CDS 212 - Homework #4

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Posted on: Friday November 23, 2007
Due on: Tuesday December 3, 2007

Problem 1
Please solve the following problems in Doyle, Francis & Tannenbaum:

(a) Problem 4.6

(b) Problem 4.9

(c) Problem 4.10

(d) Problem 4.7

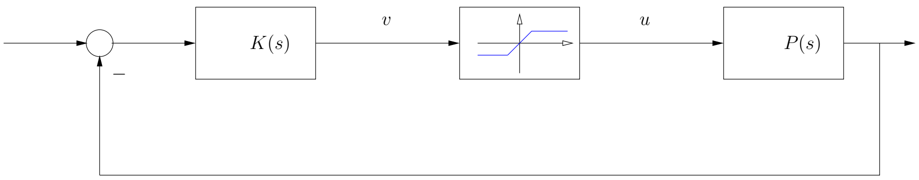

Figure 1: Feedback system in Problem 4.2

Problem 2
Consider the unity feedback system shown in the Figure above, and suppose that the plant is a low pass filter given by:

$$P(s) = \frac{1}{s+\epsilon}$$

where $\epsilon > 0$ is a small number. We wish to design a constant (non-zero) gain feedback controller (i.e. $K(s) = k$ for some constant gain $k \neq 0$) to maintain stability of the closed loop system, assuming that the controller output saturates whenever the input has amplitude greater than 1. That is:

$$u = sat(v) = \begin{cases} v & |v| < 1 \\ 1 & v > 1 \\ -1 & v < -1 \end{cases}$$

Model the nonlinearity in the system as an admissible perturbation and use the small gain theorem to obtain sufficient conditions on k to guarantee closed loop stability of the system.