Master study
Systems and Control Engineering
Department of Technology
Telemark University College
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SCEV3006 Advanced Control with Implementation

Solution Exercise 6

Task 2

a) An anergy balance for the process is

$$VC_p\rho\dot{x} = C_p\rho(x_0 - x) + u - G(x - x_0) \tag{1}$$

which gives

$$\dot{x} = a(x - x_0) + bu, \tag{2}$$

where

$$a = -\frac{G + C_p\rho q}{VC_p}, \tag{3}$$

$$b = \frac{1}{VC_p}. \tag{4}$$

b) The steady state control is obtained by putting $\dot{x} = 0$ and solve for the corresponding control. This gives

$$u_s = -\frac{a}{b}(x - x_0) = (G + C_p\rho q)(x_s - x_0), \tag{5}$$

d) We may reformulate the problem such that we obtain a standard LQ optimal control problem. Define the deviation state variable

$$\Delta x = x - x_s, \tag{6}$$

where x_s is constant. Then we obtain the process medel

$$\dot{\Delta x} = A\Delta x + B\Delta u, \tag{7}$$

where $\Delta u = u - u_s$. The control objective is then simply

$$J = \int_{t_0}^{\infty}(q\Delta x^2 + p\Delta u^2) \tag{8}$$

The optimal control is given by

$$\Delta u = G\Delta x \tag{9}$$

which gives

$$u = G(x - x_s)^2 + u_s \tag{10}$$

Oppgave 3

Her vises det til et avsnitt i kompendiet for en beskrivelse. Videre gis det en skisse i følgende MATLAB script.