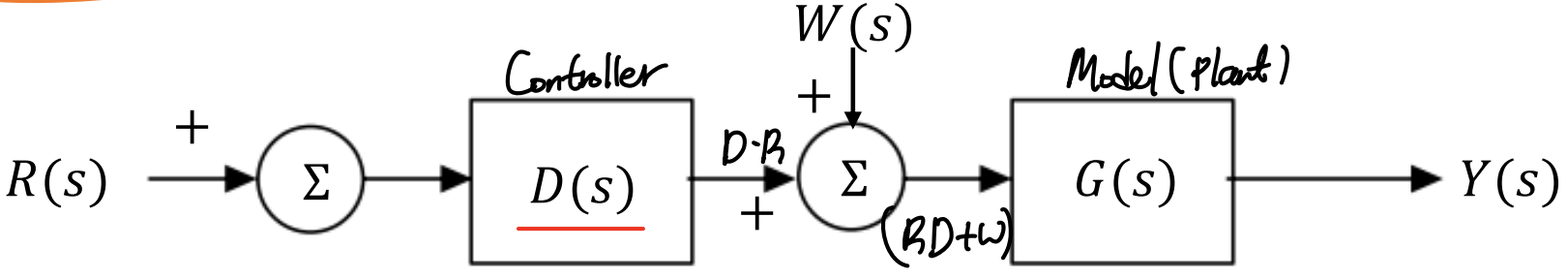
자동제어 한방에 끝내기

4. Feedback Controls

목차

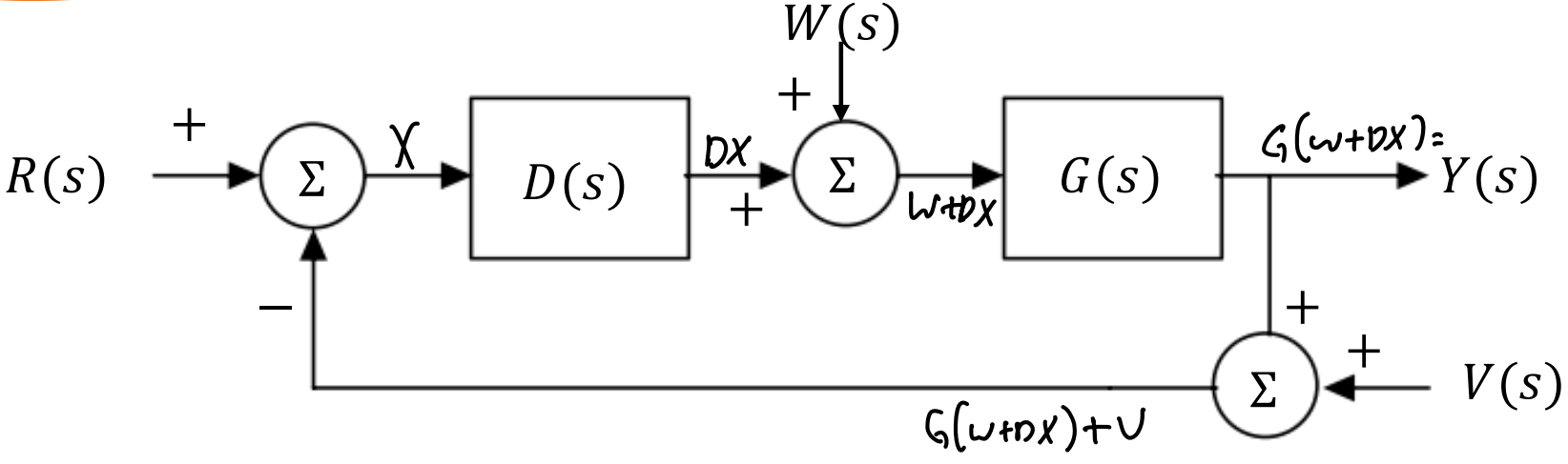
Open-Loop System



- $Y(s) = G \cdot (DR + W) = GDR + GW$

- $E(s) = R - Y = R - GDR - GW = (1 - GD)R - GW$

Closed-Loop System



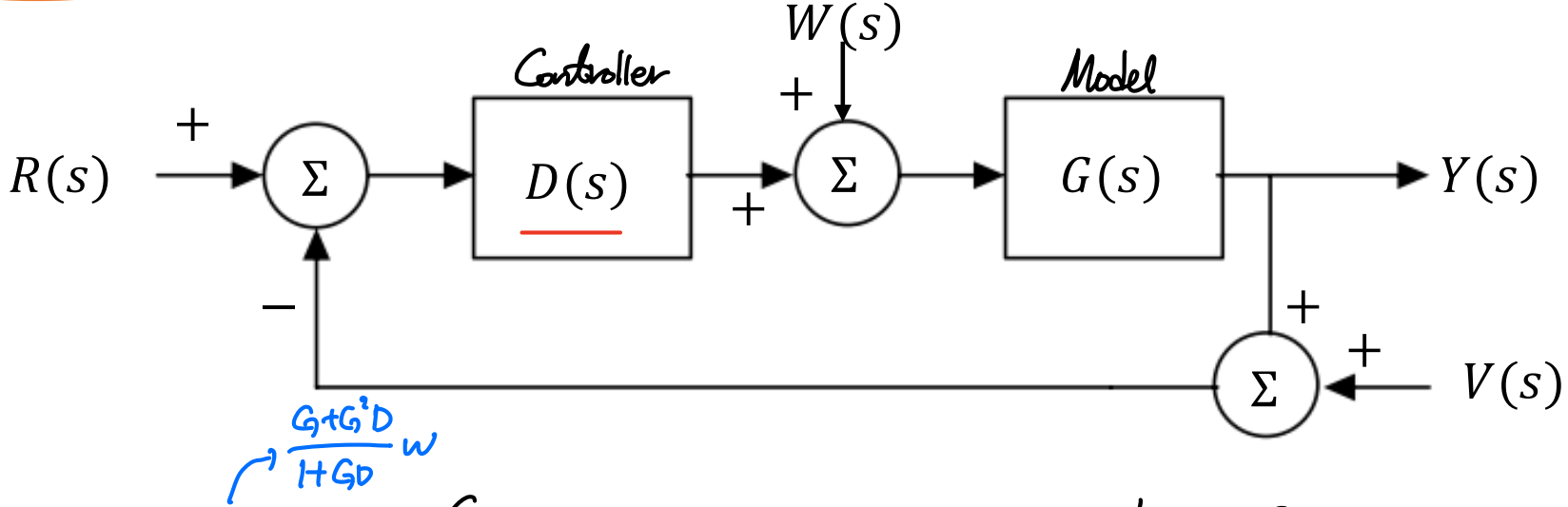
$R - \{G(W+DX)+V\} = X$

$\longrightarrow \quad R - GW - V = X + GDX$

$$X = \frac{1}{(1+GD)} R - \frac{G}{1+GD} W - \frac{1}{1+GD} V \longrightarrow Y = G(W+DX)$$

$$= GW + GDX$$

Closed-Loop System



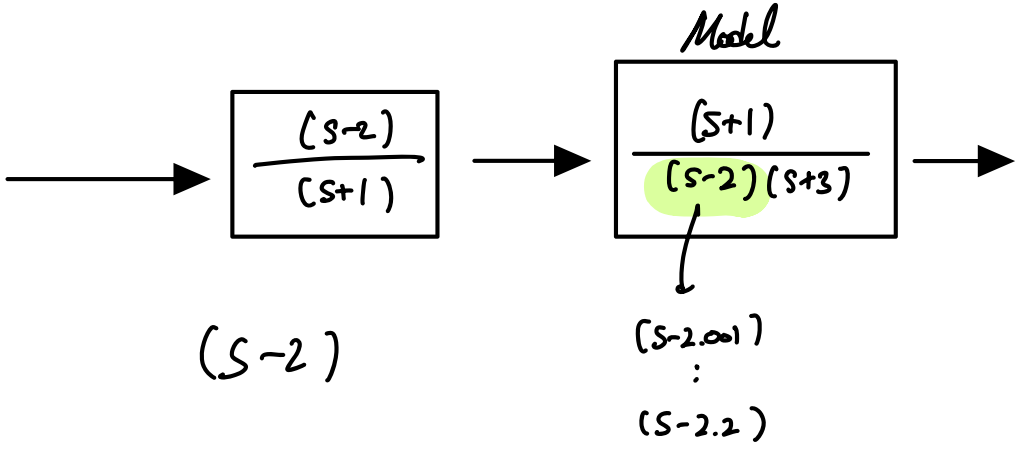
- $Y(s) = GW + GD\left\{\frac{1}{(1+GD)}R - \frac{G}{1+GD}W - \frac{1}{1+GD}V\right\}$

$= \frac{GD}{1+GD}R + \frac{G}{1+GD}W - \frac{GD}{1+GD}V$

- $E(s) = R - Y = \frac{1}{1+GD}R - \frac{G}{1+GD}W + \frac{GD}{1+GD}V$

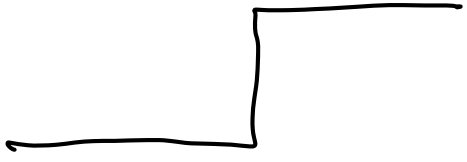
Pole-Zero Cancellation

- 기존 모델에 있는 Unstable pole $\frac{b(s)}{a(s)} = G(s)$ (Model) $\frac{d(s)}{c(s)} = D(s)$ (Controller)
  - 수학적으로는 Controller에 같은 항을 넣어 제어 가능
  - **실제로 그런가?**



Causality (proper)

- Zero의 차수가 pole의 차수보다 커진다면?
  - 남는 s항은 **미분항**
  - 신호의 미분?
  - 신호의 적분?



안정성

- Why Closed-loop Systems?
  - 특성방정식(Characteristic Equation)의 정의

$$\begin{array}{cc} G(s) & D(s) \\ b(s) & d(s) \\ \hline a(s) & c(s) \end{array}$$

  - Open-loop → $TF = G(s)D(s)$ → $CE = a(s)c(s)$

$$D(s) = K\frac{1}{s-r}$$

  - Closed-loop → $TF = \dfrac{G(s)D(s)}{1+G(s)D(s)}$ → $1 + \dfrac{b(s)d(s)}{a(s)c(s)} = a(s)c(s) + b(s)d(s)$