Managing the Exchange of Energy between Microgrid Elements based on Multi-objective Enhanced Marine Predators Algorithm

Abstract

Optimal planning for the energy storage elements' status of charging and discharging, besides managing the buying and selling energy from the grid, is the first step for enhancing energy usage and saving costs for customers. Therefore, in this work, an enhanced multi-objective optimization algorithm of the Marine Predators Algorithm (MOEMPA) is proposed to handle three objective functions for minimizing the operating cost and emission with maximizing the renewable factor for optimal usage of the energy resources. The proposed MOEMPA is applied for managing the sharing energy in an interconnected microgrid with utility grid. The considered microgrid consists of solar and wind renewable energy sources, diesel for emergence loads, and set of batteries for storage extra energy. The described system used for feeding the required power under three different cases for the weather and the grid continuity/discontinuity along 96 h horizon in India, Delhi. The proposed MOEMPA results are compared with recent multi-objective optimization algorithms including, basic variant of multi-objective versions of marine predators algorithm (MOMPA), grasshopper optimization algorithm (MOGOA), slime mould algorithm (MOSMA), grey wolf optimizer(MOGWO), antlion optimizer (MOALO), and multi-verse optimizer (MOMVO) to assess the performance of the proposed scheduled system based MOEMPA. Furthermore, the baseline system is implemented to provide a comprehensive evaluation for the proposed approach based on MOEMPA. The comparisons and analyses reveal the efficacy and excellence of the proposed approach in minimizing the cost and emission with enhancing the profit for the customers via pro viding an the optimal managing between staging, discharging, buying, and selling decisions. The analysis affirms that, the scheduled system based on MOEMPA has the highest cost-saving of 16.0%, 34.5%, and 26.9% compared with the baseline schedule and other peers over the studied scenarios of operation. Moreover, the schedules based on MOEMPA reduced the emissions by 13.37 % and 14.7%. For the renewable factor, the scheduled system based on MOEMPA enhanced its values to 69.3% and 36.6%; meanwhile, the baseline system has 73.4% and 25.9%, hence the proposed approach guarantee feeding the load with high profit.