Water level control and stabilization using PID controller and fuzzy logic

Man Thi Hoa

Abstract: This thesis investigates the design and implementation of a hybrid control system for water level regulation, combining PID controllers with fuzzy logic. The primary objective is to enhance the stability and dynamic response of a water tank system, which is inherently nonlinear and subject to disturbances such as inflow variations and outflow demands. A conventional PID controller is first tuned using Ziegler-Nichols methods to establish a baseline performance. Subsequently, a fuzzy logic controller is developed to adaptively adjust the PID gains in real-time, leveraging linguistic rules to handle system nonlinearities and uncertainties. The proposed fuzzy-PID hybrid controller is simulated and compared against the standard PID approach under various operating conditions, including setpoint changes and load disturbances. Results demonstrate that the fuzzy-PID scheme significantly reduces overshoot, settling time, and steady-state error, while improving robustness against parameter variations. This study confirms that integrating fuzzy logic with PID control offers a practical and effective solution for precise water level management in industrial and environmental applications.

Keywords: PID control, fuzzy logic, water level control, stability