Study on Joint Servo Control and High Perfomance Robotic Control in Hydraulic Robot

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Hydraulic robots have large potential for applications to higher perfomance requirements. However, their ability remains at low level and their usage is limitted to relatively simple robotic tasks. From this viewpoint, the complete software-servo controller is constructed for a joint servo or an entire robotic servo system by using the DSP (digital signal processor) so as to be applied to any compliant, control requirements.

This paper discusses some development of the servo control methods of hydraulically driven robotic joint and their applications to advanced robotic tasks. First, to improve the positioning accuracy of the robot subject to large torque disturbance, the design scheme of two-degree-of-freedom controller for hydraulic servo system is presented. The forward dynamic characteristic of the system is designed to match with a reference model by using a pressure and velocity feedback, and the feedback characteristic is designed to eliminate the effect of torque disturbance.

Next, load insensitive flow control and velocity insensitive torque control methods are developed for robotic motion control. Appliing these methods to the motion control of a 1-link hydraulically driven arm, it is shown that good tracking property is obtained,

Finally, as advanced control of the hydraulic robot, an adaptive impedance control subject to torque constraints in hydraulic actuator and a direct teaching-playback method of hybrid position/force control appliing the impedance control are discussed. These two methods are applied to a 2-link vertical articulated direct drive hydraulic robot respectively and the experimental results affirm the validity of the proposed method.