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Optimized Discrete PID Controller Design for Precision DC Motor Speed Regulation Using MATLAB

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Abstract: *This paper presents an optimized approach to the design and implementation of a discrete Proportional-Integral-Derivative (PID) controller for precise speed regulation of DC motors using MATLAB. DC motors are critical components in various industrial and robotic applications, where maintaining accurate speed control is essential for efficient operation. The study explores the dynamic modeling of a DC motor and the application of discrete PID control techniques to achieve superior performance in terms of transient response, stability, and disturbance rejection. MATLAB/Simulink is utilized for system simulation, parameter tuning, and performance evaluation. Advanced tuning methods, including Ziegler-Nichols and heuristic techniques, are employed to optimize controller gains, ensuring minimal overshoot, reduced settling time, and robust steady-state accuracy. Simulation results validate the proposed approach, highlighting its effectiveness in achieving high-precision speed regulation under varying operational conditions. This study provides a valuable resource for engineers and researchers focused on enhancing DC motor control systems*

Keywords: Discrete PID controller, DC motor speed control, MATLAB/Simulink, control systems, Ziegler-Nichols tuning, speed regulation, transient response, steady-state performance, optimization, industrial automation

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