ABSTRACT

Economic operation and planning of electric energy generating systems have always been given proper attention in the electric power system industry. A saving in the cost of electrical power generation represents a significant reduction in the operating cost (including the fuel cost) and hence, this area has warranted a great deal of attention from operating and planning engineers. The original problem of economic electric load dispatch of thermal power generating systems used to be solved by numerous methods. However, with the development of mathematical tools and advance computational methods, the economic load scheduling of generators has become more accurate and can be applied even in complex networks.

Since the basic purpose of economic operation of power system is to reduce overall running cost of power system. The overall running cost of power system can be minimized by reducing the power generation cost of each unit. This economic operation is achieved when the generators in the system share loads to minimize overall generation cost. The main economic factor in the power system operation is the cost of generating real power. In any power system, this cost has got two components, viz. the fixed cost and the variable cost.

The present work is related to the economic operation of a power system which is mainly concerned to minimize the variable cost of the system. The fixed cost has little effect on the operating cost of system.

The emergence of powerful numerical optimization methods for power system engineering and operation, have resulted in a best electrical and financial performances of the systems. Also they help in reliable operation and proper system planning. Optimization concepts and algorithms were first introduced to power system dispatching, resource allocation and planning in the mid sixties in order to mathematically formalize decision-making with regard to various objectives subject to technical and non-technical constraints.
In power system operation and planning, there are many optimization problems. In this regard, problem is classified either as operational or planning, depending upon their time frame. In the operations scheduling problem, studies are extended up to twenty-four hours. On the other hand, planning problems are solved in the time frame of a year(s). The hourly commitment of units, the decision whether a unit is on or off at a given hour, is referred as unit commitment.

In the recent years, the advancement of computer engineering and the increased complexity of the power system optimization problems have led to greater need of specialized programming techniques for large scale complex problems. These techniques include dynamic programming, Lagrange multiplier methods and evolutionary computation methods such as genetic algorithm etc. These techniques are often hybridized with many other nature inspired and intelligent techniques such as Evolutionary Techniques, Swarm Intelligence Techniques, Ant Colony Optimization, Bee Algorithm, Tabu Search Algorithm, Expert Systems (ES), Artificial Neural Network (ANN), Fuzzy System, etc. These techniques imitate some natural phenomena to find an optimum solution of a problem.

The work in this thesis is organized mainly in four sections as listed below:

1. First section deals with thorough literature review and problem formulation.
2. Second section includes the development of optimization tools using evolutionary and swarm intelligence techniques. These techniques have been used in a reasonable and reliable way so as to find an optimum solution for power system problems. These tools are also integrated with fuzzy system in order to improve their performance to get better results. The results obtained using these integrated techniques have been compared with the genetic algorithm and particle swarm optimization techniques.
3. Next section describes the validation part of the above developed tools. The proposed tools are validated with many benchmark problems with
various degrees of complexity with different dimensions such as Rosenbrock function, Rastrigrin function, Schwefel's function, Griewank function, Ackely function and Schaffer's f6 function.

4. In the last section of the thesis, these validated tools are used to solve economic load dispatch problem with different equality and inequality constraints like generation limits, prohibited operating zones, ramp rate, valve point loading effects etc. The power systems of different complexities consisting of different number of generating buses and load demand are considered in economic load dispatch problems such as 3, 5, 6, 13, 15, 38 and 40 bus systems. Further, these proposed tools are implemented on the extended version of economic load dispatch problems known as Optimal Power Flow (OPF) problems. In OPF problem, four IEEE test systems namely IEEE 30 bus system, modified IEEE 30 bus system, IEEE 57 bus system and IEEE 118 bus system have been taken. The results obtained from Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) techniques have been compared with integrated GA-Fuzzy system and PSO-Fuzzy system. The hybridization of fuzzy systems with GA and PSO improves the results.