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Review On Power System Reconfiguration and Loss Minimization for An Distribution Systems

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Abstract: The quickly expanding development expenses of electrical creating stations and the fuel utilized in that have concentrated consideration on the need to diminish the power and vitality misfortunes in transmission and dispersion lines. A piece of these, the essential region in which conveyance computerization is being connected is the region of system reconfiguration (NR). Concurring this system reconfiguration it alludes to the end and opening of switches in a power circulation framework with a specific end goal to modify the system topology, along these lines the stream of energy from the substation to clients end. There are two essential motivations to reconfigure a dispersion organize amid typical method of operation. These variables are relying on the present stacking conditions, reconfiguration may wind up noticeably vital keeping in mind the end goal to wipe out over-burdens on particular framework segments, for example, transformers or line areas. For this situation, it is known as load adjusting. As the stacking conditions on the framework transform it might likewise wind up noticeably beneficial to reconfigure so as to diminish the genuine power misfortunes in the system.

Keywords: Power System, Loss Minimization.

I. INTRODUCTION

In the past decade, with many advancements in communication system, data processing technology, and electric utility power sectors have become very interested in distribution automation. It is apparent that with the continuously day by day increasing the complexity of power distribution systems, it is becoming essential to automate some tasks that have always been done manually. It has also been estimated that utilities could save approximately 10% of their annual maintenance and operate expenses by taking advantage of this technology [14]. Nowadays, reactive power planning (RPP) problem has become one of the most challenging as well as huge problems in power systems. It has been an important stage of transmission expansion planning (TEP) problem in a recent year. In addition, reactive power control/dispatch is an important function in the planning process for the future of power systems. Its main objective to utilize all the reactive power sources efficiently, which are suitably located and sized in the planning process [5]. The rapidly increasing construction costs of electrical generating stations and the fuel used therein have focused attention on the need to reduce the power and energy losses in transmission and distribution lines. A part of these, the important area in which distribution automation is being applied is the area of network reconfiguration (NR). According to this network reconfiguration it refers to the closing and opening of switches in a power distribution system in order to alter the network topology, thus the flow of power from the substation to users end. There are two primary reasons to reconfigure a distribution network during the normal mode of operation. These factors are depending upon the current loading conditions, reconfiguration may become necessary in order to eliminate overloads on specific system components such as transformers or line sections. In this case, it is known as load balancing. As the loading conditions on the system change, it may also become profitable to reconfigure in order to reduce the real power losses in the network.

Network reconfiguration in both of these cases during the operation can be classified as a minimal spanning tree problem, which is known to be an NP–complete combinatorial optimization problem. During the execution of this method it, needed to quickly locate the network configuration which minimizes the total real power loss of the network while satisfying all of the system constraints. Several approaches have been applied to the solution of this problem with varying degrees of success as Heuristic methods [3; 13] have been used successfully to find sub-optimal solutions rapidly. The genetic algorithm [9] and

simulated annealing [12], which require much more computation time, have been used to find optimal solutions. It seems that these methods have only been applied to relatively small, balanced, or single-phase distribution systems. Power utility companies currently need an algorithm which can be applied to their large three-phase unbalanced distribution systems.

FLOWER POLLINATION OPTIMIZATION ALGORITHM (FPOA)

Flower pollination optimization algorithm (FPOA) is a recently invented optimization algorithm. It is inherited from the natural inspiration of pollination process. It mimics the process of flowering plants reproduction via pollination. As pollinators are mainly responsible for transferring pollens among flowers, pollination may occur in either local or global flow [4]. Pollination process can fall into two form categories; biotic and abiotic based on the pollens transferring mechanism. For biotic pollinations, flowers always depend on insects and/or animals as pollinators to transfer the flowering pollens. However, for abiotic, flowers do not need any pollinators for the pollens transferring process [5, 6]. Naturally, most of the flowers considered to follow the biotic pollination form. This indicates that pollination or cross pollination process can take place by pollinators' movements or travel long distances causing a global pollination. Traveling pollinators are usually followed the Levy's flight behavior. Their flying steps also follow the Levy's flight distribution [7]. For each kind of pollinators, there is a specific type of flowers that it is responsible for, this called flower consistency. Flower consistency helps to minimize the cost of investigation of each pollinator. Evolutionary wise, it increases the transferring time of pollens and hence optimize and maximize the reproduction process. With the limited available memory of pollinators, flower consistency eliminates the learning, investigation, and switching [8].

II. LITERATURE REVIEW

Marwa Sharawi et al. [1] In this paper they used the Flower Pollination Optimization Algorithm (FPOA) to propose a WSN energy aware clustering formation model based on the intra-cluster distances. The objective is to achieve the global optimization for WSN lifetime. Simulation results and performance analysis show that applying flower pollination optimization on WSNs clustering is more efficient. It effectively balances power utilization of each sensor node and hence extends WSN lifetime comparatively with the classical LEACH approach.

A.Y. Abdelaziz et al.[2] In this paper, a new and powerful algorithm called Flower Pollination Algorithm (FPA) is proposed for optimal allocations and sizing of capacitors in various distribution systems. First, the most candidate buses for installing capacitors are suggested using Power Loss Index (PLI). Then the proposed FPA is employed to reduce the size of capacitors and their locations from the selected buses. The objective function is designed to reduce the total cost and consequently to increase the net saving per year. The proposed algorithm is tested on 15, 69 and 118-bus radial distribution systems. The obtained results via the proposed algorithm are compared with other algorithms like Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Plant Growth Simulation Algorithm (PGSA), Direct Search Algorithm (DSA), Teaching Learning-Based Optimization (TLBO), Cuckoo Search Algorithm (CSA), Artificial Bee Colony (ABC) and Harmony Search Algorithm (HSA) to highlight the benefits of the proposed algorithm. Moreover, the results are introduced to verify the effectiveness of the suggested algorithm to minimize the losses and total cost and to enhance the voltage profile and net saving for various distribution systems.

Xin-She Yang et al. [3] In this paper, proposed a new algorithm, namely, flower pollination algorithm, inspired by the pollination process of flowers. They first use ten test functions to validate the new algorithm and compare its performance with genetic algorithms and particle swarm optimization. The simulation results show the flower algorithm is more efficient than both GA and PSO. Also use the flower algorithm to solve a nonlinear design benchmark, which shows the convergence rate is almost exponential.

Rui Wang and Yongquan Zhou [4] in this paper a dimension by the dimension improvement based flower pollination algorithm is proposed. In the progress of iteration of improved algorithm, a dimension by the dimension based update and evaluation strategy on solutions is used. And, in order to enhance the local searching ability, local neighbourhood search strategy is also applied in this improved algorithm. The simulation experiments show that the proposed strategies can improve the convergence speed and the quality of solutions effectively.

O. Abdel Raouf et al.[5] In this paper, a new hybrid optimization method called hybrid flower pollination algorithm (FPPSO) is proposed. The method combines the standard flower pollination algorithm (FP) with the particle swarm optimization (PSO) algorithm to improve the searching accuracy. The FPPSO algorithm is used to solve constrained optimization problems. Experimental results showed that the accuracy of finding the best solution and convergence speed performance of the proposed algorithm is significantly better compared to those achieved by the existing algorithms.

M.E. Hamedani Golshan and S.A. Arefifar [6]: The method has been tested on 33-bus and 69-bus radial distribution systems to demonstrate the performance of the algorithm and to investigate impact of some parameters such as maximum limits on size of DGRs (RPSs), constant or controllable outputs of these sources and different control variables sets on results of system planning. In addition, a novel technique for determining the candidate buses to install active (reactive) sources based on clustering system buses in view of assigning DGRs (RPSs) is presented.

O. Abarrategui et al [7]: This paper presents a new met heuristic methodology, for Feeder Reconfiguration in distribution networks, called Item-Oriented Ant Colony Optimization (IOACO), with four variations based on different Ant Colony

Optimization algorithm approaches (ACO). The methodology modifies and adapts previously proposed ACO methods in order to improve their efficiency and accuracy in solving the problem of loss reduction in a distribution network.

Susana de Leon-Aldaco et al [8]: This paper presents a comprehensive coverage of met heuristic methodologies applied in the area of power converters. The review includes a classification of the methodologies and main objective functions in each paper surveyed. An aim of this paper is to highlight the importance of the optimization tools, and the many benefits they provide to tackle the challenges encountered in the design, operation, and control of power converters.

R. Srinivasa Rao et al[9]: This paper presents a new method which applies an artificial bee colony algorithm (ABC) for determining the sectionalizing switch to be operated in order to solve the distribution system loss minimization problem. The ABC algorithm is a new population-based metaheuristic approach inspired by intelligent foraging behavior of honeybee swarm. The proposed method has outperformed the other methods in terms of the quality of solution and computational efficiency.

Merlin and Back [10] proposed a branch and bound type heuristic method to determine the network configuration for minimum line losses. Its solution scheme starts with a meshed network by initially closing all switches in the network. The switches are then opened one at a time until a new radial configuration is reached. In this process, the switch to be opened at each stage is selected in order to minimize line losses of the resulting network. The principal advantages of this method are: The final network configuration is independent of the initial stage of the network switches. The solution process leads to the optimum or near optimum.The major drawbacks are: Loads are assumed purely active and are represented by current sources that are fixed regardless of the changing network configuration. Network voltage angles are assumed negligible.

Shir Mohammadi and Hong [11] improved the method of Merlin and Back. As a result, it shares the two principle benefits of that methodology, convergence to the optimum or near optimum solution and the independent of the final solution from the initial status of the network switches. At the same time, this method avoids all the major drawbacks of Merlin and Back.

Civanlar [12] developed a branch exchange method. In this method, loss reduction is achieved by exchange operation corresponds to the selection of a pair of switches, one for opening and the other for closing so that the resulting network has lower line losses while remaining connected and radial. The major drawbacks of this method are: The final network reconfiguration is dependent on the initial state of the network switches. The optimum solution is not guaranteed. Selection of each switches exchange operation becomes very time-consuming.

Baran and Wu [13] presented a heuristic reconfiguration methodology based on the branch exchange to reduce losses and balance the loads in the feeders. To assist in the search, two approximated load flows for radial networks with different degrees of accuracy are used. They are simple Dist flow method and back and forward update of Dist flow method. The method is very time consuming due to the complicated combinations in large scale system and converges to a local optimum solution, that is, convergence to the global optimum is not guaranteed.

V.N. Gohokar et al [14] formulated the reconfiguration problem as transshipment with quadratic costs using the quadratic simplex method. The network starts with just the distribution substations and the feeder segments are switched in one at a time of the segment available to switch in, the one with minimum unit transshipment cost is chosen first. The linearlized transshipment cost was defined as the segment capacity time's resistance, so it does not depend on load. Then, of the other segment available to serve that new load point, the chosen segment is checked to make sure it results in a minimum increase in losses. This search does not necessary guarantee global optima.

S.K Goswami et al [15] defined a new set of heuristic rules for distribution system reconfiguration problem. The rules have been developed with the objective of reducing losses directly and make an effort quantize the suitability of switching options. The proposed method serves as a pre-processor to a reconfiguration algorithm removing undesirable switching options without the need to perform a complex load flow analysis.

Author Name	Paper	Technology Used	Description
Sharawi, Marwa, et al	"Flower pollination optimization algorithm for wireless sensor network lifetime global optimization."	Flower Pollination Optimization Algorithm (FPOA), WNS	Flower Pollination Optimization Algorithm (FPOA) to propose a WSN energy aware clustering formation model based on the intra-cluster distances. The objective is to achieve the global optimization for WSN lifetime.
Abdelaziz, A. Y., E. S. Ali, and SM Abd Elazim	"Optimal sizing and locations of capacitors in radial distribution systems via flower pollination optimization	Flower Pollination Algorithm (FPA)	A new and powerful algorithm called Flower Pollination Algorithm (FPA) is proposed for optimal allocations and sizing of capacitors in various distribution systems. First, the most candidate buses for installing capacitors are suggested using Power

	algorithm and power loss index."		Loss Index (PLI). Then the proposed FPA is employed to deduce the size of capacitors and their locations from the selected buses.
Yang, Xin-She, Mehmet Karamanoglu, and Xingshi He	"Flower pollination algorithm: a novel approach for multi-objective optimization."	Flower Pollination Optimization Algorithm (FPOA)	Flower pollination algorithm, inspired by the pollination process of flowers. They first use ten test functions to validate the new algorithm and compare its performance with genetic algorithms and particle swarm optimization. Also use the flower algorithm to solve a nonlinear design benchmark, which shows the convergence rate is almost exponential.
Wang, Rui, and Yongquan Zhou.	"Flower pollination algorithm with dimension by dimension improvement."	Flower Pollination Algorithm	A dimension by dimension improvement based flower pollination algorithm is proposed. In the progress of iteration of improved algorithm, a dimension by the dimension based update and evaluation strategy on solutions is used. And, in order to enhance the local searching ability, local neighbourhood search strategy is also applied in this improved algorithm.
Abdel-Raouf, Osama, and Mohamed Abdel-Baset	"A new hybrid flower pollination algorithm for solving constrained global optimization problems."	Hybrid Flower Pollination Algorithm (FPPSO), Particle Swarm Optimization (PSO)	a new hybrid optimization method called hybrid flower pollination algorithm (FPPSO) is proposed. The method combines the standard flower pollination algorithm (FP) with the particle swarm optimization (PSO) algorithm to improve the searching accuracy. The FPPSO algorithm is used to solve constrained optimization problems.
O. Abarrategui et al	"EPSO-best-of-two-worlds meta-heuristic applied to power system problems."	Item-Oriented Ant Colony Optimization (IOACO)	A new met heuristic methodology, for Feeder Reconfiguration in distribution networks, called Item-Oriented Ant Colony Optimization (IOACO), with four variations based on different Ant Colony Optimization algorithm approaches (ACO).
Baran and Wu	"Network reconfiguration in distribution systems for loss reduction and load balancing"	Dist flow method	A heuristic reconfiguration methodology based on the branch exchange to reduce losses and balance the loads in the feeders. To assist in the search, two approximated load flows for radial networks with different degrees of accuracy are used.

CONCLUSIONS

Arrangement plot begins with a fit system by at first shutting all switches in the system. The switches are then opened each one in turn until another outspread setup is come to. In this procedure, the change to be opened at each stage is chosen with a specific end goal to limit line misfortunes of the subsequent system. The chief points of interest of this technique are: The last system setup is free of the underlying phase of the system switch

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