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Name : MOHD AZRI BIN ABDUL AZIZ

Title : PERFORMANCE OF PARTICLE SWARM OPTIMIZATION UNDER DIFFERENT RANGE OF DIRECT CURRENT MOTOR'S MOMENT OF INERTIA

Supervisor : PROF. IR. TS. DR. HJ. MOHD NASIR TAIB **(MS)**
ASSOC. PROF. DR. RAMLI ADNAN **(CS)**

The implementation of Particle Swarm Optimization (PSO) algorithm in optimizing Proportional-Integral-Derivative (PID) controller's parameters is a popular technique to improve the performance of a control system. A prevalent application is a Direct Current (DC) motor control system with variations in parameters value have been used. Moment of inertia is one of the essential parameters of a DC motor which can affect the transient response including rise time, settling time, overshoot and steady state error. However, the use of moment of inertia and other parameters of DC motor are mostly to complete the transfer function and no specific analysis was done on the effects of their variations to the control method. This research investigates the effect of moment of inertia on the performance of PSO algorithm utilizing the Weighted Transient Response Index (WTRI) based fitness function in optimizing PID controller parameters to control a DC motor. Five fitness functions were used in comparing the performance of PSO algorithm which includes Integral Absolute Error (IAE), Integral Time-weighted Absolute Error (ITAE), Integral Squared Error (ISE), Integral Time-weighted Squared Error (ITSE) and WTRI. For WTRI alone, several variations of weight combinations have been tested in determining their effects on the performance of PSO algorithm under different range of moment of inertia, from 3.88x10-7 kgm2 to 3.88x10-1 kgm2 which is within a range found in literature. The experimental results shows that with a higher values of moment of inertia, WTRI based fitness function managed to outperform the other four error based fitness functions. It was also shown that a threshold for moment of inertia can be defined where the performance of PSO algorithm was affected only if the moment of inertia of the DC motor is more than the threshold value. The details exploration of WTRI based fitness function shows the significance of prioritized weight in Prioritize Single Non Zero (PSNZ) weight category towards its associated transient index was proven while for Prioritize All Non Zero (PANZ) weight category, the complex relationship between rise time, settling time and overshoot seems to interfere the ability of its prioritized weight in fully controls their associated transient response outputs.