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

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

Abstract

This paper will discuss the application of system identification techniques and robust control strategies to a proton exchange membrane fuel-cell system. The fuel-cell system's dynamic behaviour is influenced by many factors, such as the reaction mechanism, pressure, flow-rate, composition and temperature change, and is inherently non-linear and time varying. From a system point of view, however, the system can be modelled as a two-input, two-output linear time-invariant system whose inputs are hydrogen and air flow rates, and whose outputs are cell voltage and current. On the other hand, the system's non-linearities and time-varying characteristics 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 system's transfer functions. Second, the $H\infty$ robust control strategies were applied to stabilise the system. Finally, the system's stability and performance were compromised by introducing weighting functions to the controller's design. From the experimental results, the designed $H\infty$ robust controllers were deemed effective.