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Optimal Allocation and Sizing of Distributed Generation

By

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ABSTRACT

The optimal placement and size of distributed generators (DGs) have become a recent avenue to achieve an effective design and provide superior distribution system performance. This thesis uses a hybrid fuzzy-metaheuristic technique to provide an optimal design for the sizing and placement of various types of DGs. The fuzzy logic-based adaptive weights subroutine has been combined with a metaheuristic optimizer in conjunction with a power system model, load flow software, input/output software modules, and three proposed approaches software modules suitable for various types of DGs in the introduced strategy. This work introduces a multi-objective function with dynamic weight modification to minimize active and reactive power losses while also improving the voltage characteristics across the entire system. Furthermore, in addition to the previously published constant power factor and unity power factor approaches, a novel variable power factor methodology has been developed and examined. In this thesis, IEEE distribution systems of 33 and 69 buses were utilized to assess the efficiency and accuracy of the suggested strategy and demonstrate the validity of the new strategy and novel approach.

To estimate the appropriate size and location of three DGs contributing to the selected distribution systems, a unique hybrid optimization approach known as the Hybrid Fuzzy Equilibrium Optimizer (HFEO) is developed. The hybrid technique combines fuzzy logic to dynamically change the weights of the objective function with a recently developed metaheuristic algorithm called equilibrium optimizer to get better performance in the optimization process. For fair verification of the suggested technique, its outcomes were compared with those of five algorithms given in the literature to demonstrate its superiority and reliability over the other state of the art. Some statistical analysis has been built for extensive comparisons to show the minimum objective function, the fastest speed of convergence, the shortest execution time, and the most consistent result.