



# DG allocation with application of dynamic programming for loss reduction and reliability improvement

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## ABSTRACT

Distribution system companies intend to supply electricity to its customers in an economical and reliable manner whereas customers in most distribution system are outspread and connect to distribution system with different type of equipments. These equipment usually have various types and resistance together, that produce highest loss and lowest reliability for distribution systems and customers that are not appreciated in networks. Distributed generations (DGs) are one of the best reliable solutions for these problems if they are allocated appropriately in the distribution system. This paper presents multi-objective function to determine the optimal locations to place DGs in distribution system to minimize power loss of the system and enhance reliability improvement and voltage profile. Time varying load is applied in this optimization to reach pragmatic results meanwhile all of the study and their requirement are based on cost/benefit forms. Finally to solve this multi-objective problem a novel approach based on dynamic programming is used. The proposed methodology is successfully applied to a study case and simulation results are reported to verify the proposed approach.

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## 1. Introduction

Distribution system planners endeavor to supply economical and reliable electricity to customers. It is important to design, operate and maintain reliable power systems with lowest cost and highest benefit. Reliability improvement and loss reduction are two important goals for electrical distribution companies. These companies follow, consider and test a lot of technologies, optimization programs, etc. to bring above economic benefits and provide electricity with high quality and reliability and prevent interruptions in system because cost of interruptions and power outages can result severe economic impact on utility and customers.

With recent advances in technology, use of distributed generation (DG) in the power distribution system can provide the most economical solution and keep network in proper situation. A lot of Papers and studies have been carried out in recent years to present methodologies in DG placement and sizing.

One of the criteria to search the optimal DG allocation is minimizing power loss or reliability improvement.

Several papers have been published that address the use of artificial intelligence algorithms, analytical approaches or load flow approaches to optimize DG placement [1–12] based on minimizing

power loss. Authors in [1,2] solve the problem by analytical approach [3], employs non-linear programming [4], uses combination of genetic algorithm and simulated annealing [5,6], present genetic algorithm [7], submits tabu search method and [8] uses fuzzy approach for optimization of its algorithm [9,10], apply load flow approaches [11], uses sequential optimization and [12] uses heuristic approach.

All papers presented in [1–12] deal important problems and weaknesses that are listed on below mentioned clauses:

- All the simulations performed in [1–12] address a static load condition. Objective function optimization based on a single load point, such as the peak load, may not provide reliable results.
- Reliability aspects in above mentioned papers are not considered while applying DGs to a distribution system can contribute to improving system reliability.
- DG placement in network has not been considered with evaluating reliability and loss at the same time.

Also some papers have appreciated approaches in their methodologies like [13], but considering static load condition in their concepts may not lead to satisfactory results.

This paper tries to overcome above mentioned weakness and proposes a novel algorithm to optimize objective function. To follow this proper purpose, first time-varying loads are taken into

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