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Multivariable LQG Control of a Proton Exchange Membrane Fuel Cell System

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Abstract

This paper applies multivariable linear quadratic Gaussian (LQG) control strategies to a proton exchange membrane fuel cell (PEMFC) system. From the system point of view, a PEMFC can be modeled as a two-input-two-output system, where the inputs are air and hydrogen flow rates and the outputs are cell voltage and current. By fixing the output resistance, we aimed to control the cell voltage output by regulating the air and hydrogen flow rates. Due to the nonlinear characteristics of this system, multivariable LQG controllers were designed to provide steady voltage output and to reduce the hydrogen consumption of this system. The study was carried out in three parts. Firstly, the PEMFC system was modelled as multivariable transfer function matrices using identification techniques. Secondly, LQG control algorithms were utilized to design a multivariable controller. Finally, the designed controller was implemented to control the air and hydrogen flow rates. From the experimental results, multivariable LQG control is deemed effective in providing steady output responses and significantly reducing hydrogen consumption.