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Issues and Recommendations for Optimising the Energy Management System for Fuel-Cell Hybrid Electric Vehicles

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Introduction

Vehicles and mobile phones, for example, are examples of sustainable and advanced mobility technologies. Since they began to enter the automotive industry on a large scale, hybrid electric vehicles (HEVs) have piqued the interest of researchers and manufacturers. HEVs were first introduced into the automotive market in the 18th century, but it wasn't until the 20th century that they began to make significant advances in the automotive industry. The high demand for Honda Insight and Toyota Prius reflects society's growing awareness of conventional cars' environmental impact and limited fuel supply [1].

With the introduction of battery electric vehicles, automotive manufacturers and researchers were able to solve the problem of GHG emissions (BEVs). BEVs use only battery power and emit no greenhouse gases. However, because electricity is mostly generated by thermal plants, BEVs do not reduce GHG emissions. BEVs have their own limitations, such as a limited driving range, a lengthy battery charging time, a lack of charging stations, and safety concerns when changing batteries. As a result, players in the automotive industry developed a novel technology, namely fuel-cell electric vehicles (FCEVs), which are now making their debut in the automotive market. FCEVs are powered by electric motors that are powered by fuel cells (FC) [2]. Hydrogen mixed with oxygen from the air serves as the primary energy mover in FCEVs.Despite the fact that FCEVs are powered by electric motors,They still have disadvantages as an FC. FCs have a low density.and an approximate maximum efficiency of only 60%; they also lack aInfrastructure for hydrogen refuelling is extremely expensive. Furthermore, using an FC as a hybrid vehicle's sole energy source A startup device is required. As a result, automobile manufacturers developed FCHEVs are powered by an FC and either a battery or a supercapacitor (SC). Daimler Mercedes-Benz F-Cell, Chevrolet VoltGeneral Motors, Toyota FCHV, and Honda FCX are all brands [3].

Batteries are also very expensive because battery lifetime must be extended to reduce the burden of battery replacement.Solano proposed an EMS for degraded operation modes of a fuel cell-battery-ultracapacitor-based HEV to cater for failure modes of either the fuel cell or the ultracapacitor. The simulation results demonstrated that the power feed was successful, which was confirmed by experimental tests. This study, however, was limited to degraded operation and did not take into account fast detection of energy source failure, battery features, hydrogen consumption, or optimization. As a result, the EMS should be optimised to extend battery life and reduce hydrogen fuel consumption.

With the introduction of battery electric vehicles, automotive manufacturers and researchers solved the problem of GHG emissions (BEVs). BEVs run entirely on battery power and emit no greenhouse gases. However, because most electricity is generated by thermal plants, BEVs do not reduce GHG emissions. BEVs have their own limitations, such as a short driving range, a long battery charging time, a lack of charging facilities, and safety concerns when changing batteries. As a result, automotive industry players created a novel technology, namely fuel-cell electric vehicles (FCEVs), which are now making their debut in the automotive market. FCEVs are powered by electric motors that receive power from a fuel cell (FC) [4].

Description

FCEVs, despite being powered by electric motors powered by an FC, have their own set of drawbacks. FCs have a low density and a maximum efficiency of about 60%; they also lack a hydrogen refuelling infrastructure and are quite expensive.Furthermore, using an FC as the sole energy source for a hybrid vehicle necessitates the use of a startup device. As a result, automakers developed FCHEVs, which are powered by an FC and either a battery or a supercapacitor (SC). Daimler's Mercedes-Benz F-Cell, General Motors' Chevrolet Volt, Toyota's FCHV, and Honda's FCX are all hybrid vehicles with an FC and a battery energy system [5].

Conclusion

Previous research indicates that EMS is a critical component of a hybrid vehicle. The energy management system (EMS) is the controller that determines which energy source feeds the power demand for the specific mode of operation. Given that most EMSs ignore battery degradation or FC lifetime, EMS optimization for an FCHEV is critical and required. This paper reviewed and discussed previous studies on the optimization of FCHEV EMS.

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