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Model development and analysis of a mid-sized hybrid fuel cell/battery vehicle with a representative driving cycle

Mohammed Abu Mallouh [a,*], Eman Abdelhafez [b], Mohammad Salah [a], Mohammed Hamdan [b], Brian Surgenor [c], Mohamed Youssef [d]

[a] Department of Mechatronics Engineering, Hashemite University, P.O. Box 150459, Zarqa 13115, Jordan
[b] Department of Mechanical Engineering, Al-Zaytoonah University of Jordan, P.O. Box 130, Amman 11733, Jordan
[c] Department of Mechanical and Materials Engineering, McLaughlin Hall, Queen's University, ON K7L3N6, Canada
[d] Department Electrical, Computer and Software Engineering, Automotive Center of Excellence (ACE), University of Ontario Institute of Technology (UOIT), Oshawa, ON L1H7K4, Canada

HIGHLIGHTS

- Model of mid-sized ICE vehicle is developed and validated.
- Model of hybrid FC/battery vehicle is built based on validated ICE vehicle model.
- Effect of driving pattern on performance is investigated using standard driving cycles.
- Driving cycle that represents the driving patterns in Amman city is developed experimentally.
- Performance of hybrid FC/battery vehicle found to be much better than the ICE version.

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ABSTRACT

Vehicles powered with internal combustion engines (ICEs) are one of the main pollutant sources in large cities. Most of large cities (e.g. Amman, capital of Jordan) suffer from frequent traffic jams. This leads to frequent stops and starts, and hence, an increase in tailpipe emissions. One way to minimize emissions is to use electric motors in the powertrain configuration. In this study, the performance of a hybrid fuel cell (FC)/battery vehicle is investigated utilizing different worldwide driving cycles. Initially, a model of a mid-sized ICE vehicle is developed and validated against experimental tests. The ICE vehicle validated model is then modified to be driven with only an electric motor powered by a hybrid FC/battery system. The effect of driving pattern, which varies from city to city and from region to region, is investigated. A driving cycle that represents the driving patterns in Amman city is developed based on experimental data and then used to evaluate the performance of both ICE and hybrid FC/battery vehicle configurations. It is found that the performance of the hybrid FC/battery configuration is much better than the ICE version in terms of emissions, fuel economy, efficiency, and speed tracking error.