

## Sensitivity to Parameter Variations

Let's compute  $\mathcal{S}$  for our DC motor control example, both open- and closed-loop.

Open-loop:

- ▶ nominal case  $T_{ol} = K_{ol}A = \frac{1}{A}A = 1$
- ▶ perturbed case

$$A \longrightarrow A + \delta A$$

$$T_{ol} \longrightarrow K_{ol}(A + \delta A) = \underbrace{\frac{1}{A}}_{\text{design choice}} (A + \delta A) = \underbrace{1}_{T_{ol}} + \underbrace{\frac{\delta A}{A}}_{\delta T_{ol}}$$

$$\text{Sensitivity: } \mathcal{S}_{ol} = \frac{\delta T_{ol}/T_{ol}}{\delta A_{ol}/A_{ol}} = \frac{\delta A/A}{\delta A/A} = 1$$

For example, a 5% error in  $A$  will cause a 5% error in  $T_{ol}$ .