New Optimal Control of Permanent Magnet DC Motor for Photovoltaic Wire Feeder Systems

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Abstract: This article aims to improve the permanent magnet DC (PMDC) motor performance for photovoltaic (PV) wire-feeder systems (PVWFSs) of arc welding machines. The considered technique is designed by direct speed control based on optimal Fractional-order Fuzzy PID FO-Fuzzy-PID controller. The purpose is to ensure optimal control of wire feed speed reference to reduce torque ripples and hence, the performance of the WFS is improved. The dynamic reaction of the proposed solar PVWFS relies upon the scaling factors of FO-Fuzzy-PID controller, which are optimized by using teaching-learning algorithm based on Particle Swarm Optimization (PSO) method. The maximum power point tracking (MPPT) is achieved using an intelligent FO-Fuzzy-PID current controller based Perturb and Observe (P&O) MPPT algorithm. The PVWFS system incorporating the proposed method is tested and compared with the conventional PID control scheme under different weather conditions. The simulation of the proposed system by MATLAB\SIMULINK is carried out. The simulation results indicate the effectiveness of the considered control strategy in terms of the reduction in torque oscillations, optimizing electrical 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