

The development of a hybrid PEMFC power system

Yi-Fu Guo, Han-Che Chen and Fu-Cheng Wang*

Abstract

This paper describes the development of a stationary hybrid power system consisting of a 3 kW proton exchange membrane fuel cell (PEMFC) module, a battery set, and solar cells. We design PEMFC control and power managements for the hybrid system, and construct a simulation model based on experimental data. The simulation model is then used to analyze performance and efficiency of the system, employing different power management strategies. The study comprises three parts: PEMFC control, power management, and the simulation model. First, we apply robust control to regulate the PEMFC temperature and current, and achieve root mean square errors of 0.06 °C and 0.07 A, respectively. Second, we integrate the hybrid power system and design power management strategies for sustainable operation. Third, we develop a Matlab™ SimPowerSystem model based on experimental data. The simulation results are shown to match the experiments with a deviation of 0.21%. Last, we apply the simulation model to discuss the impacts of different power management strategies on system efficiency. Based on the results, the designed controllers and power management strategies are deemed effective at improving system performance and efficiency. In addition, the developed simulation model can be applied in the future to develop customized hybrid power system.