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Multivariable System Identification and Robust Control of a Proton Exchange Membrane Fuel Cell System

Fu-Cheng Wang, Hsuan-Tsung Chen, Yee-Pien Yang and Hsin-Ping Chang

Abstract

This paper develops a multivariable robust controller for a proton exchange membrane fuel cell (PEMFC) system. To give a perspective of the system, a PEMFC can be simplified as a two-input-two-output model, where the inputs are air and hydrogen flow rates, while the outputs are cell voltage and current. By fixing the output resistance, we aim to control the cell voltage output by regulating the air and hydrogen flow rates. Due to the nonlinear characteristics of this system, a multivariable robust controller is designed to provide robust performance and to reduce hydrogen consumption. The study is carried out in three parts. First, the system transfer functions are experimentally identified. Secondly, robust control algorithms are adopted to design a 2-by-1 H_∞ controller to deal with the system uncertainty and performance requirements. Finally, the designed H_∞ controller is implemented to control the air and hydrogen flow rates. From the experimental results, the multivariable robust control is deemed effective.