Chapter 8

Conclusions

8.1 General

The congestion management in electrical power system has been identified as an integral part of modern energy management systems, but its real time implementation is still a exigent task to power system engineers. The geographical area and the transmission line capability has been fixed for a particular transmission line. The new line set-up is not possible as it involved large investment. Therefore, the Available Transfer capability (ATC) calculation has been recognized as an vital part of modern power system. Because of higher load demand or Outage of a transmission unit (line or transformer) or a generator may lead to over loading of other healthy lines and cause sudden change in power flow of transmission line results in unstable system. The optimized ATC calculation has a key role for secure power system operation. Different artificial intelligence techniques has been used for computation of ATC for reliable power system in this work. The optimized ATC of any the system has been calculated for a specific loading condition with objective function. The objective function has been framed for the maximization of ATC.

The load has been served by varying generation at source bus with the outcome of optimized ATC. In this work, the generation at generator buses has been taken as decision variables for the optimization techniques.

In this proposed work, the optimized value of ATC has been determined for the specific loading condition along with the generation at different generator bus. The generation at generator bus has been changed to get optimized Available Transfer Capability (ATC) for a specific load. IEEE 30-bus test system and UPSEB 75 bus system has been used for testing the algorithm in this proposed work.

The main contribution of the thesis includes the development of,

- Fast calculation of ATC with the help of ANN explain in Chapter-3.
- Roulette Wheel Selection Genetic Algorithm (RWSGA) for the computation of ATC has been presented in chapter-4. Tournament Selection Based Genetic algorithm (TSBGA) has been used to improve ATC results obtained from RWSGA. The statistical model from the data with TSBGA for i.e the generation value with specific load and corresponding ATC has been also reported in chapter-4 to predict optimized ATC for IEEE 30 bus system.
- Particle Swarm Optimization techniques to improve ATC results has been discussed in chapter-5. The speed of PSO is greater than the all possible version of Genetic algorithms demonstrated.
- Teaching Learning based optimization (TLBO) novel approach for estimation of ATC covered in chapter-6.
- Comparison between different optimization methods has been carried out in chapter-7.

The objective of this chapter is to highlight the main findings of the work carried out in this thesis and provide suggestions for further research work in this area. Some of the main findings are given below.

8.2 Summary of Important Findings

Chapter-3 describes the ATC prediction with the help of Artificial Neural Network (ANN) using generalized back propagation. The Mean Absolute Percentage error,maximum percentage error and min percentage error are 0.545 %, 0.944 % and 0.100 % respectively between calculated and predicted value of ATC for IEEE 30 bus system. The model developed is sufficient accurate and used for on line prediction of ATC.

The chapter-4 reports about the different optimization techniques used for the computation of ATC. Results of IEEE 30 system and 75 bus UPSEB reveal the following:

1. Two different GA methods namely; Roulette Wheel Selection Genetic Algorithm (RWSGA) and Tournament Selection Based Genetic algorithm (TSBGA) for the computation of ATC has been presented in chapter-4. Tournament Selection Based Genetic algorithm (TSBGA) has been used to improve ATC results obtained from RWSGA.

2. The statistical model from the data with TSBGA for i.e the generation value with specific load and corresponding ATC has been also reported in chapter-4 to predict optimized ATC for IEEE 30 bus system. The Mean Absolute Percentage error,maximum percentage error and min percentage error are $0.41\%, 0.70\%$ and 0.12% respectively for IEEE 30 bus system using statistical model analysis. From this mathematical model, the most sensitive generation has been predicted for a specific loading condition.

The studies conducted in Chapter-5 reveals about Particle Swarm Optimization (PSO) for finding optimized value of ATC. The better result has been obtained from PSO as compare to all possible version of genetic algorithm demonstrated on IEEE 30 bus test system and UPSEB 75 bus system. The main contribution of this chapter as under: A novel approach, Teaching Learning Based Optimization (TLBO), has been discussed in chapter-6 to determine the optimized ATC. The average deviation for the best value has been observed less in TLBO for IEEE 30 bus test system and UPSEB 75 bus system. Hence, TLBO gives the best value of objective function ATC.

8.3 Scope for Further Research

Consequent to investigations carried out in this thesis, the following aspects are being suggested as future research work to be carried out.

(i) The results obtained in Chapters 4,5 and 6 were restricted to the IEEE 30 bus system and UPSEB 75 bus system with three simultaneous transactions only. The concept can be confirmed on larger practical sized systems for more than three simultaneous transactions.

(ii) The other optimization techniques can be used to calculate optimized ATC value.

(iii) After calculating ATC value, the enhancement of ATC value can be carried out with the optimization of the FACT devices.

(iv) The important findings of the chapter-3 is online Available Transfer Capability (ATC) determined by Artificial Neural Network is quite accurate, the network is trained with past information. This concept can be extended to large system and can be implemented in Energy Management System to be used by Independent System Operator.