HW 2
DUE MARCH 13TH

Problems from book: Chapter 2, Problems: 3, 5, 6, 8

Typed Problem 1: Adaptive PI Controller with Disturbance
The liner system

$$\dot{x} = \frac{1}{J}(-Bx + \tau)$$

shall be controlled by a PI Controller. As the parameters of the system J and B are unknown and are expected to slowly vary with time, an adaptive PI Controller is to be developed. A further requirement of the controller is that a constant disturbance d, entering the system in the same way as τ, does not lead to a constant tracking error in the case of a constant reference value. The plant input $\tau = u + d$, where u is the controller output.

a) For better tracking accuracy, introduce a mixed feedforward-feedback control architecture like in the lecture and sketch it.
b) Find an appropriate reparametrization of the standard transfer function of a PI-controller

$$\frac{U(s)}{E(s)} = G_c(s) = K\frac{s+\lambda}{s},$$

such that designing an adaptive controller is simplified.
c) Develop the adaptive law via a Lyapunov approach.
d) Show that the tracking error e approaches zero asymptotically.
e) Discuss the cancellation of the disturbance.

Typed Problem 2:
(a) Consider the dynamical system

$$\ddot{x} = \lambda u;$$

λ is unknown. Find an adaptive controller that computes u so that x follows x_m, x_m given by

$$\ddot{x}_m + 2\zeta\omega\dot{x}_m + \omega^2 x_m = \omega^2 r.$$

(b) Suppose a constant disturbance d is present in the plant,

$$\ddot{x} = \lambda u + d$$

Find a u so that (i) $x - x_m$ is bounded; (ii) $x - x_m$ goes to zero

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