Bacterial Foraging Optimization Algorithm is proposed to find the optimal location and sizing of DG for IEEE14 and IEEE30 bus system. Minimization of total cost, in addition to optimal location and sizing of DG, is framed as objective function and solved
respectively. Finally, the results obtained in this work, demonstrated that DG is a viable economic alternative, relative to upgrading substations and feeder facilities, if the incremental cost of serving additional load is considered.

7.2 SCOPE FOR FUTURE STUDIES

Following are some extensions that may be taken into consideration in future:

- Developing the proposed techniques to handle the continuous variables as well as the discrete variables of the problem.

- More objectives can be considered in solving OPF with FACTS and DG devices such as maximizing power transfer and enhancing system reliability.

- Inclusion of more FACTS devices such as Thyristor Controlled Phase shifters (TCPS) and Unified Power Flow Controller (UPFC).

- Different types of Distributed generators such as Solar Cells, wind energy generators, micro-turbines and fuel cells can be included in solving OPF problem with DG devices.

- Investigate the injection model of FACTS as opposed to the Y-