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Robust Control Design of a Proton Exchange Membrane Fuel-Cell System

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Abstract

This paper utilizes the system identification and robust control techniques for a Proton Exchange Membrane fuel-cell system. The dynamic behaviour of the fuel-cell system is influenced by many effects, such as the reaction mechanism, pressure, flow-rate, composition and temperature change, and is inherently non-linear and time-varying. However, from the system point of view, a fuel cell can be modeled as a two-input, two-output linear system with inputs of hydrogen and air flow rates, and outputs of cell voltage and current. And the un-modeled non-linear and time-varying characteristics of the system can be regarded as system uncertainties and disturbances that are treated by the designed robust controllers. This paper is comprised of three parts. First, system identification techniques were adopted to model the fuel-cell system. Secondly, a H_∞ robust controller was designed to stabilize the system. Finally, the system stability and performance were compromised by introducing a weighting function to the controller design. From both the simulation and experimental results, the designed H_∞ robust controllers were deemed effective.