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Design and Performance Evaluation of a Sliding Mode Control Based on the K Observer for a Three-tank Non-interacting System

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DESCRIPTION

The design and performance evaluation of control systems play a pivotal role in optimizing the efficiency and stability of complex processes. One notable application is the utilization of sliding mode control based on the K observer for a three-tank non-interacting system. This sophisticated approach involves the integration of advanced control strategies to ensure precise regulation and response in a dynamic and interconnected environment. Sliding mode control (SMC) is a robust and adaptable methodology employed in control engineering, known for its ability to handle uncertainties and disturbances effectively. In the context of the three-tank non-interacting system, SMC becomes particularly relevant due to the inherent challenges posed by dynamic interactions and disturbances within the system. The core principle of sliding mode control involves creating a sliding surface that guides the system's behavior towards a desired state, even in the presence of uncertainties. The integration of a K observer further enhances the control system's performance by providing an accurate estimate of the system's internal state variables. The K observer acts as a supplementary component, continuously monitoring and updating the system's internal dynamics. This real-time information enables the controller to make more informed decisions, enhancing the overall responsiveness and adaptability of the control system to changes in the environment. The three-tank non-interacting system, often employed as a benchmark in control system studies, consists of three interconnected tanks with varying fluid levels. The challenge lies in regulating the fluid levels in each tank while accounting for the non-interacting nature of the system. Traditional control approaches may struggle to address the inherent complexities, making the application of advanced control strategies, such as sliding mode control with a K observer, particularly relevant. The design process involves formulating a mathematical model of the three-tank non-interacting system and defining the control objectives. Subsequently, the sliding mode control algorithm, augmented by the K observer, is developed to achieve precise control over the fluid levels in each tank. The parameters of the control system are tuned to ensure optimal performance, accounting for the unique dynamics of the three-tank configuration. Performance evaluation is a critical phase in assessing the effectiveness of the designed control system. Metrics such as settling time, overshoot, and steady-state error are analyzed to quantify the system's response to setpoint changes and disturbances. Simulation studies and real-world experiments are conducted to validate the robustness and reliability of the sliding mode control with the K observer in managing the three-tank non-interacting system. The advantages of this advanced control approach become apparent in its ability to handle uncertainties, disturbances, and non-linearities inherent in the three-tank system. The sliding mode control with a K observer excels in providing accurate state estimates and maintaining stable control even under challenging conditions. This makes it a valuable tool in industrial processes, chemical engineering, and other applications where precise control over interconnected systems is essential. As industries continue to embrace automation and sophisticated control strategies, the design and performance evaluation of control systems like sliding mode control with a K observer for three-tank non-interacting systems contribute to advancements in process optimization, efficiency, and reliability. The continuous refinement of such control methodologies underscores the commitment to pushing the boundaries of control engineering, fostering innovation in diverse fields.

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CONFLICT OF INTEREST

The author declares there is no conflict of interest in publishing this article.

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