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Design and Control of a Fuel Cell Powered Electric Lifter

Fu-Cheng Wang, Chung-Huang Yu, Jeff Tsung-Hui Tsai, Bo-Yi Lee, Po-Chen Kuo and Hsiao-Kan Ma

Abstract

This paper illustrates the design and control of a fuel cell powered electric lifter. The fuel cell is an attractive alternative energy source and has been applied to various vehicle systems, such as bicycles, motorcycles, and personnel carriers. In this paper, we integrated a 2 kW proton exchange membrane fuel cell (PEMFC) module with a 3.5 kW electric lifter, and designed a parallel power management system. The study was divided into three main areas: fuel cell control, power management, and system integration. First, we applied robust control strategies to regulate the hydrogen flow rate of the PEMFC in order to provide steady electric power. The designed robust controller improved the system's stability, performance, and efficiency. Second, we constructed a parallel power train, which consisted of the 2 kW PEMFC and a 23 Ah Li–Fe battery set. When the current load was low, the PEMFC was able to provide steady power to drive the lifter and to charge the Li–Fe battery set. Under high current load, both the PEMFC and the Li–Fe battery set provided electricity to operate the lifter. Lastly, these subsystems were integrated for experimental verification. Quantitative comparison of hydrogen consumption and system efficiency demonstrated the effectiveness of the proposed system.