Business

- Today: Exam Review
- Tues-Thurs: Exam 3
- Then
  - 5 Class Periods
  - 2 days for Lab (before & after Thanksgiving)
  - Review for Final
  - Final Exam on Dec. 16 (7-10 am)

Chapter 12

How to get tuning parameters

1. ITAE

- Integrated time-weighted absolute error
- Graph at right is IAE
  - Needs time weighting

$$ITAE = \int_0^\infty t \cdot |e(t)| dt$$

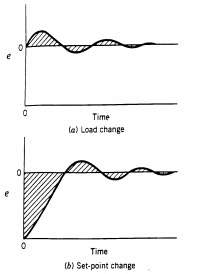


Figure 12.9. Graphical interpretation of IAE. The shaded area is the IAE value.

Table 12.3 Controller Design Relations Based on the ITAE Performance Index and a First-Order-plus-Time-Delay Model (Smith and Corripio, 1997)[a]

Type of Input	Type of Controller	Mode	A	B
Disturbance	PI	P	0.859	−0.977
		I	0.674	−0.680
Disturbance	PID	P	1.357	−0.947
		I	0.842	−0.738
		D	0.381	0.995
Set point	PI	P	0.586	−0.916
		I	1.03[b]	−0.165[b]
Set point	PID	P	0.965	−0.85
		I	0.796[b]	−0.1465[b]
		D	0.308	0.929

[a] Design relation: $Y = A(\theta/\tau)^B$ where $Y = KK_c$ for the proportional mode, τ/τ_I for the integral mode, and τ_D/τ for the derivative mode.
[b] For set-point changes, the design relation for the integral mode is $\tau/\tau_I = A + B(\theta/\tau)$.

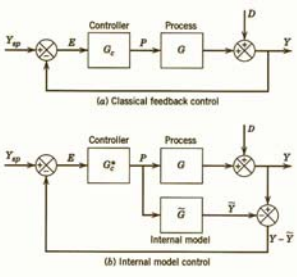
So for a PI controller
$K_pK_c = A\ (\theta_p/\tau_p)^B$ from P Mode
$\tau_p/\tau_I = A + B\ (\theta_p/\tau_p)$ from I Mode

2. Direct Synthesis

- Pick out form desired for Y/Y_{sp}
  - FOPDT
  - Second order
- Adjust G_c to make this happen
  - May or may not look like PID controller
- Gives some values for K_c, τ_I, and τ_D in special cases

3. Internal Model Control

- Use a model of the process
  - May use a time delay
- Compare process response to model response
- Change block diagram
- Gives values for K_c, τ_I, and τ_D
  - Table 12.1 and Control Station



Other Stuff in Ch. 12

- On-line controller tuning
  - In closed loop mode
- Recommendations for different systems
  - PI vs PID, etc.
- Troubleshooting
  - Equipment problems
    - Sticky valve stem
    - Fouled heat exchanger
  - Change in feed rate conditions
  - Cavitation in pumps