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Research Article
Congestion management – Deregulation

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Keywords

Bacterial foraging, Congestion management, Wheeling transactions, Optimal power flow, Nelder–Mead algorithm, Deregulation.

Abstract

In this paper the sub-problems associated with the economical operation of a power system can be reduced. But the electrical marketing of a system is so complicated. The congestion management is the recent problem facing today much in order to provide constant supply of power to the consumers in an reliable manner. So we are trying to remove the congestion in the transmission line by means of generation rescheduling with the cost involved in the rescheduling process will be minimized. In this paper the adaptive bacterial foraging algorithm with Nelder Mead is used for optimizing the congestion cost. The outputs and results are compared with the optimization techniques like genetic algorithm (GA), Particle Swarm Optimization (PSO) and simple bacterial foraging algorithm. The numerical expression for representing the performance of the optimization techniques are done by means of six generating units having standard IEEE 30 bus system. This technique can be reformulated in future for the continuous iteration of simulations so that it will give the applicability for such evolutionary algorithms for practical applications.

Introduction

The open access competitive based electricity market tries to make the full utilization of electric network (transmission network) with high economical benefits and also simultaneously the security is maintained. The comprehensive set of actions or proceduresare referred as congestion management, which principally consists of re-dispatch of generation and load levels so as to establisha system state without violations of system constraints. The problem of congestion management in the deregulated environmentis solved by many approaches in the recent works.. There are four major ways to solve the problem and they are (1) sensitivity factors basedmethods (2) auction based congestion management (3) pricing based methods and (4) re-dispatch and willingness to pay methods.The re-dispatching based congestion removal with contingency constrained limits is considered in this paper. The impacts ofcongestion management on the reliability of power transactions based on factors such as expected power curtailment, curtailmentprobability, and expected cost of congestion management and probability distribution of total power curtailment are discussedin this paper. The auction based power transaction bidding and its various issues are analyzed in the following. The impact of co ordination based transaction curtailment in the market environment is discussed in this paper. The Auction based congestion management in the presence ofsome interruptible loads with N _ 1 contingencies is given. The transaction curtailment based congestion removal on IEEE14 node system based on DC load flow is reported in the below chapter. The concentric relaxation based congestion removal is to minimize the amount of transaction curtailing. The validation of optimal power flow in the deregulated environment using steepestdescend method, genetic algorithm and evolutionary programming based approaches are reported . The generation rescheduling by evolutionary programming approach is discussed in the below chapters. Thevoltage stability index based relative electrical distance measurements to remove congestion are processed. The multi objective framework to minimize both generation cost and line overload index is given in this paper. A fuzzy interactive multi objective optimization for optimizing total social welfare, emission and network congestion factor is reported.

This paper proposes a new optimization approach, to solve the congestion management using bacterial foraging (BF)

optimization technique, which is a stochastic optimization technique. The bacterial foraging optimization technique was proposed by Passino andsome interesting literatures pertaining to this beautiful optimization technique including the convergence and stability analysis ofthe technique can be obtained from literatures by the same authors [14–17]. The bacterial foraging strategy is based upon the fact of survival of species in any natural evolutionary process depends upon their fitness criteria, which relies upon their food searchingand motile behavior. The foraging strategy of Escherichia coli bacteria present in human intestine can be explained by four processes, namely chemotaxis, swarming, reproduction, and elimination–dispersal. In this work, an attempt has been made to solve the congestion management problem in deregulated environment using bacterial foraging methodology combined with the Nelder– Mead local search technique. The preferred generation schedule for the test system has been obtained by running the optimal power flow problem with cost minimization as objective function.In order to establish the capability of the proposed hybridized technique to optimize the congestion cost, this algorithm is tested with IEEE 30 bus system. The results obtained are compared with simple bacterial foraging (SBF), genetic algorithm (GA) and particle swarm optimization (PSO) methods. The proposed algorithm can fit to solve many optimization problems in the area of power systems.

Problem description

In a power system, the economic operation of generating utilities is always preferred. The loads are getting supply from the system through transmission network and any power transmission related problems are well managed by the controlling authority.In the deregulated market environment the power dispatch problemhas various sub-problems varying from linear programmingproblems to complex non-linear problems. The concerned problemhas two parts. The First part is finding out the preferred scheduleusing optimal power flow and the second part is reschedulingthe generation for removing the congestion. The Optimal PowerFlow (OPF) problem is one of the different non-linear programmingsub-problems. The OPF problem is about minimizing the fuel costof generating units for a specific period of operation so as toaccomplish optimal generation dispatch among operating unitsand in return satisfying the system load demand, generator operationconstraints and line flow limits (security constraints).

A. Congestion management

In an open access competitive electric market environment, the important role of system operator (SO) is to maintain system security and reliability while making the economical decisions on market participants. These transactions are modeled as either bilateral transaction between two buses or multi lateral transactions between many seller and buyer buses considering the system power balance conditions in mind. The bilateral transaction between a pair of buyer bus ‘j’ and seller bus ‘i’ can be modeled as

$$PGi - PDj = 0$$

where PGi and PDj are the amount of power injections added at seller bus ‘i’ and amount of power taken at buyer bus ‘j’, respectively. The multi lateral transaction can also be modeled as

$$PGi - PDj = 0$$

The transactions are submitted by various buyer and seller buses to SO for checking the feasibility without any violations on network constraints. If any violation is there, then congestion management methodology should be applied to make the system operating in secure mode. Here in this paper rescheduling the real power generation level from the preferred schedule is considered to relieve the congestion. The incremental and decremental bidding cost are submitted by each and every generating units to SO. This bidding is useful to calculate the minimum cost necessary to remove congestion,called as congestion cost.

Conclusion

The congestion management problem can be devised as the emerging problem needs to concentrate much in order to supply power to the consumers in most reliable manner. In this paper we have tried to remove the congestion in the transmission line by generation rescheduling with the cost involved in the rescheduling process should beMinimized. This paper proposes a new optimization approach, to solve the congestion management using bacterial foraging (BF) optimization technique, which is a stochastic optimization technique. The adaptive bacterial foraging algorithm with Nelder–Mead (ABFNM) is used in this work to optimize the congestion cost. The results are also compared with the genetic algorithm (GA), particle swarm optimization (PSO) and simple bacterial foraging (SBF) algorithms.

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