



Document details

< Back to results | < Previous 6 of 722 Next >

Export Download Print E-mail Save to PDF Add to List More... >

View at Publisher

International Journal of Hydrogen Energy
Volume 45, Issue 53, 30 October 2020, Pages 29222-29234

Robust high order sliding mode control for performance improvement of PEM fuel cell power systems (Article)

Derbeli, M.^{a,c}, Barambones, O.^a, Farhat, M.^b, Ramos-Hernanz, J.A.^a, Sbata, L.^c

^aEngineering School of Vitoria-Gasteiz, University of the Basque Country UPV/EHU, Nieves Cano 12, Vitoria, 1006, Spain

^bAmerican University of Ras-Al-Khaimah, PO Box 10021, Ras-Al-Khaimah, United Arab Emirates

^cNational Engineering School of Gabes, Omar-Ibn-Elkhattab, Gabes, 6029, Tunisia

Abstract

[View references \(55\)](#)

In this paper, an efficient algorithm is applied to high step-up power converter for performance improvement of Polymer Electrolyte Membrane (PEM) Fuel Cells. The action is done on forcing the fuel cell to operate at an adequate power point by tuning the power converter duty cycle. Due to inherent nonlinearities in the fuel cell dynamics and variations of the system parameters, a nonlinear sliding mode control (SMC) is suggested. However, the SMC causes severe changes in the PEM fuel cell output power, which lead to serious life-shortening and acute cell degradation. To overcome these shortcomings, a robust high order SMC based on "Twisting Algorithm" (HOSM-TA) is designed to improve the power quality and to keep the fuel cell operating at an adequate power point. The stability of both SMC and HOSM-TA is demonstrated via Lyapunov analysis. To demonstrate the effectiveness of the proposed HOSM-TA control scheme, a hardware setup is carried out on a real PEMFC stack. The implementation of the control system and the data acquisition are done on a dSPACE real-time digital control platform. It is deduced that the proposed HOSM-TA with high robustness, fast convergence (1s), and chattering reduction of 82.7% can be used to achieve great improvements in fuel cell power system. © 2020 Hydrogen Energy Publications LLC

SciVal Topic Prominence ⓘ

Topic: Proton Exchange Membrane Fuel Cell (PEMFC) | Powerpoint | DC-DC Converter

Prominence percentile: 97.913 ⓘ

Author keywords

dSPACE High step-up power converter HOSM-TA PEM fuel cell

Indexed keywords

Engineering controlled terms:

Control nonlinearities Data acquisition Digital control systems Fuel cell power plants Polyelectrolytes Power converters Sliding mode control

Engineering uncontrolled terms

Chattering reductions Fuel cell power systems Fuel-cell dynamics High-order sliding mode controls Nonlinear sliding mode Polymer electrolyte membranes Real time digital controls Twisting algorithms

Engineering main heading:

Proton exchange membrane fuel cells (PEMFC)

Metrics ⓘ [View all metrics >](#)

2 Citations in Scopus

75th percentile

0.96 Field-Weighted

Citation Impact



PlumX Metrics ⌵

Usage, Captures, Mentions, Social Media and Citations beyond Scopus.

Cited by 2 documents

Real-time implementation of a new MPPT control method for a DC-DC boost converter used in a PEM fuel cell power system

Derbeli, M. , Barambones, O. , Silaa, M.Y. (2020) *Actuators*

Design and Implementation of High Order Sliding Mode Control for PEMFC Power System

Silaa, M.Y. , Derbeli, M. , Barambones, O. (2020) *Energies*

[View all 2 citing documents](#)

Inform me when this document is cited in Scopus:

[Set citation alert >](#)

Related documents

Real-time implementation of a super twisting algorithm for PEM fuel cell power system

Derbeli, M. , Barambones, O. , Ramos-Hernanz, J. (2019) *Energies*

Model predictive control with lifetime constraints based energy management strategy for proton exchange membrane fuel cell hybrid power systems

He, H. , Quan, S. , Sun, F. (2020) *IEEE Transactions on Industrial Electronics*