

PSO ALGORITHM BASED ON OPTIMAL COORDINATION OF DIRECTIONAL OVER CURRENT RELAYS IN MICROGRIDS

S.Sumitha¹, R. Bibin Bose²

¹PG Scholar, Dept. of EEE, Udaya School of Engineering, Vellamodi

²Assistant Professor, Dept. Of ECE, Udaya School of Engineering, Vellamodi

ABSTRACT- Distributed Generations (DGs) and micro grids play a significant role in development of power systems. DGs produce several protection problems especially in optimal coordination of Directional Overcurrent Relays (DORs). Optimal coordination of DORs is a highly constrained Non-Linear Programming Problem (NLPP), which has attracted attention of many research studies in recent years. PSO Algorithm is introduced as an optimization tool in this project. Directional overcurrent relays measure the fault current magnitude of each phase and issue a trip signal after a specific operating time, which depends on setting values and the fault current magnitude. The over-current protection can be given directional feature by adding directional element in the protection system. Directional over-current protection responds to over-currents for a particular direction flow. If power flow is in the opposite direction, the directional over-current protection remains un-operative. The primary protection is the first line of defense and is responsible to protect all the power system elements from all the types of faults. The backup protection comes into play only when the primary protection fails. The important requirement of backup relaying is that it must operate with sufficient time delay so that the primary relaying is given a chance to operate. An accurate fault clearance takes place, if primary and backup relays are set and coordinated properly, but the coordination becomes more complicated by the advent of DGs.

I. INTRODUCTION

In an interconnected power system, abnormal conditions (faults, overload, over voltage, etc.) can frequently occur. Due to this, interruption of the supply and damage

of equipment's connected to the power system may occur. During these situations, the faulted components must be readily identified and isolated in order to guarantee the energy supply to the largest number of

consumers as possible and to maintain the system stability. Therefore a reliable protective system is required. So, to ensure reliability, a backup protective system should be provided in the case of failure of main or primary protective device (relay failure or breaker failure). This backup protection should act as a backup either in the same station or in the neighboring lines with time delay according to the selectivity requirement. This time delay ensures reliability, so that the backup system doesn't come into action unless the primary system fails. The determination of the time delays of all backup relays is known as coordination of the protection system. This time delay is known as Coordination time interval.

II. LITERATURE REVIEW

H. B. Elrafie, M. R. Irving (1993) have developed a linear programming method with constraint relaxation is applied to the directional overcurrent relay coordination problem in an interconnected power network. This method allows for hierarchical constraint relaxation and removal in cases where an infeasible problem exists. This method is applied to coordinate the directional overcurrent relays for an example interconnected power network with six buses and seven lines. Different suggestions for choosing the pickup current and the resulting time dial settings are presented. These results are compared with those given by the breakpoint approach. A complete algorithm for

calculating the time dial settings corresponding to given pickup currents is introduced to make this method suitable for computer implementation. Advantage of this system is Produces better results. Disadvantages are Low reliability and Slow convergence.

Dinesh Birla, Rudra Prakash Maheshwari, and H. O. Gupta (2006) have investigated this viewpoint and verify that indeed by such an approach the optimality is not lost. But, this study reveals that in doing so, the coordination quality is sacrificed to some extent. It is also observed that if all remaining valid constraints (after relaxing few constraints based on the back-up coordination philosophy and strength of fault level generated) are considered and if the objective function is changed to running sum of all violating constraints, all valid considered constraints are satisfied. It produces Better performance. Disadvantages are Time consuming process and Low efficient method.

MostafaBarzegari, S.M.T Bathae, Mohsen Alizadeh (2010) have presented a harmony search algorithm (HSA) for optimal coordination of DOR in a looped distribution system. Directional over current relays (DOR) are used to protection of interconnected networks and looped distribution systems. Several techniques and formulations have been proposed to solve the optimal coordination of DOR problem. The algorithm is developed to a new

Improved harmony search algorithm (IHSA) to solve the same problem. IHSA employs a new method that enhance fine tuning and convergence rate of HSA. The optimal settings of over current relays for a standard distribution network are obtained and comparison between the new methods and some other methods is made. The advantages are More computational speed, Better efficiency. Disadvantages are Less accuracy and Slow convergence.

Dharmendra Kumar Singh, S. Gupta (2012) have developed the optimization of coordination of directional overcurrent relays in an interconnected power system is presented. The objective of protective relay coordination is to achieve selectivity without sacrificing sensitivity and quick fault clearance time. The calculation of the time dial setting (TDS) and the pickup current (I_p) setting of the relays is the core of the coordination study. The inequality constraints guarantee the coordination margin for each primary/backup relay pair having a fault very close to the primary relay. Using this formulation, the size of the optimization problem is significantly reduced. Genetic algorithm is the algorithm being applied to minimize the operating times of the relays. In this paper both linear and nonlinear equations are framed for the test bus system used and optimized using the genetic algorithm. Advantages are Minimize the operating time of relays and Increase the operation speed. Disadvantages are High complexity and Low performance. Christo Ananth et al. [6] discussed about Improved

Particle Swarm Optimization. The fuzzy filter based on particle swarm optimization is used to remove the high density image impulse noise, which occur during the transmission, data acquisition and processing. The proposed system has a fuzzy filter which has the parallel fuzzy inference mechanism, fuzzy mean process, and a fuzzy composition process.

III. PROPOSED SYSTEM

Directional overcurrent relays measure the fault current magnitude of each phase and issue a trip signal after a specific operating time, which depends on setting values and the fault current magnitude.

The over-current protection can be given directional feature by adding directional element in the protection system. Directional over-current protection responds to over-currents for a particular direction flow. If power flow is in the opposite direction, the directional over-current protection remains un-operative.

The protection provided by the protective relaying equipment can be categorized into two types as:

1. Primary protection
2. Backup protection

The primary protection is the first line of defence and is responsible to protect all the power system elements from all the types of faults. The backup protection comes into play only when the primary protection fails. The important requirement of backup

relaying is that it must operate with sufficient time delay so that the primary relaying is given a chance to operate.

An accurate fault clearance takes place, if primary and backup relays are set and coordinated properly, but the coordination becomes more complicated by the advent of DGs.

In this project, the hybrid PSO-LP approach is employed to optimize the coordination problem of DORs in grid-connected and island mode operations of Micro grids by taking Fault current limiter (FCL) into account. Coordination problem can be solved by setting the relay parameters such as pick up current and time delay settings. The FCL value is also optimally determined as an integrated problem with DORs settings. The type of the FCL used in this research is inductive. The FCL is placed where the micro grid is connected to the utility. The current for which the relay initiates its operation is called pick up current of relay. The time dial setting adjusts the time delay before the relay operates whenever the fault current reaches a value equal to, or greater than, the relay current setting.

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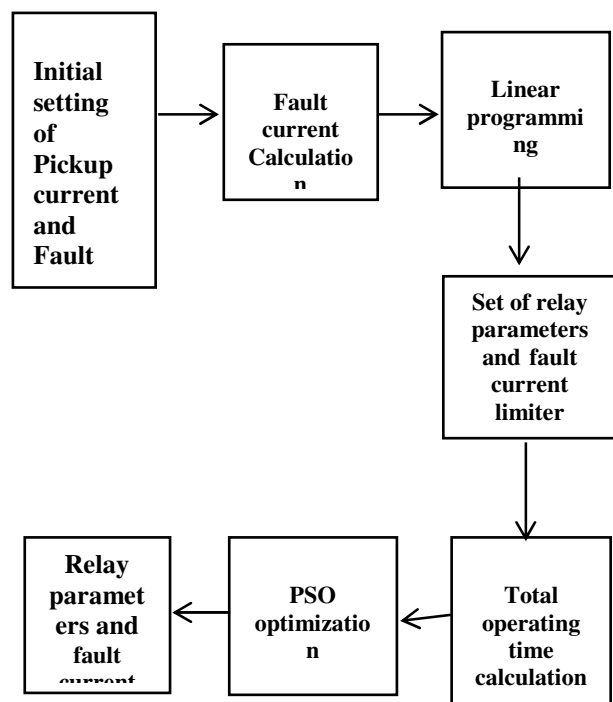


Fig.1 Block diagram

IV. PARTICLE SWARM OPTIMIZATION

Particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given

measure of quality. It solves a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formula over the particle's position and velocity. Each particle's movement is influenced by its local best known position, but is also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions.

Particle Swarm Optimization might sound complicated, but it's really a very simple algorithm. Over a number of iterations, a group of variables have their values adjusted closer to the member whose value is closest to the target at any given moment. Imagine a flock of birds circling over an area where they can smell a hidden source of food



Fig.2 Single sighted topology

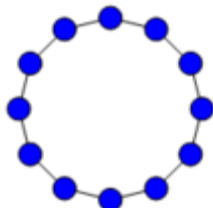


Fig.3 Ring topology

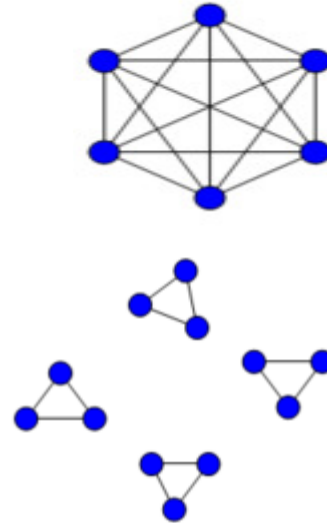


Fig.4 (a) Fully connected topology

Fig.4 (b) Isolated Topology

The one who is closest to the food chirps the loudest and the other birds swing around in his direction. If any of the other circling birds comes closer to the target than the first, it chirps louder and the others veer over toward him. This tightening pattern continues until one of the birds happens upon the food. It's an algorithm that's simple and easy to implement.

A basic variant of the PSO algorithm works by having a population (called a swarm) of candidate solutions (called particles).

1. These particles are moved around in the search-space according to a few simple formulae

a. Updation of particle's velocity:

$$\mathbf{v}_{i,d} \leftarrow \omega \mathbf{v}_{i,d} + \phi_p r_p (\mathbf{p}_{i,d} - \mathbf{x}_{i,d}) + \phi_g r_g (\mathbf{g}_d - \mathbf{x}_{i,d})$$

b. Updation of particle's position:

$$\mathbf{x}_i \leftarrow \mathbf{x}_i + \mathbf{v}_i$$

2. The movements of the particles are guided by their own best known position.

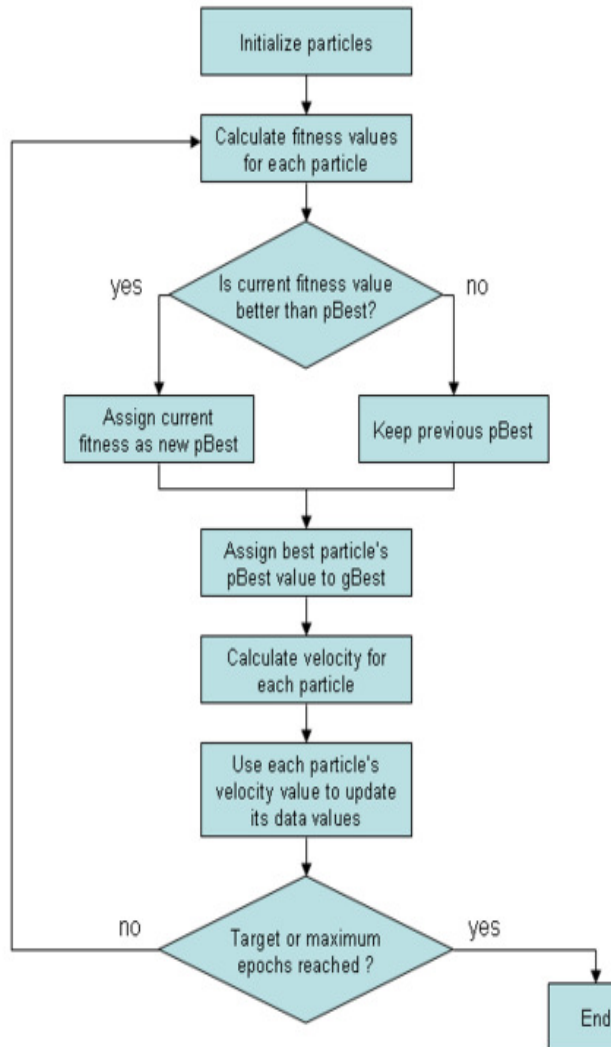


Fig.5 Flow diagram

V. RESULT

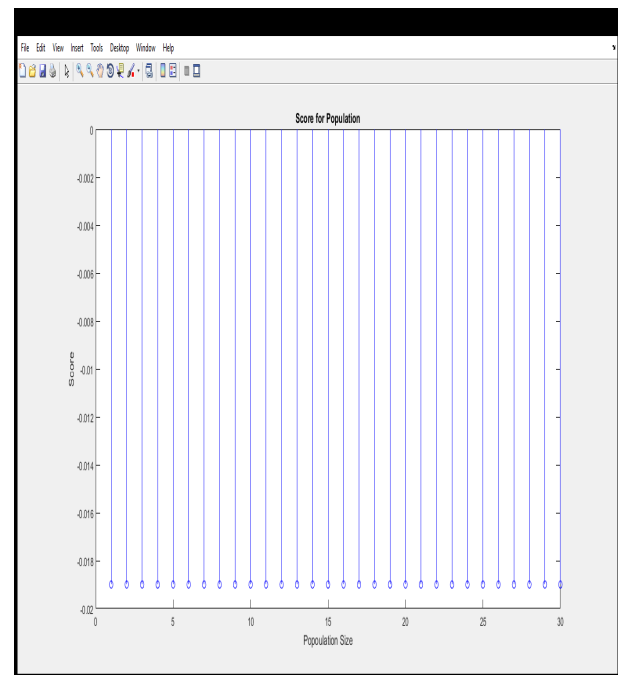


Fig.6 PSO Scope

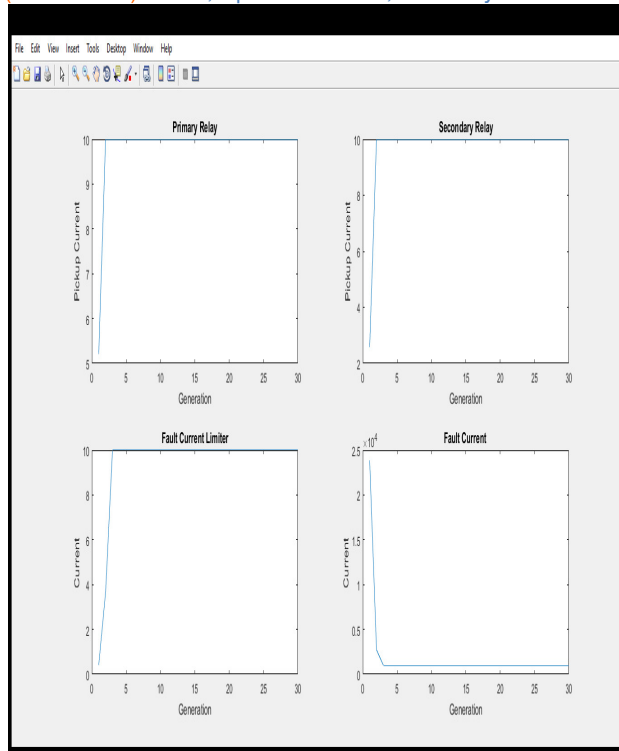


Fig.7 PSO Optimization for current

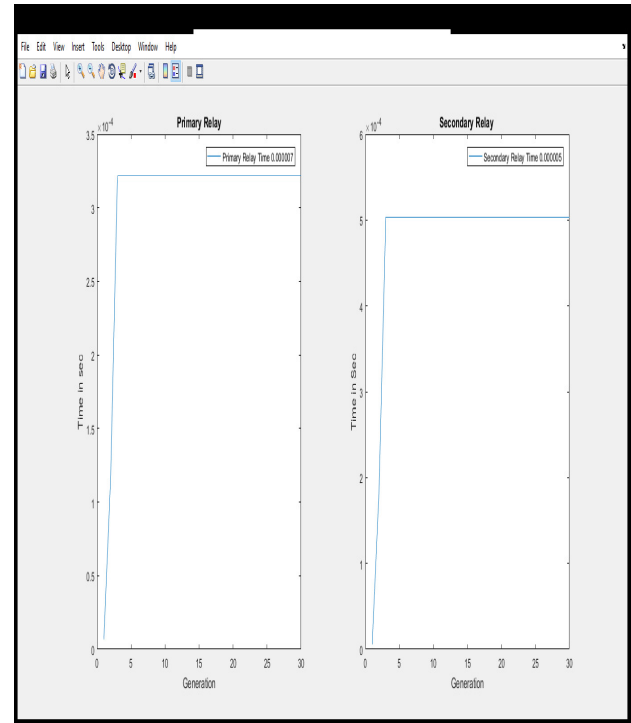


Fig.8 PSO Optimization for Time

VI. CONCLUSION

An optimization methodology is implemented to solve the problem of coordinating directional overcurrent relays in an interconnected power system. The algorithm was also compared with other optimization algorithms, and it was shown that the proposed algorithm is converged to the optimum solution faster than the other methods in both operating modes of microgrids. In future, the optimization of the coordination of Directional over current relays will analyzed by BAT algorithm.

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