ME360: FUNDAMENTALS OF SIGNAL PROCESSING, INSTRUMENTATION AND CONTROL

Laboratory No. 7 − PID Control and the Parker-Hannifin Hydraulic Station Pre-lab Questions

1. It is impossible to implement a “true” derivative; transfer function H(s) = s. So an approximation is needed to implement the derivative term in a PID controller. Use the “bode” command in Matlab to show that the transfer function $H_{approx}(s)=100s/(s+100)$ approximates H(s) = s at least until 100 rad/s. Turn in bode plots of both the true derivative and the derivative approximation showing the range of frequencies the approximation closely matches the true derivative. (15 pts)

2. Refreshing your memory from last week’s lab (it may be helpful to look at Lab 6’s appendix material) and getting ready for this week’s lab, draw an overall block diagram for the following control system. The plant is a hydraulic cylinder that has as output a distance measured in volts from a linear potentiometer; this signal will be our feedback. The input to the system is a voltage to an electronic value. This input voltage determines the direction and speed at which the cylinder travels; this signal will be our control input. In your block diagram the plant is simply a block that has a single input and single output with transfer function G(s). (You do not need to approximate the transfer function G(s).) The controller is a PID controller. The reference input is a step representing the desired position of the cylinder. The error then into the PID controller is the difference between this reference and the actual position of the cylinder. The derivative term in the PID controller is implemented with the approximation 100s/(s+100). (15 pts)