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Adaptive control for high speed on/off valve to preserve dynamic performance

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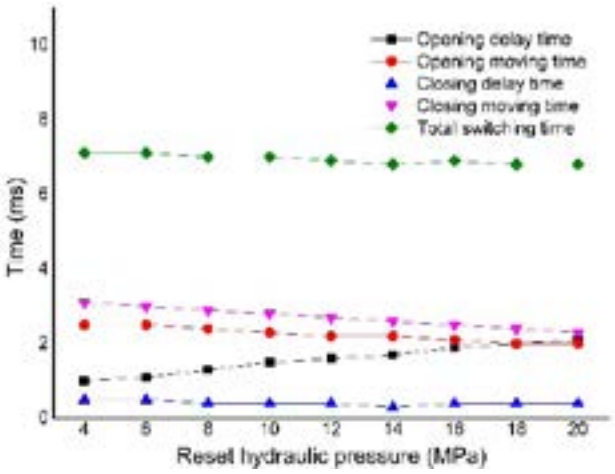
High speed on/off valve (HSV) is an essential digital hydraulic component, and has been widely used for pressure and flow control in hydraulic systems, which require faster and more stable dynamic performance of HSVs to improve control preciseness. However, for some special kinds of HSVs, like ball structure and poppet structure valves which can reset by the hydraulic pressure instead of a traditional reset spring, their dynamic performance is greatly affected by the hydraulic pressure. Aiming at this problem, a self-correcting PWM control algorithm based on current feedback (SPWMCF) is proposed to improve and even maintain the HSVs' original dynamic performance under changing pressures. Using current feedback analysis based on critical switching currents, the operational state of the HSV is estimated, and adaptive logic switching of different duty ratios of power source is also realized to preserve the dynamic performance of HSV under changing supply pressure to the maximum extent. Finally, a ball structure HSV is used as a research object, through numerical and experimental studies, it is demonstrated that the supply pressure has a great influence on the dynamic characteristics of the HSV, and the proposed control algorithm achieves the expected effect that the dynamic characteristics of the HSV is not only greatly improved but adapted to pressure changes, and the variation range of the dynamic performance can be controlled within 7.4% (0.3ms) under 4-20MPa operating conditions. The presented control algorithm is effective and can be applied in HSV-controlled systems to improve the robustness of the target actuator.



Switching performance of HSV under varying pressure with SPWMCF

Biography

Qi Zhong received the B.S. degree in Mechanical Engineering and Automation from Zhejiang University of Technology, Hangzhou, China, in 2010. He is currently working toward the Ph.D. degree in the School of Mechanical Engineering, Zhejiang University, Hangzhou, China. His research interests include digital hydraulic technology and its application in engineering machinery, intelligent control, and mechatronic systems

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