Journal Européen des Systèmes Automatisés

Volume 53, Issue 2, 2020, Pages 157-166

Optimal Tuning of Fractional Order Proportional-Integral-Derivative Controller for WireFeeder System Using Ant Colony Optimization

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Abstract: The goal of this work is to present a robust optimal control approach, in order to improve the speed error-tracking and control capability of a permanent magnet DC Motor (PMDC)driven wire-feeder systems (WFSs) of gas metal arc welding (GMAW) process. The proposed speed controller employs an optimized fractional-order proportional + integral+ derivative (FOPID) controller that serves to eliminate oscillations, overshoots, undershoots and steady state fluctuations of the PMDC motor and makes the wire-feeder unit (WFU) has fast and stable starting process as well as excellent dynamic characteristics. The fixed controller parameters are meta-heuristically selected via an ant colony optimization (ACO) algorithm. Numerical simulations are performed in Matlab/Simulink environment and the performance of the proposed ACO-FOPID controller is validated. The simulation results clearly demonstrate the significantimprovement rendered by the proposed approach in the wire-feeder system's reference tracking performance, torque disturbance rejection capability, and transient recovery time.

Keywords : gas metal arc welding process, wire-feeder system, fractional-order-proportionalintegral-derivative controller, ant colony optimization algorithm