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# Model Reference Adaptive Control of a Low Power Proton Exchange Membrane Fuel Cell

Yee-Pien Yang, Zhao-Wei Liu and Fu-Cheng Wang

**Abstract**

Nonlinearity and time-varying dynamics of fuel cell (FC) systems make it complex to design a controller for improving the output performance. This paper introduces an application of model reference adaptive control to a low power proton exchange membrane (PEM) FC system, which consists of three main components: a FC stack, an air pump to supply air, and a solenoid valve to adjust hydrogen flow. From the system perspective, the dynamic model of PEMFC can be expressed as a multivariable configuration of two inputs, hydrogen and air flow rates, and two outputs, cell voltage and current. The corresponding transfer function can be identified off-line to describe the linearized dynamics with a finite order at a certain operating point, and is written in a discrete-time auto-regression moving-average model for on-line estimation of parameters. This provides a basis of adaptive control strategy to improve the FC performance in terms of efficiency, transient and steady-state specifications. Experiments show that the proposed adaptive controller is robust to the variation of FC system dynamics and power request.