"Efficient Power Distribution Based On Virtual MIMO Model With Swarm Intelligence"

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Abstract –

This paper presents the efficient and economic power distribution based on switching operation **.** For efficient power distribution load should be balance among the feed lines, and various parameters like , such as voltage, current in the line, temperature, pressure, and oil level of the transformers continuously monitoring is required. Now a days, automation is done with the help of Intelligent Electronic Devices (IEDs) and Supervisory Control and Data Acquisition (SCADA). This paper proposes a method for efficient distribution of power with particles swarm optimization algorithm using MATLAB.

***Keywords*- -** *Power, Centralized Monitoring and Control, Performance Improvement, and Distribution Automation.*

I. INTRODUCTION

The main objective of the paper is to presents a simulation for efficient power distribution using particle swarm optimization algorithm with switching operation for economic distribution of power in the power distribution system . The balancing of load is done with the help of switches.

Due to increase in demand and consumption of electrical energy a natural growth was presented by the distribution power system. This is due to dependence on power by modern society's and in large urban centers and in regions of greater industrial concentration. The occurance of faults along the line is very inherent to the power distribution system or even greater due to the rise in complexity and natural factors. So, after the occurance of fault , it is extremely important that the distribution of power supply should be such with minimum loss and up to the satisfaction of the customers. If the faults occurance is greater , the greater the loss for the company as well as for the consumer. This situation becomes worse when the fault reaches in an industrial area. To reduce the losses of power load balancing, process is required.

II. SWARM INTELLEGENCE

SI systems are typically made up of a population of simple agents interacting locally with one another and with their environment. The group of individuals acting in such a manner is referred to as a swarm. The term stigmergy is used to describe the indirect form of communication between individuals in a swarm via environment (one individual modified the environment, which in return modified the behavior of other individuals - they respond to the change). Individuals within the group interact by exchanging locally available information such that the problem (global objective) is solved more efficiently than it would be done by a single individual. Problem-solving

behavior that emerges from such interactions is called swarm intelligence.

Such algorithmic models of that kind of behavior are called computational swarm intelligence (CSI). Mostly it is known as ”swarm intelligence”. and self-organized includes all social behavior activities. Self organization (SO) is a set of dynamical mechanisms where the structures which appear from interactions among its lower-level components.
at the global level of a system .

SO relies on four basic ingredients:
1.Positive feedback (amplification) examples are recruitment and reinforcement. For example, a food source recruitment is a positive feedback that relies on trail-laying and trail-following in some t species..
2. A Negative feedback is used which balances the positive feedback and helps to stabilize the collective pattern in the form of saturation, and exhaustion or competition.
3. Amplification of fluctuations randomness is often crucial since it enables discovery of new solutions.
4. *A* self-organized structure is required to generate with a minimal density of mutually tolerant individuals for multiple interactions.

The main objective of SI is used to solve complex problems, mostly optimization problems by modeling the simple behavior of the individuals, their local interactions with the environment and neighboring individuals, in order to obtain more complex behaviors. A critical number of individuals are required for an “intelligence” . The two Best known SI algorithms are:

1. Particle Swarm Optimization (PSO)
2. Ant Colony Optimization (ACO).

SI techniques are population-based stochastic methods used in combinatorial optimization problems in which the collective behavior of relatively simple individuals arises from their local interactions with their environment to produce functional global patterns. There is no best optimization technique for all the problems. Each method has its advantages, and the set of parameters define the quality of the solution.

Now a day’s engineers are increasingly interested in swarm behavior since the resulting swarm intelligence can be applied in optimization (e.g. in telecommunication systems), robotics, traffic patterns in transportation systems, military applications, power distribution systems etc. More and more new applications arise from the research in SI. Every problem, application, which has some kind of optimization, can be tackled with SI techniques.

Swarm WSN management is a new rapidly developing field that gets the inspiration from swarm intelligence. The animal societies are good examples of what future WSN management might achieve, but they are not at all limited by biological plausibility. The efficiency, flexibility, robustness, and cost are possible criteria that should be used in development of such systems problems.

1. PARTICLE SWARM OPTIMIZATION

Swarm Intelligence is optimization technique which is based on social behavior of swarming animals, for example a flock of birds or school of fish. It was developed by James Kennedy and Russel Eberhart in 1995 [3,5]. Then it is, applied in various areas like in function optimization, power distribution system , the traveling salesman problem, telecommunications, and others. This provides an excellent solution to optimization combined problems. There are many similarities between PSO and Genetic Algorithm (GA). The basic concept of both algorithms are same as they will produce an initial solution randomly at first and then through iterations of the evolution process, optimal solution can be obtained. The Genetic algorithm varies from PSO . PSO have no explicit selection, crossover and mutation operations and the concept of PSO is simple, and is easy to implement. And therefore , the PSO is a powerful algorithm to aid and speed up the decision-making process for reconfiguration problem to identify the best switching strategy. PSO is designed for continuous functions optimization, and not for discrete functions optimization. Therefore, Kennedy and Eberhart proposed a modified version of PSO called Binary Particle Swarm Optimization (BPSO) that can be used to solve discrete function problems.

PSO is a robust stochastic optimization technique which is basically based on the movement and intelligence of swarms. PSO applies the concept of social interaction for solving various problems. In which each particle tries to modify its position using the following information: the current

positions, the current velocities, the distance between the current position and pbest, the distance between the current position and the gbest. Each particle also keeps track of its coordinates in the solution space which are associated with the best solution (fitness) that has achieved so far by that particle. This value is called personal best , a *pbest value*.

PSO tracked another best value and that is the best value obtained so far by any particle in the neighborhood of that particle. This value is called global best or *gbest value* .

PSO accelerates each particle toward its pbest and the gbest locations, with a random weighted acceleration at each time step.

The modification of the particle's position can be mathematically modeled according the following equation :

$$\mathbf{V_i^{k+1} = wV_i^k + c_1\ rand_1(\ldots)\ x\ (pbest_i - s_i^k) + c_2\ rand_2(\ldots)\ x\ (gbest - s_i^k) \ldots\ (1)}$$

where,

v_i^k: velocity of agent i at iteration k,

w: weighting function

c_j:weighting factor,

rand: uniformly distributed random number between 0&1

s_i^k : current position of agent i at iteration k,

$pbest_i$: pbest of agent i,

gbest: gbest of the group.

III The Power Distribution Sytsem

To reduce the operational problems of distribution networks by the electric utilities Electric Power Distribution Automation system is adopted . The Distribution Automation not only provides a system with health monitoring system but also helps in coordinating controls which was required to increase the quality and reliability of the power supply. This system was maintained using a system which have the extensive size of the network, & this was achieved with in coordination of information technology ,which was utilizing the available high speed computers and communication networks. Such a system of monitoring and control of electric power distribution networks is also known as the Distribution Automation System.

The economic growth and development of a country depends on the efficient power distribution system which was heavily depending on the reliability and quality of the electric power supply. For the addition of the generation and expansion of the transmission networks, rigorous planning is required and the distribution systems which have generally grown in an unplanned manner resulting into poor quality of power with a high technical and commercial losses.

Due to non-availability of system topological information, current health information of the distribution components such as distribution transformers and feeders, historical data etc. an efficient operation and maintenance of distribution system are hampered and disturbed. The distribution system can also be hampered due to lack of availability of efficient tools for advanced methodology for quick fault detection, operational planning and isolation, and service restoration, etc. All these lead to the increased peak demand of power supply with system losses, poor quality and reliability of power supply.

To get the solution of all the above problems , it is very necessary to improve and upgrade the operation of distribution systems and hence to improve the quality of power supply. This can be achieved by use of better and improved methods, for proper monitoring and control of the distribution system. An Automation System can encompasses data acquisition, telemetry and decision making system. which involves the collection of information, transferring the information to a DCC, and displaying the information and carrying out analysis for control decisions and improvement and enhancement the operation of the distribution system operation .

The distribution system control action is initiated by using, either through remotely operable devices or by manually. There are two key software elements – one the Master DA Software and another an Engineering Analysis Software at the DCC. The main task of the master DA software is to collect all the system data that is both the static and dynamic data and converts this data into an information system. The engineering analysis software is used to provide the control decision by utilizing the system information, available at the DCC. One of the most important feature of the distribution system which distinguishes it from the normal SCADA (Supervisory Control and Data Acquisition) system., is the decision making feature of the

distribution automation system In the conventional SCADA system, the most important is the control decision and hence it is supervisory, i.e., on the basis of experience and the available real time data. the control decision is taken manually and then it is executed through the man machine interface. On the other side, in the DA system ,computer based control decisions are taken and through human intervention , these control decisions are executed in either automatic mode or in semi-automatic mode.

Thus the system have many benefits as the system have a distribution automation with reduced technical loss, , improved cash flow, low service restoration time, reduction in equipment damage, availability of system information, better operational planning, remote load control and shedding, and improved power quality and reliability and it also support for commercial loss reduction..

V CONCLUSION

An efficient and economic power Distribution system can be indigenously designed, developed using the particles swarm optimization algorithm. As it reduces the power loss and other losses by providing economic power supply without effecting much area even under faulty condition .Even in case of some fault occur in the generator side ,the distribution system will works by supplying electric power to the substation and satisfying the load condition.

A developed Distribution Automation System include: Monitoring of voltage, current, Power factor, real power, reactive power, voltage and Current balance etc. on in-coming / out-going feeders and transformers.

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