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Design and Implementation of Fixed-Order Robust Controllers for a Proton Exchange Membrane Fuel Cell System

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Abstract

This paper applies fixed-order multivariable robust control strategies to a proton exchange membrane fuel cell (PEMFC) system, and implements the designed controllers on a microchip for system miniaturization. In previous studies, robust control was applied to guarantee system stability and to reduce hydrogen consumption for a PEMFC system. It was noted that for standard robust control design, the order of resulting H_∞ controllers is dictated by the plants and weighting functions. However, for hardware implementation, controllers with lower orders are preferable in terms of computing efforts and cost. Therefore, in this paper the PEMFC is modeled as multivariable transfer matrices, then three fixed-order robust control algorithms are applied to design controllers with specified orders for a PEMFC. Finally, the designed controllers are implemented on a microchip to regulate the air and hydrogen flow rates. From the experimental results, fixed-order robust control is deemed effective in supplying steady power and reducing fuel consumption.