Predictive Control - Exercise Session 4

Adaptive Control: Self Tuning Regulators and Model Reference Adaptive Systems

1. **Indirect Self Tuning Regulator:** Consider the system

$$G(s) = G_1(s)G_2(s)$$

where

$$G_1(s) = \frac{a}{s+b}$$
$$G_2(s) = \frac{c}{s+d}$$

Here a and b are unknown parameters and c and d are known. This could for example represent a system where the plant is known but where certain sensor dynamics are unknown. The system is to be controlled in such a way that the closed loop system is given by:

$$G_m(s) = \frac{\omega^2}{s^2 + 2\omega\zeta s + \omega^2}$$

   a. Construct a discrete time indirect self tuning regulator *without* zero cancellation.

   b. Construct a discrete time indirect self tuning regulator *with* zero cancellation.

2. **Direct Self Tuning Regulator:** Using the same plant and specification as in Problem 1, design:

   a. A direct self tuning regulator *without* zero cancellation.

   b. A direct self tuning regulator *with* zero cancellation.

3. **Model Reference Adaptive Control using MIT Rule:** In this problem we consider a linear process with the transfer function $kG(s)$, where $G(s)$ is known and k is an unknown parameter. Find a feedforward controller that gives a system with the transfer function $G_m(s) = k_0G(s)$ where k_0 is a given constant. Use the controller structure

$$u = \theta u_c$$

where u is the control signal and u_c the command signal. Use the MIT rule to update the parameter θ, and draw a block diagram of the resulting adaptive system.