ChE381A: Process Dynamics and Control

Laboratory Assignment 3

Shinskey has proposed a PID_θ (PID dead-time) controller, as shown in Figure below. P, PI and PID controllers can be obtained by switching off I (set τ_I = very large number), D (set $\tau_D = 0$) and θ (set dead time = 0) modes in the block diagram. To quantify the tightness of control, the integral absolute error (IAE) may be used as a convenient metric. IAE is defined as

$$IAE_t = \int_0^t |y - y_\infty| d\tau$$

where y_∞ is the final steady state value of the closed loop response, with the process at rest initially and then forced either by a setpoint change or a disturbance change at t = 0.

Obtain the optimal tuning of PI, PID and PID_θ controllers to minimize IAE for the unit step regulator response for the SISO process of Lab Assignment 2. Use Matlab's *fmincon* non-linear programming optimization function for the optimization.

Plot the optimized unit step regulator responses of the PI, PID and PID_θ controllers. Also plot the unit step servo responses using the same tuning.

Quantify the IAE for the responses and comment on the improvement in control, if any, by adding controller modes D and θ to a PI controller.