Exercises for Chapter 7

1. Given a process model in terms of a linear transfer function. Determine approximately the bandwidth that can be achieved using a P, PI, PD, and a PID controller, respectively.

2. What process information is needed to tune a PI and a PID controller, respectively? Hint: Look at Figures 7.1 and 7.3.

3. Discuss the properties of lambda tuning, Skogestad's method, and the AMIGO method for processes with lag-dominated dynamics.

4. Figure 7.8 shows the ratio between T_i and T_d for MIGO design of the processes in the test batch. Based on this figure, discuss rules-of thumb for the ratio between the two controller parameters.

5.

a. Discuss the effects of measurement noise on a PID controlled closed loop system.

b. Consider the process $P(s) = 1/(s+1)^3$ and the IAE optimal PID controller, with respect to $M_s = M_t = 1.4$, $K = 3.81$, $T_i = 1.14$ and $T_d = 1.12$. Derive low-pass filters according to (3.15) and (3.16) in the book using N = 2 and 20 (compare to the rule of thumb) with $T_f = T_d/N$. Compare both the load disturbance performance and the robustness of the filtered closed-loop systems with the nominal system. Also plot the gang of four for the five different cases. What are your conclusions?

c. Another common method of choosing the low-pass filter is to include it in the process model and then design the PID controller. Discuss advantages and disadvantages to the method given in Problem 5 b.

d. Discuss alternative methods for choosing the low-pass filter.