Sensitivity to Parameter Variations

Closed-loop:

- nominal case $\quad T_{\mathrm{cl}} = \dfrac{AK_{\mathrm{cl}}}{1 + AK_{\mathrm{cl}}}$
- perturbed case

$$A \longrightarrow A + \delta A \qquad T_{\mathrm{cl}} \longrightarrow T_{\mathrm{cl}} + \underbrace{\delta T_{\mathrm{cl}}}_{\substack{\text{how to}\\ \text{compute this?}}}$$

Taylor expansion:

$$T(A + \delta A) = T(A) + \frac{\mathrm{d}T}{\mathrm{d}A}(A)\delta A + \text{higher-order terms}$$

In our case:

$$\frac{\mathrm{d}T_{\mathrm{cl}}}{\mathrm{d}A} = \frac{K_{\mathrm{cl}}}{1 + AK_{\mathrm{cl}}} - \frac{AK_{\mathrm{cl}}^2}{(1 + AK_{\mathrm{cl}})^2} = \frac{K_{\mathrm{cl}}}{(1 + AK_{\mathrm{cl}})^2}$$

$$\delta T_{\mathrm{cl}} = \frac{K_{\mathrm{cl}}}{(1 + AK_{\mathrm{cl}})^2}\delta A$$