

**MODELING, DESIGN, AND CONTROL OF
FORCED-FEEDBACK METERING POPPET VALVE SYSTEM**

MATTHEW MULLER

THESIS SUPERVISOR DR. ROGER FALES

ABSTRACT

This research explores valve design, dynamic modeling, and techniques to achieve flow control for a forced-feedback metering poppet valve system. In particular, nonlinear and linear models of a forced feedback configuration are developed and tuned through the use of root locus techniques. Typical steady state conditions as well as extreme high and low pressure drops are simulated in attempts to uncover instabilities and other possible undesirable performance characteristics of the valve. It is shown that by using a variable inlet orifice to the control volume as opposed to a constant orifice, desired system bandwidth and stability can be achieved. Open loop valve designs are then simulated with several electronic control schemes which incorporate feedback of load pressure and in some cases valve flow. An observer design is investigated as a means of providing flow feedback without additional sensor costs. Electronic flow control schemes are compared to standard mechanical pressure compensation and finally a robust analysis is provided for a chosen electronic control scheme.