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ABSTRACT

Distributed generation integration to power system is important for customer and utilities both. However, in spite of several advantages like reduction in power loss, improvement in voltage profile, better power quality and reliability. Integration of DG to the power system has several challenges also which needs to be focused while integrating. The benefits of the employing DG to the distribution system can be classified in three major categories technical benefits, Environmental benefits and Economical benefits. Technical benefits include minimum energy losses, improved voltage profile, improved power quality and reliability. Environmental benefits include low emission, low noise and green power. Economical benefits include reducing electricity cost, transmission and distribution cost saving etc. Therefore, the aim of the research work in this thesis is to develop and implement optimization methodologies for the strategic planning and operation of dispatchable and nondispatchable DG units considering various objectives subject to the constraints in distribution networks.

The primary contribution of the thesis is to address the development and implementations of different analytical, metaheuristic and hybrid method for the allocation of several types of dispatchable and nondispatchable energy resources under various different loading conditions and performance parameters in radial distribution systems.

At the beginning, an analytical method based on exhaustive search approach has been developed for the allocation of DG. This method has capability to handle the nonlinear optimization problem. Different types of distributed generation with objective function as loss minimization and voltage profile improvement are considered for the study.

Afterward, a Crow search algorithm (CSA) is implemented to find the optimal location and size of DG in distribution networks. This method can handle discrete and continuous variables both. Further, this algorithm is validated for the minimization of power loss subject to equality and inequality constraints. It is observed that this method gives equal or better performance than analytical or other heuristic methods.

Afterwards, Crow search algorithm is implemented for dispatchable DG. Here the modeling of solar PV generation and battery energy storage is considered for the study. Further the algorithm is validated for multiobjective function. Result is compared with Genetic algorithm (GA), Particle swarm optimization (PSO) and hybrid PSOGA method. This method presents improved results compare to the other methods discussed in the study.

Afterwards, Analytical crow search method is implemented for the optimal allocation of dispatchable DG in distribution system. Uncertainty of solar PV generation, battery energy storage and load modeling is discussed in details. Analytical method is carried out to calculate the optimal size of the hybrid system while Crow search algorithm is used to find the optimal size of the hybrid system. All the calculation is carried out for 24-hours of the duration. The method is validated for multiobjective function using weighted index approach. The results demonstrate the superiority of the method over other methods EELF, FIA, RELF, RIA, IA, PSO, APSO, FIA methods.

In the proposed work, JAYA algorithm is implemented to find the optimal location and size of nondispatchable DG. JAYA algorithm is a parameter independent algorithm and it is capable of handling mixed integer nonlinear optimization problem with fast convergence characteristics. This method is implemented on multiobjective function where performance parameters considered are power loss, voltage profile and voltage stability index. Different types of DG and loads are considered for the study. The results demonstrate the equal or improved results compare to the GA/PSO, TLBO, IWO methods.

The proposed work discusses about the allocation of dispatchable and nondispatchable DG using analytical, Crow search, analytical crow search and Jaya algorithm method. Out of all these methods Jaya algorithm gives improved result and it is easy to implement. Analytical methods give accurate result and less convergence time for small distribution network while heuristic methods are independent of the size of the distribution network from convergence point of view. But sometimes it gives local optimal vale also. Therefore for some problem formulation analytical methods are accurate while for others heuristics methods are accurate. There is no universal algorithm which gives accurate result for all the problem formulation.