Robust Nonlinear Liquid Level Control of a Coupled-Tank System Using Backstepping Integral Sliding Mode Control

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Abstract This paper presents the formulation of nonlinear robust control that integrates backstepping and integral sliding mode control strategies for controlling liquid level in a two-tank system. In the classical sliding mode control, a discontinuous control law is synthesized to drive the system state to the sliding surface in a finite time and maintain it thereafter on that surface. The technique is naturally suited for the tracking of controlled systems, such as liquid level control inside two-tank system. However, the effects of the discontinuous nature of the control, known as the chattering phenomenon is harmful because it leads to low control accuracy and high wear and tear of moving mechanical parts. The hybrid control preserves the main advantages as it is reduced the chattering effect and provide higher accuracy in realisation of the control system. The performance of the proposed controller is simulated using MATLAB/Simulink software which tested for nominal system, system with external disturbance and system with parameter variation. The performance of proposed controller is compared against the performance of backstepping sliding mode control and integral sliding mode control in terms of chattering reduction and steady state error. The simulation results have shown that the proposed controller has improved the output tracking performance better than the performance backstepping sliding mode control (BSMC) and integral sliding mode (ISMC) with ISMC shows slowest respond. Undesired chattering in sliding surface has been reduced.

Keywords Coupled-tank system · Chattering reduction · Backstepping · Integral sliding mode control

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