ABSTRACT

In most interconnected power systems, the power requirement is principally met by thermal power generation. Several operating strategies are possible to meet the required power demand, which varies from hour to hour of the day. An important criterion in power system operation is to meet the power demand at minimum fuel cost using an optimal mix of different power plants. Moreover, in order to supply high-quality of electric power to the customer in a secure and economic manner, thermal Unit Commitment (UC) is considered to be one of the best available options. It is thus recognized that the optimal UC of thermal systems, which is the problem of determining the schedule of generating units within a power system subject to a variety of operating constraints, results in a great saving of electrical utilities. So, the general objective of the UC problem is to minimize the system’s total operating cost while satisfying all the constraints. The Unit Commitment Problem (UCP) is commonly formulated as a nonlinear, large scale, mixed-integer combinational problem. The exact solution to the Unit Commitment Problem can be obtained by a complete enumeration of all feasible combinations of generating units which could be a huge number. Then, the economic dispatch problem is solved for each feasible combination to optimally allocate the load demand among the running units, while satisfying the power balance equation and unit operating limits. Basically, the high dimension of the possible solution space is the real difficulty in solving the unit commitment problem.
In this research, two hybrid models between Lagrange Relaxation (LR) with Evolutionary Programming (EP) and Lagrange Relaxation (LR) with Particle Swarm Optimization (PSO) are used, to solve the profit based unit commitment problem in a deregulated electricity market. In recent days, the operation and control of the generating unit is modified because of the revolution in the power system structure. The energy price becomes an important parameter, to make a decision in this restructured system. Unit commitment (UC) in such a competitive environment is not the same as the traditional one. The objective of UC is not only to minimize the production cost as before, but also to find the solution that produces the maximum profit for the generation company (GENCO). The three unit system has been considered for the profit based unit commitment problem and this hybrid method shows the effectiveness of the proposed approaches.

The main objective of this research work is to solve the Multi- Area Unit Commitment problem (MAUC) using Evolutionary Iterative Particle Swarm Optimization (EIPSO) technique. This technique is developed with emphasis on their suitability for online applications. Efforts are taken to make the proposed algorithms simple, reliable and efficient with excellent convergence characteristics.

The Particle Swarm Optimization is an optimization algorithm that was introduced in 1995 by Kennedy. Imagine that we have a population of particles looking around in a given search space for the global optimum. This particle movement mimics in a way is coordinated with movement of flocks of birds, schools of fish or swarms of insects. This is a good image of a PSO optimization algorithm. In Evolutionary Algorithms, there is no coordination
in the movement of individuals within the search space. However, the powerful selection procedure allows solutions with superior characteristics to pass these from generation to generation while the mutation (and recombination) schemes produce diversity in the solution pool.

Evolutionary Programming (EP) and Particle Swarm Optimization (PSO) joins together as Evolutionary Particle Swarm Optimization (EPSO) for the best of two worlds. In the Evolutionary Programming method, solution characteristics are mutated and passed to the following generations by the action of a selection mechanism. In the Particle Swarm Optimization (PSO) algorithm, there is exchange of information among solutions when they are successively moved around in the search space.

EPSO defines these parameters as the genotype of a moving solution. Therefore, they are subject to mutation and the particles holding them as phenotypes are subject to selection. This scheme turns out to be a successful self tuning mechanism and self-adaptive evolutionary process acting on strategic parameters to use the language of the Evolution Strategy community. EPSO has a better behavior than classical PSO and it also has a better behavior than other meta-heuristics method. The hybrid characteristics of Evolutionary and Particle Swarm model gives guaranteed convergence properties. In terms of efficiency, lower bounds are guaranteed but it experience to demonstrate that there is an effective acceleration and a better search for the optimum than classical approaches.

In the problem formulation, the tie-line transfer capacities are treated as a set of design constraints to increase the system security.
Evolutionary Swarm Optimization consists in a strong co-operation of EP and PSO, since it maintains the integration of the two techniques for the entire run. In each iteration, the population is divided into two parts and it is evolved with the two techniques respectively. The two parts are then recombined in the updated population which is again divided randomly into another two parts in the next iteration for another run of evolutionary or particle swarm operators.

Furthermore, the area spinning reserve requirements are also incorporated in order to ensure the system’s security and reliability. A reserve-sharing scheme is used to enable the area without enough capacity to meet its reserve demand. A four-area test power system is used as an application example, to verify the effectiveness of the proposed method through numerical simulations. A comparative study is also carried out to illustrate the different solutions of the proposed method.

To help the generating companies and load-serving entities to choose the appropriate relative levels of the interconnected system versus bilateral trade while considering risk, economic performance. In competitive power market, the electricity prices are determined by the balance between demand and supply in electric power exchanges or bilateral contracts. The concept of bilateral contract is incorporated into Multi-area unit commitment with import/export and tie-line constraints. This method considering maximizing the profit or minimizing the operating cost among the generating companies in a multi-area system. The feasibility of this algorithm to be demonstrated using the system with four areas.