Control Systems Course, Academic Year 2013-2014

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Final Exam, January 21^{st} 2014

Available time: 2 h

Ex1 (15 points) Given a plant characterized by the transfer function

$$G(s) = \frac{1}{s(s^2+4)},$$

use the root locus to design a control scheme and a controller such that:

1. the absolute value of the steady state error with respect to a ramp input is smaller or equal to 10^{-1};
2. the closed loop system is astatic with respect to a step additive disturbance applied to the output of the plant $G(s)$.

Plot the root locus of the controlled system.

Ex2 (8 points) Given a plant characterized by the following state space representation

$$\begin{aligned} \dot{x}_1(t) &= a^2 x_1(t) + (a-1)x_2(t) - u(t), \\ \dot{x}_2(t) &= 2a x_1(t) - x_2(t) + u(t), \\ y(t) &= x_1(t) - x_2(t), \quad t \geq 0, \end{aligned}$$

with $a \in \mathbb{R}$ a real parameter, define the set of values of a such that it is possible to assign the eigenvalues of the closed loop system in -1 and design the corresponding control scheme and controller parameterized in a.

Ex3 (7 points) Define the Luenberger Observer, state the necessary and sufficient observer existence conditions and discuss the convergence speed of the estimation error.