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Literature Review on Security Constrained Economic Dispatch Problems with Line Flow and Voltage Limit Constraints

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ABSTRACT

This survey paper acquaints recent research in the area of Economic Dispatch(ED) Problems in electrical power system. The research papers published in the indexed journals and proceedings in the broad area of ED with line flow and voltage constraints are addressed and presented in a Hierarchical methodology. A detailed survey is done in the sphere of ED Problems for finding different classical, hybrid and non-hybrid methods by means of which ED problems can be solved effectively. It will be quite helpful to the investigators or researchers to be employed in this area.

INTRODUCTION

Economic Dispatch (ED) is an optimization problem where optimum possible generation for each generator is determined to minimize total fuel costs, while satisfying all unit and system equality and inequality constraints. The voltage and line flow constraints which are salient for any practical implementation of ED problems are taken in to consideration. The ED problem is an important function in power system planning and operation and the solutions are establish by solving the conventional load flow equations while at same time minimizing fuel costs (Samir & Khaled 2006) .

LITERATURE REVIEW

Classical Optimization Techniques: The following classical optimization methods such as Interior Point method, Successive LP method, Newton-Raphson method and Quadratic Programming method are used to solve ED problem with line flow and voltage limit constraints.

Interior Point and Successive Linear Programming Methods: Vargas et al (1993) reported on the application of an Interior Point Method (IPM) for the solution to Security Constrained Economic Dispatch (SCED) problem. A comparison of the proposed method with an efficient complex code was carried out by solving SCED problems of two standard IEEE test systems. The results show that the interior point technique was consistent, precise and more than two times as fast as the simplex algorithm.

Samir & Khaled (2006) solved the economic load dispatch with security constrained problems using Successive Linear Programming (SLP) method. In the proposed method, voltage and line flow constraints were taken as additional constraints and the SLP concept was implemented on the Algerian 59-bus test system. The results proved the potential of the proposed method in real-time implementation of the economic load dispatch problems.

Rabih et al (2000) proposed a Linear Programming (LP) method for solving Security Constrained Economic Dispatch (SCED) problem considering power balance equation, generator limits and line flow limit constraints. An important feature of the optimizing interior point LP algorithm was that it could detect infeasibility of the SCED problem reliability. The proposed approach was validated on the standard IEEE -24 bus test system and a practical 175 bus network. The results obtained were compared with the predictor corrector point algorithm.

Newton-Raphson and Quadratic Programming Methods: Jiann-Fuh & Shin-Der (1997) suggested Newton-Raphson method to solve the power system, Multi- objective Power Dispatch (MPD) problem with line flow constraints. In this proposed approach, two conflicting objectives, together with minimization of fuel cost and emission were considered. The Jacobian matrix was formulated by the incremental transmission loss in terms of the sensitivity factors, line flows and line resistances. The sensitivity factors were obtained from line flow solutions based on a DC load flow model. The usefulness of the proposed method was tested on the IEEE- 14 and 30 bus test systems. The results obtained from the proposed method were put up without the advantage of computation rapidity and solution accuracy over that of the AC load flow method and the conventional B-coefficients methods.

Ji-Yuan & Zhang (1998**)** used Quadratic Programming (QP) method for solving real time economic dispatch problems. The proposed method formulates the problem with a quadratic objective function based on the limits cost curves on quadratic forms. The goal programming techniques were also incorporated in the problem formulation which guaranteed the best available solution even under infeasible conditions. The support of the proposed method was documented by an example power system problem.

Evolutionary Computing Methods: The Evolutionary computing techniques such as Pattern search, Evolutionary programming, Genetic algorithm and PSO methods have been used to solve ED problem with line flow and voltage limit constraints.

Pattern Search Method: AI-Othman & EL-Nagger (2008) proposed the Pattern Search (PS) method to solve the power system Security Constrained Economic Dispatch (SCED) problem. In this proposed approach, the Pattern Recognition (PR) technique was used first to rightly use dynamic security. Linear classifiers are used to establish the stability of electric power system were presented and added to other system stability and operational constraints. The proposed method was tested 2 machines-5 bus 6 line test system and the results were compared with GA and QP methods.

Evolutionary Programming: Somasundram & Kuppusamy (2005) offered EP method to solve SCED problem. In the proposed method, the controllable system quantities in the base case were optimized to some defined objective function to diminish the total fuel cost subject to the constraints recognized in the problem. The recommended method was tested on a 10 bus system and the IEEE- 30 bus test system.

Particle Swarm Optimization: Pancholi & Swarup (2004) proposed a PSO method for SCED problem. In this problem the range of minimum and maximum velocity limit is quite large which makes the approach slow in the rate of convergence, takes more computational time and leads to local convergence.

Swarup & Rohit kumar (2006) presented a new approach called Attractive and Repulsive Particle Swarm Optimization (ARPSO) algorithm for solving economic dispatch with security constraints. In this paper the line flow and bus voltage constraints, which are so important for any practical implementation of ED, were taken into consideration. The proposed approach was implemented on the IEEE-14, 30 and 57 bus test systems and the results were compared with LP, QP and GA methods.

Genetic Algorithm: Hosam K. Youssef & Khaled (2000) reported the application of Genetic Algorithm (GA) for the security constrained power system economic dispatch problem. In this approach, the pattern recognition technique was used to handle the dynamic security and linear classifiers were used to determine the stability of electric power systems. Finally GA was used to solve this constrained nonlinear optimization problem.

Hybrid Evolutionary Techniques: Some of the hybrid evolutionary techniques which are formed by integrating an evolutionary computing technique with either another conventional or evolutionary computing technique for solving nonlinear optimization problems are discussed.

EP- LR Method: Somasundram et al (2005) suggested the hybrid algorithm based on EP and LP to solve the security constrained economic dispatch problem. In the proposed algorithm, the EP was used as base level search which could give a good direction in the optimal global region and the LP concept was applied to determine the best possible solution. A 10 bus and 66 bus Indian utility systems were considered to demonstrate the effectiveness of the proposed method.

SA- PSO Method: Kuo (2008) presented the combined SA-PSO hybrid algorithm to solve practical economic dispatch problem, considering the power balance equation, ramp-rate limits, prohibited operating zones, generation limits and line flow constraints. In this proposed method, the PSO was combined with SA to create an innovative approach capable of generating high quality solutions with greater stability in convergence characteristics and reduced calculation time. The proposed hybrid method was tested on 6, 13, 15 and real TAI-POWER system consisting of 40 units and the results were compared with other methods.

PSO- DE Algorithm: Vaisakh et al (2102) solved, the Dynamic Economic Dispatch (DED) problems with security constraints using bacterial foraging PSO- DE algorithm. The proposed hybrid method eliminated the problem of stagnation of solution with the inclusion of the PSO and DE operators in the original bacterial foraging algorithm. It achieved global cost by selecting the bacterium with good foraging strategies. The bacteria with good foraging strategies are obtained in the updating process of every chemo-tactic step by the PSO operator. The DE operator fine tuned the solution obtained through bacterial foraging and PSO operator. The feasibility of the presented approach was demonstrated on various standard test systems.

HGA-PSO Method: Abdelmalek Gacem & Djilani Benattous (2014) suggested a Hybrid Genetic Algorithm and Particle Swarm Optimization (HGAPSO) for solving the optimal power flow problem with non- smooth, cost function and subjected to limits on generator real, reactive power outputs, bus voltages, transformer taps and power flow of transmission lines. In this proposed hybrid method the individuals in a new generation were created not only by crossover and mutation operators, as in GA but also by PSO. The effectiveness of this algorithm was tested on the standard IEEE-30 bus system with 6 units. The results of the proposed algorithm were compared with the PSO and other methods reported in the literature.

CONCLUSION

This literature review covers the various algorithms both conventional and intelligent techniques used to analyze the Economic Dispatch with line flow and voltage limit constraints Problems. The merits and limitations of each research paper is discussed and highlighted. This paper will be the guiding force for the researchers working in the area of ED problems

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