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Optimal Feeder Reconfiguration and DG Placement in Distribution Network

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Abstract
This paper presents an efficient algorithm for network reconfiguration associated with DG allocation to minimize real power losses in radial distribution networks. A modified Binary Particle Swarm Optimization algorithm, called Selective Particle Swarm Optimization algorithm (SPSO), is used to solve network reconfiguration problem. Allocation of DG units has been done by sensitivity analysis. A multi objective function is formulated to solve the problem of real power loss minimization and voltage profile improvement in distribution system. The type-I DG (which gives only active power) is used here. The effectiveness of proposed algorithm is demonstrated on IEEE 33 bus radial distribution systems at three different load levels namely light, nominal and heavy loads. Maximum penetration of DG is considered in a range of 0-30% of total system load. The results are promising when compared with recently proposed algorithms.

Keywords: Feeder Reconfiguration, Selective Particle Swarm Optimization algorithm (SPSO), Distributed Generation, Sensitivity Analysis

Introduction

The main purpose of electric power system is to efficiently generate, transmit and distribute electrical energy. There is an increasing trend to automate the distribution system. It has become possible to install distribution operating center to monitor and control the distribution networks as well as reconfiguring the distribution system to reduce the power losses and balance loads under normal operating conditions. Distribution networks have two types of switches, sectionalizing switches that are normally close and tie switches that are normally open. The distribution system has to operate in a way that the operating costs would be reduced as much as possible while the distribution system is supposed to remain radial, all loads should be provided, the transformers and lines should not be overloaded, and the voltage drop should remain within the permissible limit. Network reconfiguration for loss reduction was first proposed by Merlin and H. Back [1]. They solved the problem by the branch and bound method. *Civanlar et. al. [2]* introduced a simple method for calculating the power loss by branch exchange method. The drawback is final solution depends on the initial status of the switches. *D. Shirmohammadi, et. al [3]* presented the power flow method *to* reduce their resistive line losses under normal operating conditions. *S. K. Goswami et-al [4]* presented a heuristic algorithm for the reconfiguration of feeders. G. J. Peponis *et-al [5]* developed two heuristic methods to minimize the resistive line losses as well as for load balancing. Y. H. Song *et-al [6]* presented a fuzzy controlled EP (FCEP) based approach for reconfiguration. *Ching-Tzong Su et-al [7] used* simulated annealing (SA) technique for power-loss reduction and voltage profile enhancement in distribution systems. J. Z *Zhou et-al [8]* presented refined GA method to solve the feeder reconfiguration problem. *Debapriya Das [9]* presented a method for feeder reconfiguration problem by using heuristic rules and fuzzy multi objective approach. *K. R. Niazi, et-al [10] presented* analytical approach using incremental complex power concept to solve network reconfiguration problem. In *[11]* Plant Growth Simulation Algorithm (PGSA) was employed to solve feeder reconfiguration problem. *Essa*-J-Abdul Zehra *et. al. [12]* used branch exchange method to solve feeder reconfiguration problem in radial distribution system. In *[13]*, Niknam, *et-al* presented a multi-objective honey bee mating optimization (MHBMO) evolutionary algorithm to solve the multi-objective distribution feeder reconfiguration. *Wu-Chang Wu et. al. [14]* presented an enhanced integer coded particle swarm optimization (EICPSO) technique to determine the switch operation schemes for feeder reconfiguration. In *[15] [B. Amanulla et. al.* used binary particle swarm optimization (BPSO) technique to determine the optimal configuration of switches in the network in order to maximize the reliability at the load points. *Ying-Yi Hong et-al [16]* presented PSO algorithm to