Control Systems Course, Academic Year 2013-2014

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First Exam Session, Part 2. February 12^{th} 2014

Available time: 2 h

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

$$G(s) = \frac{s^2 - 2s + 2}{s^3(s+2)},$$

trace the root locus of $G(s)$, then design a control scheme and a controller such that:

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

Plot the root locus of the controlled system.

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

$$\begin{aligned} \dot{x}_1(t) &= ax_1(t) + a^2x_2(t) + au(t), \\ \dot{x}_2(t) &= -x_1(t) + (a+3)x_2(t) + au(t), \\ y(t) &= x_1(t) + x_2(t), \quad t \geq 0, \end{aligned}$$

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) Illustrate the *Internal Model Design* method for tracking polynomial reference inputs in state-variable feedback linear systems.