

Rule F: $j\omega$ -crossings

In our example, the characteristic polynomial is

$$s^4 + 4s^3 + 6s^2 + (4 + K)s + K$$

Form the Routh array:

$$\begin{array}{l} s^4 : \quad 1 \quad \quad 6 \quad K \\ s^3 : \quad 4 \quad \quad 4 + K \quad 0 \\ s^2 : \quad 20 - K \quad 4K \\ s^1 : \quad 80 - K^2 \quad 0 \\ s^0 : \quad 4K \end{array}$$

For stability, need $20 - K > 0$, $80 - K^2 > 0$, $4K > 0$

The characteristic polynomial is stable for $K < \sqrt{80} = 4\sqrt{5}$

$$\implies K_{\text{critical}} = 4\sqrt{5}$$