INTERNATIONAL RESEARCH JOURNAL OF ENGINEERING & APPLIED SCIENCES
ISSN: 2322-0821(O) VOLUME 7 ISSUE 2
ISSN: 2394-9910(P) Apr 2019 - June 2019
www.irjeas.org

A REVIEW OF TRANSMISSION LINES OVERLOAD ALLEVIATION USING VARIANTS OF PSO

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Abstract— Transmission lines in Electric Power System are becoming heavily loaded and will further affect system stability. With rapid growth of electricity market trades and the availability of insufficient transmission resources leads to network congestion. Real-time transmission congestion is defined as the operating condition in which there is not enough transmission capability to execute all the traded transactions all together due to some unforeseen contingencies. Transmission line overload is among the same contingencies. In this paper a review of various techniques for managing overloaded lines as published in various by various researchers.

Keywords – PSO, Transmission, Overload Alleviation

I. INTRODUCTION

Number of market participants are increasing in terms of generation, transmission and distribution owners, the number of desired transactions between the various participants is increasing. Each transaction requires energy to be transferred from one point to another point. The owners of electric energy rely on the transmission network for its transportation. Before restructuring, the power grid were operated by vertically integrated utilities, who had control over both generation and transmission facilities. But after unbundling of generation and transmission and the coming of restructured system, it has become a challenge to operate the system in synchronism. The current transmission networks were not planned for trading in a competitive market. A problem that is becoming more and more significant nowadays is transmission congestion. This is due to reason that market participants intend to take a high number of transactions to transfer energy between various points in the network, the realization of all schedules might lead to violations of one or more limits of the transmission system. This situation is called transmission system overloading. To manage overloading of transformers the problem formulation can be done for techniques like load shedding, generator rescheduling etc. Further optimization techniques can be implemented to solve the given problems.

Various Evolutionary algorithms have been applied successfully in many complex problems in the field of industrial and operational engineering. In power systems, well known applications include thermal unit commitment, hydrothermal coordination, economic dispatch, load forecasting, reliability studies, and various resources allocation problems. Among various evolutionary computation techniques, Particle Swarm Optimization (PSO) is a simple, effective, and extremely powerful evolutionary computation technique that solves real-valued problems based on the principles of natural evolution.

II. VARIENTS OF PSO

1) Inertia weight PSO-

The inertia weight was introduced by Shi and Eberhart [1] as a mechanism to control the exploration and exploitation abilities of the swarm and as a mechanism to eliminate the need for velocity clamping. The inertia weight was successful in addressing the first objective, but could not completely eliminate the need for velocity clamping. The inertia weight, w, controls the momentum of the particle by weighing the contribution of the previous velocity, basically controlling how much memory of the previous flight direction will influence the new velocity. The value of w is extremely important to ensure convergent behavior, and to optimally tradeoff exploration and exploitation.

2) LDWPSO-

Linear Decreasing Weight Particle Swarm Optimization Linear Decreasing Weight particle swarm optimization (LDWPSO) algorithm was presented by Shi and Eberhart [2]. The inertia weight w is decreased linearly over the searching iterations, from an initial value to a final.

3) Multi-swarm Particle Swarm Optimization-

In [3], the authors have proposed a Multi-swarm Particle Swarm Optimization (MPSO) to maintain the swarm diversity. This method applied a mixed local search behavior modes and information exchange among sub swarms. When the premature convergence occurs in one sub-swarm then that particles should escape from the local area through the initialization their position in the search space.

4) PSO with Nonlinear Decreasing inertia Weight (PSO-NDW)-

Ultrasonic motor (USM) exhibits non-linearity that relates the input and output. It also causes serious characteristic changes during operation. PID controller has been widely used as the control scheme for USM. However, it is difficult for the fixed-gain type PID controller to compensate such characteristic changes and non-linearity of USM. [4] proposed a modified PSO with Nonlinear Decreasing inertia Weight (PSO-NDW) for optimal self-tuning of PID controller in positioning control of USM. A modified PSO employs the strategy that nonlinearly decreases the value of inertia weight from a large value to a small value. This strategy is to improve the performance of the standard PSO algorithm in global search and fine-tuning of the solutions. The performance of PSO-NDW based PID controller has been evaluated on the USM servo system. The results demonstrate that the proposed modified PSO can improve the accuracy of USM

5) Constrained Particle Swarm Optimization-

Constrained Particle Swarm Optimization CPSO In the other study, a Constrained Particle Swarm Optimization (CPSO) is developed by [5]. In this method, constraint handling is based on particle ranking and uniform distribution. For equality constraints, the coefficient weights are defined and applied for initializing and updating procedure. This method applied to schedule generation and reserve dispatch in a multi-area electricity market considering system constraints to ensure the security and reliability of the power system. CPSO applied to three case studies and results showed promising performance of the algorithm for smooth and nonsmooth cost functions.

III. LITRETURE SURVEY

Ch. Naga Raja Kumari , M. Anitha [6] discusses a solution for congestion relief. This paper has been explored the Day-Ahead market scheduling under normal as well as congestion states. The re-schedule and load curtailment approaches have been applied to the congestion relief. The case studies once again revels that the re-dispatch is not possible in all the cases. Under this mode, only load reduction will be the alternative solution which is not good in practice. In order to keep reliability and security, the need of transmission system loadability enhancement is also discussed in this paper.

B. V. Manikandan, S. Charles Raja, P. Venkatesh and Manasarani Mandala [7] discussed cluster/zone method and relative electrical distance (RED) method for congestion management and are compared based on the considered parameters. In the cluster/zone method, rescheduling of generation is based on user impact on congestion through the use of transmission congestion distribution factors. In the RED method, the desired proportions of generations for the desired overload relieving are obtained. Even after generation rescheduling, if congestion exists, load curtailment option is also introduced. Rescheduling cost, system cost, losses, and voltage stability parameter are also calculated and compared for the above two methods of congestion management. The results are tested on sample 6-bus, IEEE 30-bus, and Indian utility 69-bus systems.

C. M. Wankhade, A.P.Vaidya [8] have discussed congestion management with the application of Optimal Power Flow solution by using Lagrange's Multiplier Method (LMMS) and Conventional algorithm (NBOPF) and compared them. The congestion management is possible in better way with the application of Optimal Power Flow solution and will improve the overall performance of the transmission system by using LMMS algorithm over the Conventional algorithm (NBOPF) under the contingency condition. These algorithms are tested on IEEE 30 bus systems and are compared with each other.

K.Vijayakumar [9] have discussed optimal location of FACTS devices i.e TCSC and UPFC to relieve congestion in the network by using genetic algorithm (GA) technique. This paper proposes an optimal congestion management approach under hybrid electricity market using Self organizing hierarchical particle swarm optimization with Time Varying Acceleration Coefficients (SPSO-TVAC). The aim of the proposed work is to minimize deviations from preferred transaction schedules and hence the congestion cost under hybrid electricity market. The values of Transmission Congestion Distribution factors (TCDFs) are used to select redispatch of generators. Generator reactive power support is considered to lower the congestion cost. Numerical results on IEEE 57 bus system is presented for illustration purpose and the results are compared with Particle swarm optimization (PSO) in terms of solution quality.

L.Rajalakshmi, M.V.Suganyadevi, S.Parameswari [10] have introduced a method to determine the optimal location of FACTS based on real power Performance Index and reduction of total system VAR power losses. FACTS devices such as TCSC by controlling the power flows in the network can help to reduce the flows in heavily loaded lines. Because of the considerable costs of FACTS devices, it is important to obtain optimal location for placement of these devices. The results shows that sensitivity index along with TCSC cost should be effectively used for determining optimal location of TCSC. The effect of TCSC on line outage in order to relieve congestion has also been studied.

M.A. Abido [11] has proposed a novel based approach to solve OPF problem. The problem is formulated as an optimization problem with mild constraints. In this study, different objective function has been considered to minimize the fuel cost, to improve the voltage profile and to enhance the power system voltage stability. The

proposed approach has been tested and examined with different objectives to demonstrate its effectiveness and robustness on IEEE 30 bus standard system. The results using the proposed approach were compared to those reported in literature. The results confirm the potential of the proposed approach and show its effectiveness and superiority over the classical techniques and genetic algorithm.

Manoj Kumar Maharana and K. Shanti Swarup [12] proposed a novel corrective control action to alleviate overloads in transmission lines by the Particle Swarm Optimization (PSO) method. The main intent of the paper is to propose a technique to identify the participating generators for corrective control actions. In this DAG is used to identify the participating g generators and load buses for generator rescheduling/load shedding. With respect to the contingency, the participating generators are classified into two groups based on the power flow directions. Generation in one group of generators is increased while in the other group it is decreased. Generators which are contributing to the contingency line identified as the Generator Decrease (GD) group and the generators which are not contributing to the contingency line are categorized as the Generator Increase (GI) group. The corrective control strategy is modeled as an optimization problem. The corrective control action for overload-alleviation is a PSO-based-generator rescheduling and/or load-shedding method applied to the GI and GD groups. The proposed corrective control action provides an optimal solution of generator-rescheduling and load-shedding which would bring back the system to normal state.

Manasarani Mandala, C.P.Gupta [13] proposed an optimal congestion management approach under hybrid electricity market using Self organizing hierarchical particle swarm optimization with Time Varying Acceleration Coefficients (SPSO-TVAC) and generators are selected based on their Transmission Congestion Distribution factors (TCDFs). This paper proposes an optimal congestion management approach under hybrid electricity market using Self organizing hierarchical particle swarm optimization with Time Varying Acceleration Coefficients (SPSO-TVAC). The aim of the proposed work is to minimize deviations from preferred transaction schedules and hence the congestion cost under hybrid electricity market. The values of Transmission Congestion Distribution factors (TCDFs) are used to select redispatch of generators. Generator reactive power support is considered to lower the congestion cost. Numerical results on IEEE 57 bus system is presented for illustration purpose and the results are compared with Particle swarm optimization (PSO) in terms of solution quality.

S.Venkatesan, J.Senthil kumar, T.S.Manipriya [14] this paper proposes a methodology to identify the reliable wheeling transaction in hybrid power market by performing Particle Swarm Optimization (PSO) based Optimal Power Flow(OPF). The customer location is selected based on Locational Marginal Price (LMP). The new generation schedule for all generator buses are computed by PSO with an objective of increasing the system performance by optimizing the generation cost. Based on the power transfer capability the transaction is suggested for the Independent Power Producer (IPP) in deregulated environment. The proposed frame work is illustrated with IEEE-30 bus system and Indian utility 69 bus system.

V.P. Sakthivel , S.V.Vijayasundaram[15] has discussed the method of congestion relief by Chaotic Particle Swarm Optimization. In the proposed method, generators are selected based on their sensitivity to the congested line for efficient utilization. The task of optimally rescheduling the active powers of the participating generators to reduce congestion in the transmission line is attempted by CPSO and conventional PSO. The rescheduling has been carried out by taking minimization of cost and satisfaction of line flow limits into consideration.

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