Environmental Engineering and Management Journal

November 2023, Vol. 22, No. 11, 1913-1924
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu
http://doi.org/10.30638/eemj.2023.165

"Gheorghe Asachi" Technical University of Iasi, Romania

MOBSDEA-BASED OPTIMAL SIZING AND SITING OF RENEWABLE ENERGY-BASED DISTRIBUTED GENERATION UNITS TO REDUCE: POWER LOSSES, ELECTRICAL ENERGY COST AND VOLTAGE PROFILE DEVIATION

Mosayeb Moradi[1], Maryam Najafi[2], Ali Kakavand[3], Ali Darvish Falehi[4*]

[1]Department of Electrical Engineering-Control, Islamic Azad University, Tehran Science and Research Branch (Damavand), Tehran, Iran
[2]Isfahan Electricity Distribution Company, Isfahan, Iran
[3]Persian Gulf Bidboland Gas Refining Company, Behbahan, Iran
[4]Department of Electrical Engineering, Shadegan Branch, Islamic Azad University, Shadegan, Iran

Abstract

Optimal sizing and siting of the renewable energy distributed generation (REDG) and capacitor bank (CB) units in the distribution systems takes over several advantageous economical and practical consequences which can effectively enhance the overall performance of distribution system issues. The sizing and siting optimization scheme for REDG, specially wind turbine (WT) and photovoltaic (PV) corresponds to a tough mission because of their stochastic nature. This paper aims to propose a novel optimization scheme based on multi-objective bezier search differential evolution algorithm (MOBSDEA) to solve the accurate sizing and siting of REDG and CB units which will be followed by the economical and practical benefits. Hence, some important objective functions such as: reduction of power losses, cost-effectiveness of electrical energy and enhancement of voltage profile are considered. Two different power systems have been studied to approve the proposed optimal sizing and siting scheme. Finally, the simulations result under IEEE 33-bus and IEEE 69-bus power systems have determinedly confirmed the high-performance of MOBSDEA-based optimal sizing and siting scheme as compared to other optimization algorithms. A brief improvement of simulation results in percentage is presented as follows: (1) the power loss reduction using MOBSDEA-based optimization has been attained 88.2% and 69.8% for IEEE 33-bus and IEEE 69-bus power systems, respectively. (2) The energy production cost reduction using MOBSDEA-based optimization has been attained 19.2% and 32.8% for IEEE 33-bus and IEEE 69-bus power systems, respectively. The voltage profile deviation reduction using MOBSDEA-based optimization has been attained 5.4% and 3.1% for IEEE 33-bus and IEEE 69-bus power systems, respectively.

Key words: capacitor bank, distributed generation, multi-objective bezier search differential evolution algorithm, renewable energy, sizing and siting optimization scheme

Received: June, 2023; Revised final: September, 2023; Accepted: October, 2023; Published in final edited form: November, 2023

* Author to whom all correspondence should be addressed: e-mail: a_darvishfalehi@sbu.ac.ir; falehi87@gmail.com