APEM journal

Advances in Production Engineering & Management
Volume 18 | Number 4 | December 2023 | pp 403–416
https://doi.org/10.14743/apem2023.4.481

ISSN 1854-6250
Journal home: apem-journal.org
Original scientific paper

A combined genetic algorithm and A* search algorithm for the electric vehicle routing problem with time windows

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ABSTRACT

With growing environmental concerns, the focus on greenhouse gases (GHG) emissions in transportation has increased, and the combination of smart microgrids and electric vehicles (EVs) brings a new opportunity to solve this problem. Electric vehicle routing problem with time windows (EVRPTW) is an extension of the vehicle routing problem (VRP) problem, which can reach the combination of smart microgrids and EVs precisely by scheduling the EVs. However, the current genetic algorithm (GA) for solving this problem can easily fall into the dilemma of local optimization and slow iteration speed. In this paper, we present an integer hybrid planning model that introduces time of use and area price to enhance realism. We propose the GA-A* algorithm, which combines the A* algorithm and GA to improve global search capability and iteration speed. We conducted experiments on 16 benchmark cases, comparing the GA-A* algorithm with traditional GA and other search algorithms, results demonstrate significant enhancements in searchability and optimal solutions. In addition, we measured the grid load, and the model implements the vehicle-to-grid (V2G) mode, which serves as peak shaving and valley filling by integrating EVs into the grid for energy delivery and exchange through battery swapping. This research, ranging from model optimization to algorithm improvement, is an important step towards solving the EVRPTW problem and improving the environment.

ARTICLE INFO

Keywords:
Vehicle routing problem (VRP);
Electric vehicle;
Optimization;
Time windows;
Spatiotemporal electricity price;
Smart microgrids;
Genetic algorithm (GA);
A* search algorithm;
GA-A* algorithm

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Article history:
Received 25 September 2023
Revised 17 November 2023
Accepted 21 November 2023

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