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A combined sensitivity factor based GA-IPSO approach for system loss reduction and voltage profile enhancement

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ABSTRACT

Though several algorithms for optimizing DG location and size in a network with the aim of reducing system power losses and enhancing better voltage profile have already been proposed, they still suffer from several drawbacks. As a result much can be done in coming up with new algorithms or improving the already existing ones so as to address this important issue more efficiently and effectively. Majority of the proposed algorithms have emphasized on real power losses only in their formulations. They have ignored the reactive power losses which is key in the operation of power systems. In modern practical power systems reactive power injection plays a critical role in voltage stability control, thus the reactive power losses need to be incorporated in optimizing DG allocation for voltage profile improvement. The results of the few works which have considered reactive power losses in their optimization can be improved by using more recent and accurate algorithms. This research work aimed at solving this problem by proposing a hybrid of GA and IPSO to optimize DG location and size while considering both real and reactive power losses. Both real and reactive power flow and power loss sensitivity factors were utilized in identifying the candidate buses for DG allocation. This reduced the search space for the algorithm and increasing its rate of convergence. This research considers a multi-type DG; type 1 DG (DG generating real power only), type 2 DG (DG generating both real and active power) and type 3 DG (DG generating real power and absorbing reactive power).

Key words: Distributed Generation (DG), Particle Swarm Optimization (PSO), Genetic Algorithm (GA), system loss reduction, voltage profile improvement.

INTRODUCTION

Distribution Systems

The objective of power system operation is to meet the demand at all the locations within power network as economically and reliably as possible. The traditional electric power generation systems utilize the conventional energy resources, such as fossil fuels, hydro, nuclear etc. for electricity generation. The operation of such traditional generation systems is based on centralized control utility generators, delivering power through an extensive transmission and distribution system, to meet the given demands of widely dispersed users. Nowadays, the justification for the large central-station plants is weakening due to depleting conventional