Public Abstract
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Title:Nonlinear Control and Active Damping of a Forced-Feedback Metering Poppet Valve

For a metering poppet valve developed at the University of Missouri, Columbia (MU valve), the valve can be configured for performance at the cost of stability. It is desirable to achieve both performance and stability using electronic control. Presently, in the MU valve, the pilot poppet is damped by the flow of hydraulic fluid through a channel or orifice running through the poppet. Here, it is proposed that the solenoid be used to provide damping (active damping) to the pilot poppet. The damping input to the solenoid is determined using the pilot poppet velocity. In practice, the velocity is difficult to measure due to the MU valves configuration and it is estimated according to the self-sensing actuator concept. Theoretical results demonstrated that a valve actuator could be designed with an emphasis on high speed performance while an electronic control system is used to damp unwanted oscillations. For flow control, several researchers have used feedback linearization to cancel part of a hydraulic systems nonlinearities in spool valves. Here, this is an attractive approach since experimental studies have shown that poppet instabilities are caused by nonlinear mechanisms like flow forces. In this work, nonlinearities are cancelled in the input-output relationship of the metering poppet valve. The controller was shown to achieve robust tracking of a reference trajectory.