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Particle Swarm Optimization of Fuzzy Fractional PDµ+I Controllerof a PMDC Motor for Reliable Operation of Wire-Feeder Units ofGMAW Welding Machine

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Abstract: In this article, we consider the development of an optimal control approach based on fuzzy fractional PD μ +I controller to improve thespeed 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 controller employs an optimized fractional-order proportional derivative + integral (PD μ +I) controller that serves toeliminate oscillations, overshoots, undershoots and steady state fluctuations of the PMDC motor and makes the wire-feeder unit (WFU) has fast andstable starting process as well as excellent dynamic characteristics. The fixed controller parameters are meta-heuristically selected via a particleswarm optimization (PSO) algorithm. Numerical simulations are performed in MATLAB/SIMULINK environment and the performance of the proposedfuzzy fractional PD μ +I controller is validated. The simulation tests clearly demonstrate the significant improvement rendered by the proposed fuzzyPD μ +I controller in the wire-feeder system's reference tracking performance, torque disturbance rejection capability and robustness against modeluncertainties.

 $\label{eq:Keywords:GMAW process, Wire-feeder System (WFS), fuzzy fractional PD\mu+I controller, Particle Swarm Optimization (PSO) algorithm$