Model Predictive Control of Hydraulic Drive Unit Considering Input Delay

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Abstract

Hydraulic drive unit (HDU) is a typical actuator, but the characteristic of input delay hinders the application of many advanced control methods in HDU. Firstly, in this paper, a mathematical model of HDU with input delay is established and the parameters are identified. Then, aiming at the input delay problem in HDU, a Smith estimated compensation model predictive control (SECMPC) strategy is proposed. On the one hand, the input delay state equation is employed to be a mathematical pattern for the state observation and predictive model. However, the combination between model predictive control (MPC) and Smith estimated compensation (SEC) is realized, the system state at $k+d$ (d is the time delay coefficient) time is estimated in advance at k time to compensate the delay of the state. And then the prediction model based on input delay state equation is used for model prediction and rolling optimization. Thus the delay system which is unstable is promoted to a stable system without delay, and the effectiveness of SECMPC is proved with the HDU experiment and simulation. The SECMPC have some guiding significance for the control of systems with input delay.

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