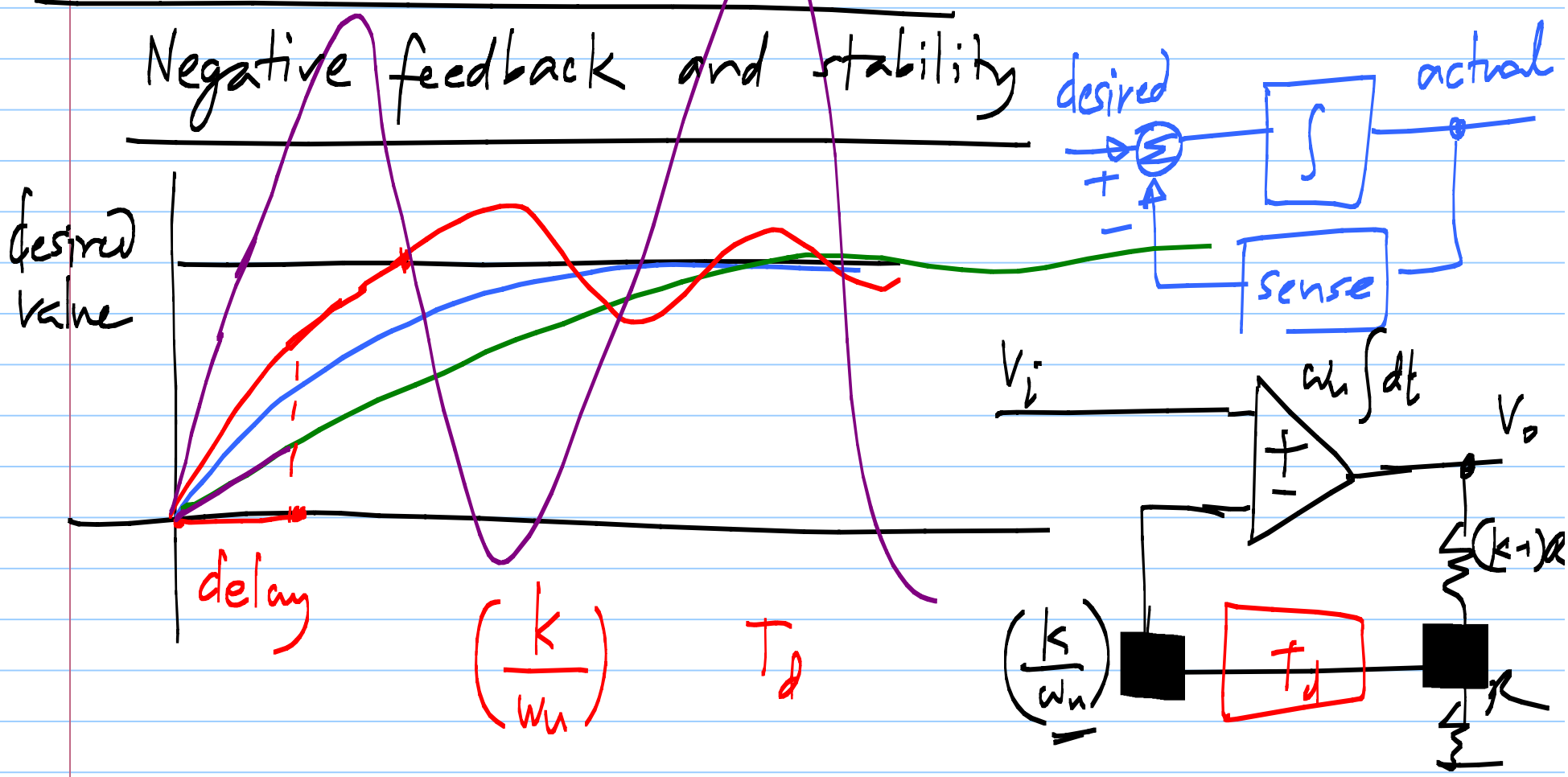
Lecture 37

4/4/2016

Negative feedback and stability



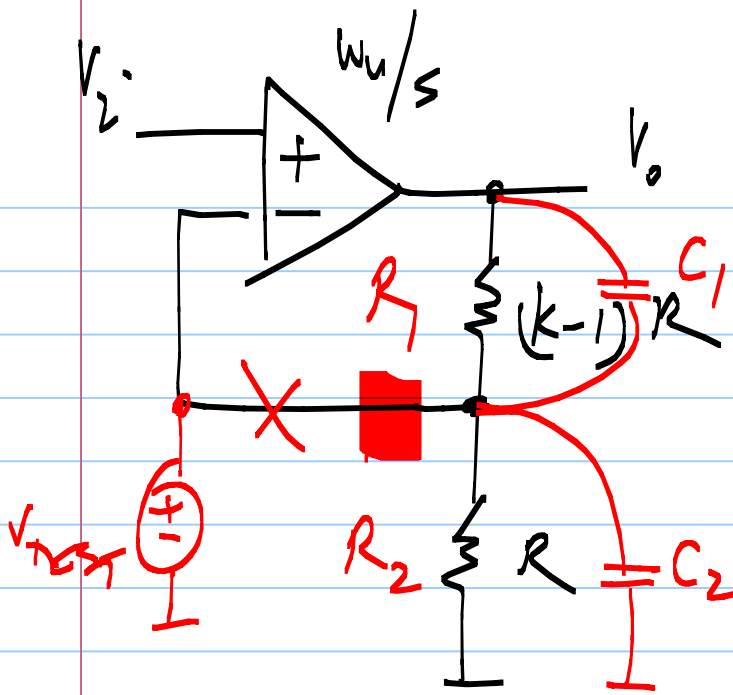
Excess delay can cause instability.

Causes instability if $T_d \gg \frac{1}{\omega_{u,loop}}$

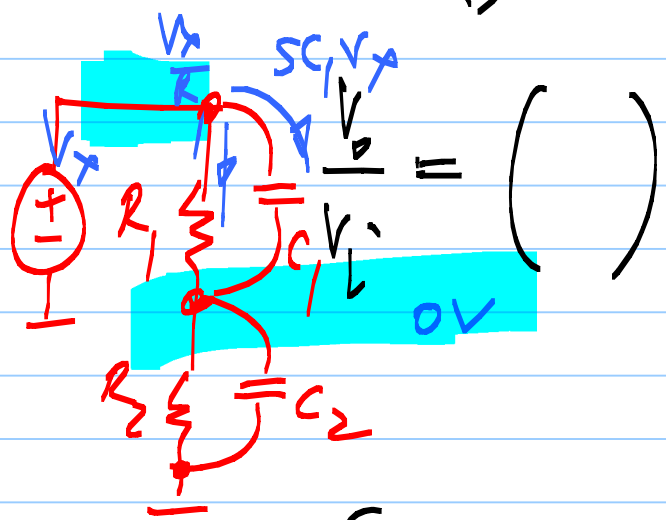
For stability, $T_d < \frac{1}{\omega_{u,loop}}$

Better circuit design, improved technology → reduce T_d

reduce $\omega_{u,loop}$ → Slowing down the system



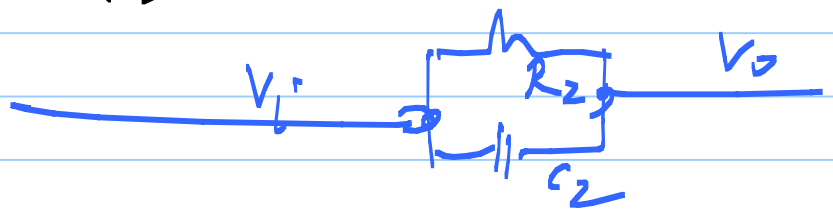
Loop gain: $\frac{\omega_u}{ks} = L(s)$

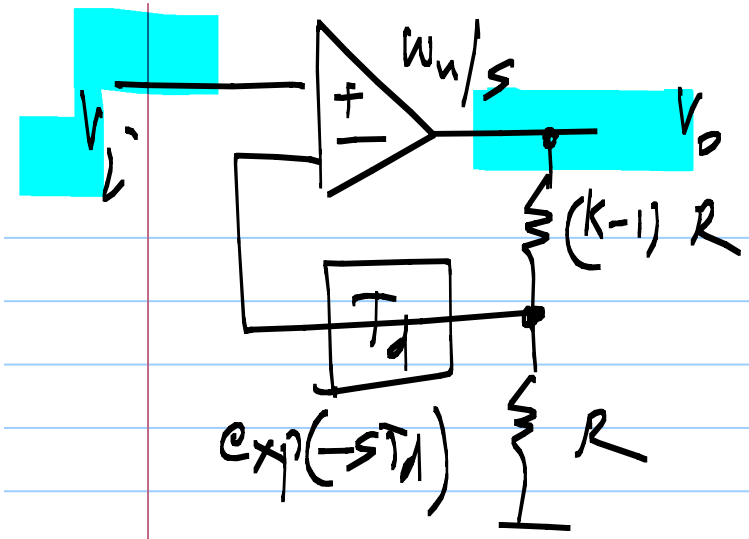


$$\frac{V_o}{V_i} = \left(\frac{L(s)}{1+L(s)} \right)$$

$$L(s) = \frac{\omega_u}{k \cdot s}$$

$$L(s) = \frac{\omega_u}{ks} \left(\frac{1 + sC_1R_1}{1 + s(C_1+C_2)(R_1 \| R_2)} \times \right)$$

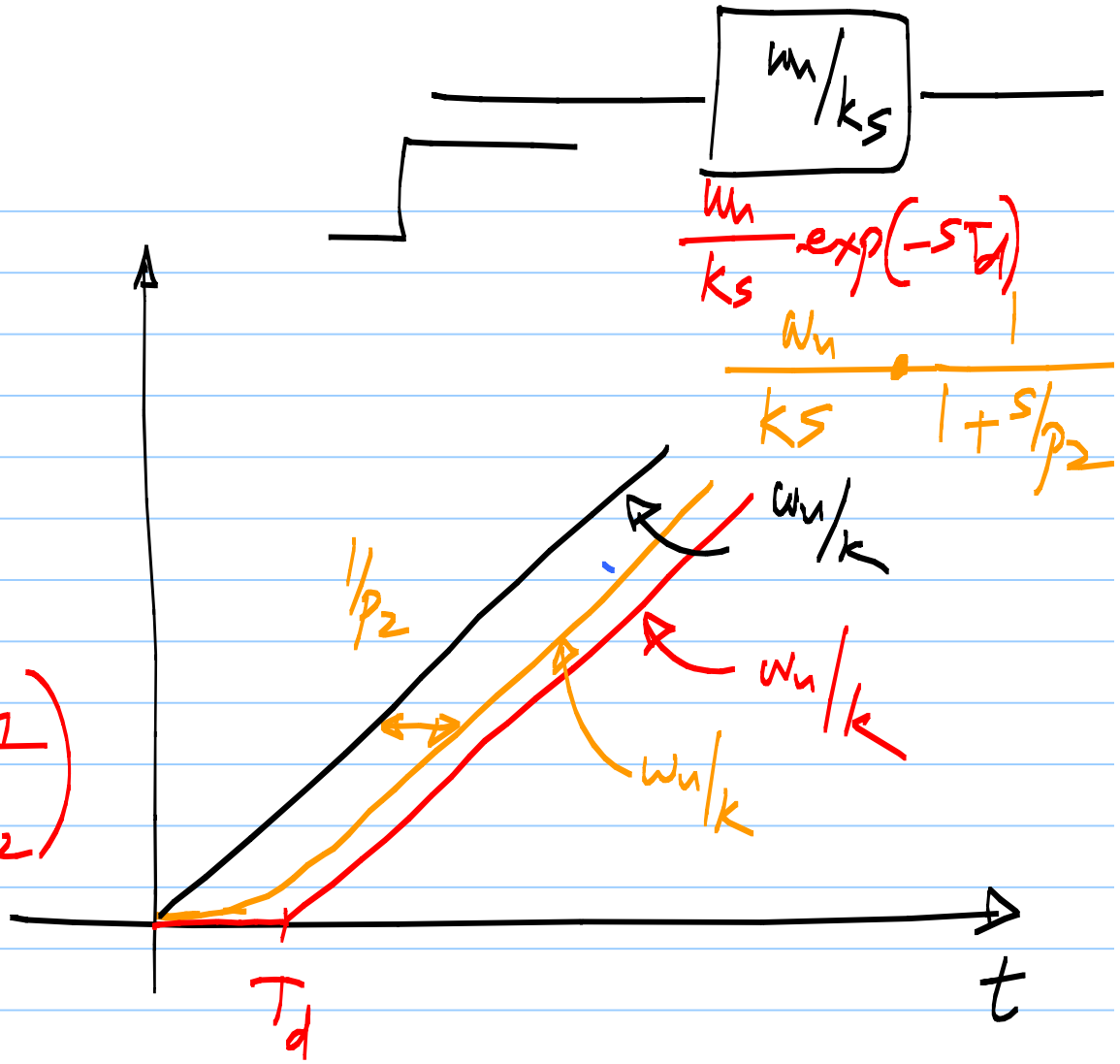




Loop gain: $\frac{\omega_n}{ks} = L(s)$

Step response $\frac{\omega_n}{ks}\left(\frac{1+s/z_1}{1+s/p_2}\right)$

$\frac{\omega_n}{ks}\left(1+s/z_1\right)$



$$L(s) = \frac{\omega_n}{ks} \cdot \frac{1}{1 + s/p_2} = \frac{\omega_n}{k}\left[\frac{1}{s} \cdot \frac{1}{1 + s/p_2}\right]$$

$$= \frac{\omega_n}{k}\left[\frac{1}{s} - \frac{1/p_2}{1 + s/p_2}\right]$$

$$\frac{1}{s+p_2} \qquad \frac{1/p_2}{1 + s/p_2}$$

$$\left(1 - \exp(-p_2 t)\right)\frac{1}{p_2}$$