ABSTRAK

HO scale (1:87) miniature trains are not only used as a hobby medium, but also as an educational and research tool in control systems. These miniatures become an ideal platform to test control algorithms such as PID before they are applied to full-scale systems. On the other hand, speed control systems on real trains such as diesel-electric locomotives in Indonesia are still closed and conservative in dealing with dynamic conditions. This study simulates a PID (Proportional-Integral-Derivative) controller for miniature train speed regulation to evaluate the stability and effectiveness of the control. The method starts from system design, transfer function identification based on voltage and speed data, to simulation using MATLAB/Simulink. Parameter tuning is done through autotuning and trial-and-error. Tests were conducted without control and with PID control. The results show that PID improves system performance with a rise time of 0.0106 seconds, settling time of 0.0161 seconds, overshoot of 1.531%, and steady-state error of 0.00004%. The system becomes faster, stable, and accurate to changes in load and line conditions. This research shows that PID control is effectively applied to miniature trains and has the potential to be developed for full-scale train systems.

Keywords: PID, HO scale miniature train, DC motor, Simulink, speed control