Optimal finite- time prescribed performance of servo pneumatic positioning with PID control tuning using an evolutionary mating algorithm

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ABSTRACT
This paper presents an optimum tuning on finite-time prescribed performance with PID (FT-PPC-PID) controller using the Evolutionary Mating Algorithm (EMA) approach for a pneumatic servo system's (PSS) rod-piston positioning. The design objective is to optimize the convergence rate and finite time of the prescribed performance function in error transformation in parallel with PID controller's gains. The multi-step input trajectory on the PPVDC model plant was used for simulations with specific load and random noise as disturbances. The results demonstrate that the controller optimized with EMA outperforms the same controller optimized with other methods in achieving dynamic multi-step positioning of the rod-piston. This highlights the significant enhancement in overall performance of PPVDC positioning, including the stability of its internal system, through the EMA-optimized finite-time prescribed performance controller with PID.

KEYWORDS
Pneumatic actuator; Prescribed performance control; Evolutionary mating algorithm; Position control; Pneumatic robot

ACKNOWLEDGMENT

The authors would like to thank the Ministry of Higher Education for providing financial support under Fundamental Research Grant Scheme (FRGS) No. FRGS/1/2019/TK04/UMP/02/1 (University reference RDU1901106) and Universiti Malaysia Pahang for laboratory facilities.