Journal Européen des Systèmes Automatisés

Volume 53, Issue 6, 2020, Pages 811-823

New Optimal Control of Permanent Magnet DC Motor for Photovoltaic Wire FeederSystems

Badreddine BABES, Amar BOUTAGHANE, Noureddine Hamouda, Sami KAHLA, Ahmed KELLAI, Thomas Ellinger, Jürgen Petzoldt

Abstract: This article aims to improve the permanent magnet DC (PMDC) motor performance forphotovoltaic (PV) wire-feeder systems (PVWFSs) of arc welding machines. Theconsidered technique is designed by direct speed control based on optimal Fractional-orderFuzzy PID FO-Fuzzy-PID controller. The purpose is to ensure optimal control of wire feedspeed reference to reduce torque ripples and hence, the performance of the WFS isimproved. The dynamic reaction of the proposed solar PVWFS relies upon the scalingfactors of FO-Fuzzy-PID controller, which are optimized by using teaching-learningalgorithm based on Particle Swarm Optimization (PSO) method. The maximum powerpoint tracking (MPPT) is achieved using an intelligent FO-Fuzzy-PID current controllerbased Perturb and Observe (P&O) MPPT algorithm. The PVWFS system incorporatingthe proposed method is tested and compared with the conventional PID control schemeunder different weather conditions. The simulation of the proposed system byMATLAB\SIMULINK is carried out. The simulation results indicate the effectiveness ofthe considered control strategy in terms of the reduction in torque oscillations, optimizingelectrical power and wire feed speed.

Keywords : Solar photovoltaic (PV) module, wire feeder systems (WFSs), DC-DC buck converter, MPPT control, FO-Fuzzy PID controller, Particle Swarm Optimization (PSO) algorithm