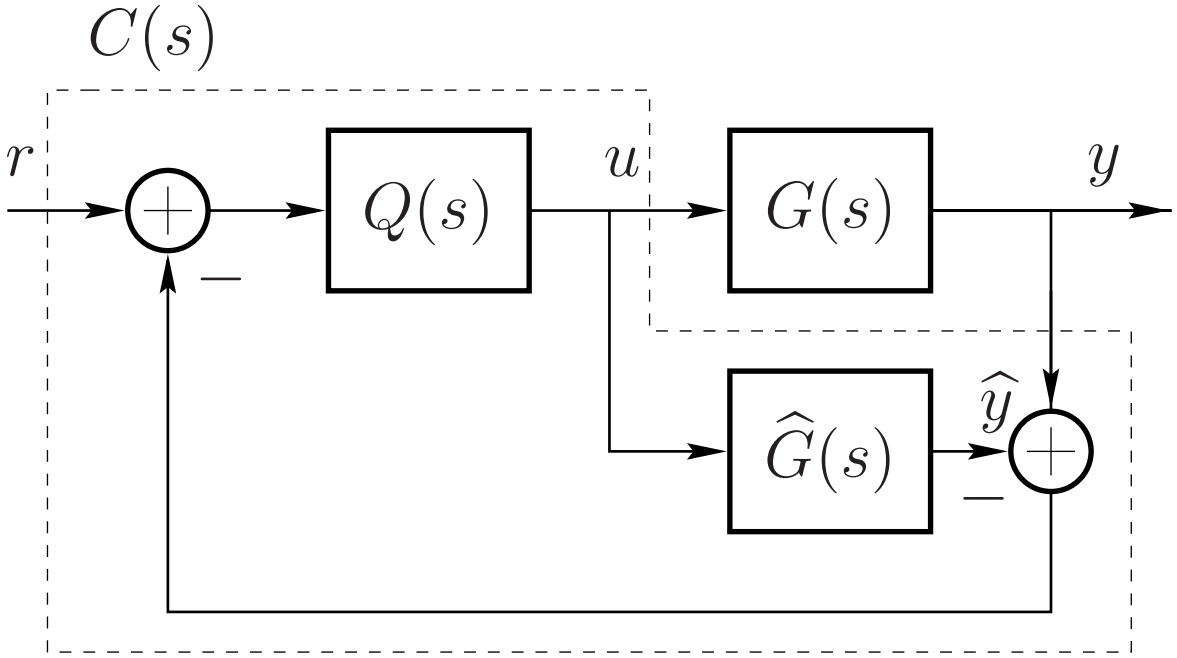
Internal Model Control (IMC)

IMC: apply feedback only when system G and model $\hat{G}$ differ!



- Assume G stable. Note: feedback from the model error $y - \widehat{y}$.
- Design: assume $\widehat{G} \approx G$ and choose Q stable with $Q \approx G^{-1}$.

Example

$$\widehat{G}(s) = \frac{1}{T_1 s + 1}$$

- Choose

$$Q = \frac{T_1 s + 1}{\tau s + 1}, \quad \tau < T_1$$

- Gives the controller

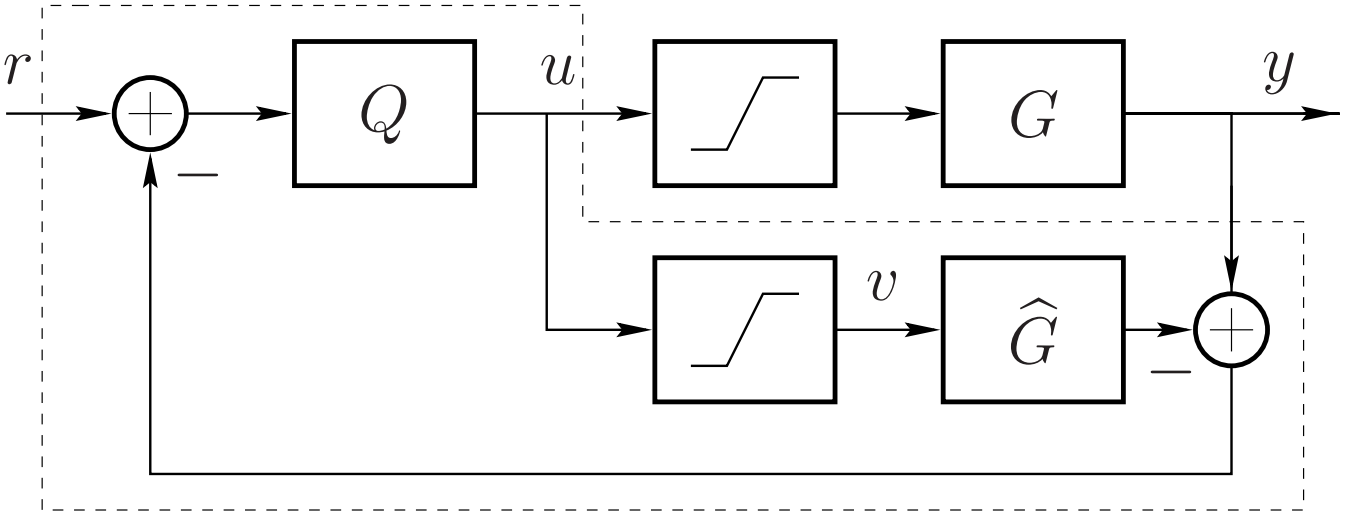
$$F(s) = \frac{Q}{1 - Q\widehat{G}} \quad \Rightarrow$$

$$F(s) = \frac{T_1 s + 1}{\tau s} = \frac{T_1}{\tau}\left(1 + \frac{1}{T_1 s}\right)$$

PI-controller!

IMC with Static Nonlinearity

Include nonlinearity in model



Choose $Q \approx G^{-1}$.

Example (cont'd)

Assume $r = 0$ and abuse of Laplace transform notation

$$u = -Q(y - \widehat{G}v) = -\frac{T_1 s + 1}{\tau s + 1} y + \frac{1}{\tau s + 1} v$$

if $|u| < u_{\max}$ ($v = u$): PI controller $u = \dfrac{-(T_1 s + 1)}{\tau s} y$

If $|u| > u_{\max}$ ($v = \pm u_{\max}$):

$$u = -\frac{T_1 s + 1}{\tau s + 1} y \pm \frac{u_{\max}}{\tau s + 1}$$

No integration.

An alternative way to implement anti-windup!