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Meta-heuristic optimization Methods for Under Voltage Load Shedding Scheme

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Abstract: The aim of this paper is to provide a comparison of different Meta Heuristic Techniques used in Under Voltage Load Shedding schemes in Power Systems. Voltage stability issue remains a major concern in the operation and control of power systems. An Under Voltage Load Shedding can be used to protect the power system where voltage collapse is expected and can potentially lead to a Blackout situation The particular reliability involving conventional UVLS approaches becomes controversial when voltage fail in energy systems or blackouts take place. Conventional UVLS approaches are demonstrated as unacceptable for current large as well as complex energy systems. So, the beginning of meta- heuristic optimization techniques presents efficient coping with of this sort of modern energy systems.Finally, all optimization approaches have its pros and cons. Nonetheless, the implementation of the meta-heuristic strategies to UVLS can certainly decrease the prospect of power system problems and improve the dependability of energy system. On the other hand, further development of such techniques is essential for feasible practical use appropriate for online as well as real-time applications.

Keywords: Under voltage load shedding, Meta Heuristic, Voltage stability, Voltage collapse, Blackout.

I. INTRODUCTION

The ever-increasing variety of voltage steadiness events worldwide has attracted lots of concerns on the list of power electric operators. Substantial development has become made within the research around the implementation in the load dropping schemes over the past few generations [1–2]. Among different countermeasures for preventing the voltage lack of stability, load shedding is the final therapy of defense travellers have the no various other substitute to quit an impending voltage failure [3]. Even so, inadequate fill shedding has led to a variety of voltage failure occurrence. This was because of the excess fill being shed or bad load shed. Ultimately, this problem has quizzed the capacity and reliability for existing conventional fill shedding techniques. Hence, alternative techniques must enhance the actual reliability regarding today's modern day, complex, and huge strength systems. Considering the complexity of a power method network, researchers who seek to solve under voltage fill shedding (UVLS) difficulties have directed considerable awareness toward meta-heuristic approaches. A meta- heuristic is some algorithmic concepts which they can use to establish heuristic approaches applicable to a wide number of different troubles. In other words, a meta- heuristic is usually a general-purpose algorithmic framework that could be applied to be able to different optimization difficulties with relatively number of modifications [4]. Meta heuristic algorithms are also an algorithms which in turn, in order to escape from neighborhood optima, drive

some essential heuristic, which can be either any constructive heuristic originating in a null option and adding elements to make a very good complete a single, or a neighborhood search heuristic originating in a complete solution and iteratively modifying some of its elements to get a much better one. The meta- heuristic element permits the actual low-level heuristic to obtain solutions a lot better than those it could possibly have achieved alone, even if iterated. Also, the voltage profile in the system improves as a result of efficient fill shedding since voltage breathing difficulties are a key pont for dropping load.

Table 1 shows a comaprision between conventional and computational techniques which clearly shows the differnce.Figure1 shows the flow chart for conventional load shedding techniques which are unable to estimate the accurate power imbalance and take decision accordingly,while Meta-herustic do accordingly.

This paper aims to review some Meta-heuristic methods, In section II such as genetic algorithm (GA) its advantages and applications to UVLS problem.While Section III outlines particle swarm optimization (PSO) technique and its application in UVLS,next session shows Ant colony optimization (ACO), section VI fuzzy logic command (FLC), and finally the last section discuss Big-Bang Big crunch (BB-BC) optimization thus protecting the electricity system by power outage situations[5].A comparision is made in table form to summarize tha advantages and drawbacks of discussed techniques.

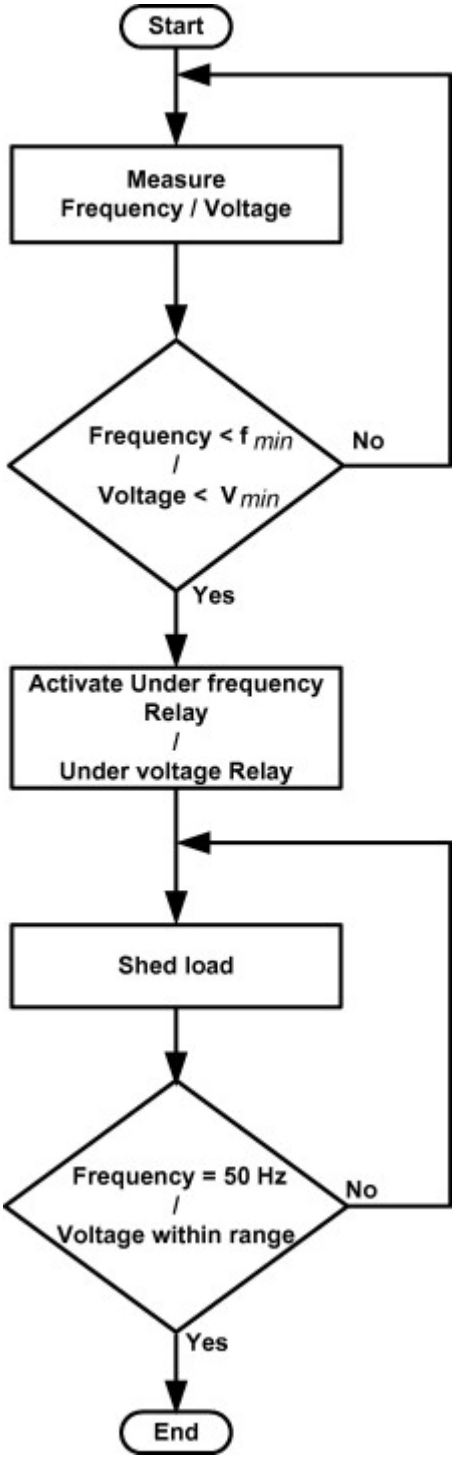

Figure1. Flow chart of conventional load shedding techniques

Table 1 Comparison features of Conventional and Meta-Heuristic Techniques

No	Feature	Conventional Technique	Meta-Heuristic Techniques
1	Optimum Load shedding	Do not give otimum load shedding	Provide optimum load shedding
2	Complex and large Power system	Cannot face efficiently with large and complex power systems	Deal efficiently with all size and type of Power system
3	Calculation of Power Imbalance	It works1112 on predefined thershold values only	It effectly deal with power imbalnce by calculating it accurately.

II. GENETIC ALGORITHM

Genetic algorithm (GA) application in load shedding is global otimization technique for solving non-linear,multi-objective problems introduced by John Henery Holland at University of Michigan in 1975 [6].GA involves three types of operators namely ,sleection,crossover and mutation.GA also has some application in load shedding problems. Sanaye-Pasand and Davarpanah [7] applied a genetic algorithm for load shedding applications in power systems. The database for load shedding problems was obtained from a power flow study and was successfully implemented on the IEEE 30-bus system. Another GA based load shedding technique that considers the load shedding from each bus is proposed in [8]. The implementation of GA to solve UVLS in [9] considered the load shed at each of the bus voltages in the IEEE 30-bus test system. Alongside GA, PSO is applied to solve generator outage and line outage cases for result validation .However, the study found that PSO has faster Computation time than GA in finding the solution for the optimum amount of load to shed, but the fewer loads to shed in abnormal cases and produced more accurate results in all cases by using GA Technique. The main drawback of genetic algorithms which restricts its implementation in real-time application is its slow response.

III. PARTICLE SWARM OPTIMIZATION

Kennedy and Eberhart introduced the PSO technique in 1995, inspired by the social behavior of organisms as birds flocking and fish schooling [10].PSO has been proved as a robust and fast technique in solving non-linear, multi-objective problems. PSO has been well implemented in UVLS Studies with an objective function of identifying the Maximum loading point or collapse point, aside from the minimization of the service interruption cost [11]. This approach is based on the concept of the static stability margin and its sensitivity value at the maximum loading point. The voltage stability criterion is modeled as a soft constraint into the load shedding scheme. This method was implemented on the IEEE 14-bus system.PSO can identify the global optimum solution more quickly its convergence time is less so more suitable for on line applications

IV. ANT COLONY OPTIMIZATION

ACO [12] is a meta-heuristic way of solving tough combinatorial optimization problems. This pheromone traillaying and following habits of actual ants, designed to use pheromones as being a communication choice, inspired the development associated with ACO. In

an analogy to the biological case in point, ACO will depend on indirect communication within a colony associated with simple providers, called (artificial) ants, mediated by means of (artificial) pheromone hiking trails. The pheromone hiking trails in ACO work as distributed numerical data, in that your ants are used to assemble probabilistic methods to the difficulty being sorted out and adapt because of their search practical knowledge during algorithm execution [13].

V. BIG BANG BIG CRUNCH FOR UVLS

Newly come forth optimization te chnique known as the BB-BC algorithm is just like the GA because it creates a preliminary population randomly [14]. The creation from th e initial population is known as the big-bang p hase. In this specific phase, the candidate solut ions tend to be spread uniformly above the sea rch living space. The big-bang phase is then t he big-crunch phase. The big-crunch can be a convergence operator containing several advices but one output as well as center involving m ass. The idea of “mass” identifies the inverse f rom the fitness functionality value.

In reference [15], optimal dimensions of Acco mmodating AC Transmissions (FACTS) to furt her improve the voltage stability limit in additi on to voltage user profile, as well concerning minimize real power deficits are confirmed. Th e voltage stability limit development and real p ower damage minimization tend to be tested fo r the standard IEEE 30-bus method under stan dard and N-1 line outage contingency conditio ns.

VI. FUZZY LOGIC BASED FOR UVLS

Fuzzy Logic (FL) is a mathematical tool befitting modeling a system that will be too complicated and vaguely described by mathematical formulation. FL may be widely employed in nearly all part of your power technique. Many experts have employed FLC intended for load reducing application. A unclear controller may be used intended for intelligent weight shedding to produce vulnerability control inside a grid-connected power system [16]. The FLC done accurate weight shedding on the IEEE 300-bus check system throughout contingencies. The fuzzy reason application intended for preventing voltage fall by reducing weak weight buses will be presented throughout [17]. The technique was tested on the Ward-Hale 6-bus system and the IEEE 15, 30, along with 57-bus methods. The simulation final results show the FLC technique is usually implemented on the system associated with any sizing. Sallam along with Khafaga [18] employed FLC intended for load shedding to obtain voltage stability in the IEEE 14-bus technique. Simulation final results show in which load shedding with all the fuzzy reason controller stabilized the device and refurbished the voltage to your nominal worth.

Table 2 advantages and disadvantages of Meta-Heruistic Techniques

S.NO	Technique	Advantages	Disadvantages
1	GA	GA is global optimization technique for solving non-linear multi-objective problems	GA respose is slow
2	PSO	PSO is faster and have the ability to find optimum value	PSO is easily interrupted by partial optimization
3	FLC	FLC may be used on large power systems	The membership parameters of FLC require prior information
4	BB-BC	Ability to solve probles that depends on large number of variables	It is nature-inspired algorithm
5	ACO	Can be use in Dynamic applications,its convergence is guranteed	Time of convergence is uncertain.very complicated coding

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VI. CONCLUSIONS

Load shedding schemes are initiated in order to relieve system overload and correct the declining system voltage. With the numerous developments of meta- heuristics methods for the purpose of finding optimized load shed amount signifies its importance for the stable and reliable power system operations globally. More advanced simulations are required in order to further prove the comparison studies of the proposed methods for a large power system network. It can be concluded that implementation of meta heuristic methods for UVLS can reduce the possibility of Blackouts, and enhance the power system's reliability. It is clear from table2 that each technique have some advantages and some drawbacks. However further development for hybridization of these techniques will assured the Power System security .The under voltage problem can be reformulated in the future by other UVLS techniques implemented by optimization methods

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