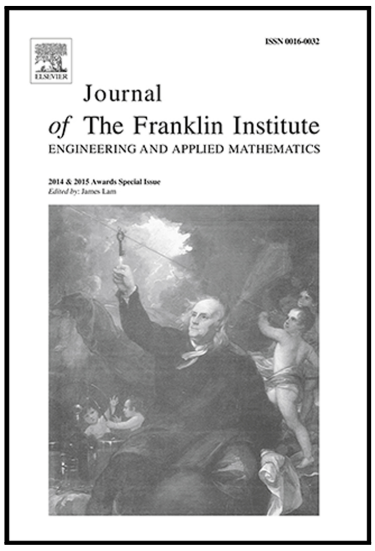

A Novel Combinatorial Optimization Algorithm for Energy Management Strategy of Plug-in Hybrid Electric Vehicle

Liang Li , Liyan Zhou , Chao Yang , Rui Xiong , Sixiong You , Zongqi Han

PII: S0016-0032(17)30393-9
DOI: 10.1016/j.jfranklin.2017.08.020
Reference: FI 3103

To appear in: *Journal of the Franklin Institute*

Received date: 20 March 2017
Revised date: 17 July 2017
Accepted date: 7 August 2017

Please cite this article as: Liang Li , Liyan Zhou , Chao Yang , Rui Xiong , Sixiong You , Zongqi Han , A Novel Combinatorial Optimization Algorithm for Energy Management Strategy of Plug-in Hybrid Electric Vehicle, *Journal of the Franklin Institute* (2017), doi: 10.1016/j.jfranklin.2017.08.020

A Novel Combinatorial Optimization Algorithm for Energy Management Strategy of Plug-in Hybrid Electric Vehicle

Liang Li[1,2], Liyan Zhou[1,3], Chao Yang[1*], Rui Xiong[2,4], Sixiong You[1], Zongqi Han[3]

[1] *State Key Laboratory of Automotive Safety and Energy, Tsinghua University, Beijing 100084, China*
[2] *Collaborative Innovation Center of Electric Vehicles in Beijing, Beijing 100081, China*
[3] *College of Vehicles and Energy, Yanshan University, Qinhuangdao 066004, China*
[4] *National Engineering Laboratory for Electric Vehicles, Beijing Institute of Technology, Beijing 100081, China*

HIGHLIGHTS

- The historical data matrix is built based on the departure time of the buses running on the same route.
- A novel combinatorial algorithm is proposed for the optimization of rule-based control parameters.
- An algorithm transformation mechanism is built in the proposed combinatorial algorithm.
- Adaptive crossover operation is added to the ant colony algorithm to enhance the optimization results.
- The proposed combinatorial optimization algorithm is verified through simulation.

Abstract- Optimization design of energy management strategy (EMS) for plug-in hybrid electric vehicle (PHEV), which significantly affects the vehicle performance on fuel economy and pollutant emission, has always been a focal issue. Of various EMSs, rule-based strategies are dominant in practical applications due to their relatively low computational burden, but to obtain the optimum control parameters precisely and efficiently remains an unsolved problem. In this paper, a novel combinatorial algorithm utilizing the historical data from remote monitoring platform is proposed for the EMS optimization of PHEV. Firstly, the historical driving data are processed, and then a table which records different conditions at different time is built for reflecting the future PHEV operation schedule. Based on the historical data, a combinatorial algorithm which combines the advantages of genetic algorithm (GA) with enhanced ant colony algorithm (EACA) is proposed to optimize the control parameters. The principle of algorithm transformation from GA to EACA is when the objective function value is smaller than the default value after five generations of changing continuously in GA optimization process, and then the control parameter combinations can be regarded as the pheromone for EACA. Results show that the combinatorial algorithm successfully overcomes the low solution precision by GA and the slow resolving speed by EACA. The energy consumption of PHEV on a specific bus route can be reduced greatly by the proposed method, and it can provide a theoretical guidance for practical applications.

Index Terms—combinatorial optimization algorithm; energy management strategy; control parameters optimization; plug-in hybrid electric vehicle

1. Introduction

Nowadays, the dwindling fossil fuel supplies and the severe pollution caused by motor vehicles have aroused grave concern. To address this issue, the international automotive industry has actively been probing new solutions