Integration of the Hydrogen Fuel Cell Hybrid Electric Motorcycle System Control and Simulation

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ABSTRACT

The purpose of this study is to establish integration of the hydrogen fuel cell hybrid electric motorcycle system control and simulation environment, and develop its power management fuzzy logic and mode logic controller. Test the plant and controller under the European Community Normalized (ECN) driving cycle, the plant model was build with the dynamic model of scooter, tire model, final drive model, motor model, fuel cell model and storage battery model, etc. The error of fuel cell output power and battery State of the Charge (SOC) were used as input parameters to the controller to optimize control the hydrogen flow so that fuel cell output power and SOC be maximized while maintained the minimum consumption of the hydrogen fuel. As mention for different controller ’ s comparison, fuzzy logic controller showed more fuel cell output power, higher SOC and less hydrogen fuel consumption than the mode logic controller. In the settlement of the fuzzy logic controller parameters, trapezoid membership function after the simulation and analysis, showed more output power of fuel cell and SOC but less hydrogen consumption than triangular distribution. This result demonstrates that the importance of selecting proper continuity membership function. Different optimized strategies for the controller were compared in this study to achieve better performance of the fuel cell motorcycle. First of all, the two fuzzy logic controller input parameters which are output power and SOC errors were optimized corresponding to different performance requirement. The fuzzy controller parameters, then be optimized to clarify the effects of fuzzy controller designs. From the design of experiment analysis, the optimized input parameters and fuzzy controller parameters were sent to the controller and result showed better fuel cell output power and SOC with less hydrogen fuel consumption. If the output power and SOC were to be maximized, while ignored the hydrogen consumption effects, the design of experiment optimization can also be varied for the customer ’ s specification. This simulation optimization integration approach provides engineer more efficiently and more economically adjusting the controller parameters for future fuel cell motorcycle power management system design.

Keywords : Hydrogen Fuel Cell Motorcycle Dynamic Control, Fuzzy Logic Controller, Optimization of Fuzzy Logic Controller Parameters.

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