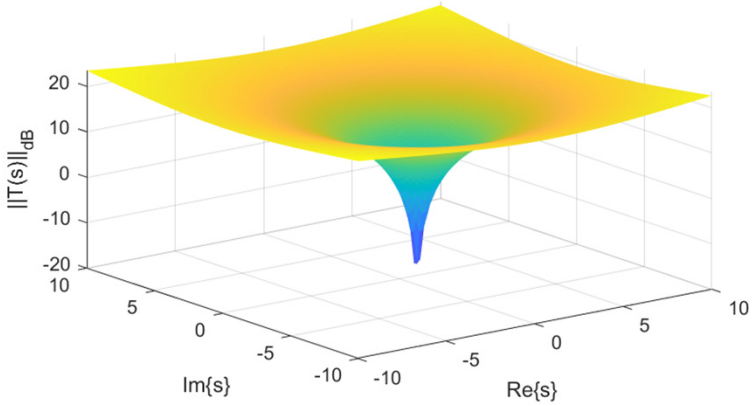
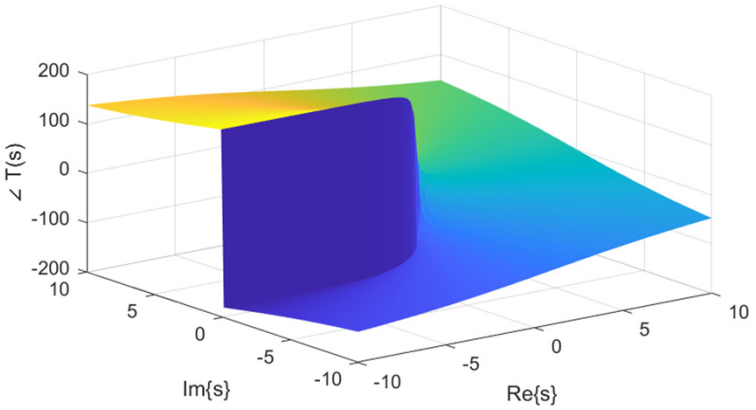
Determining Stability From T(s)

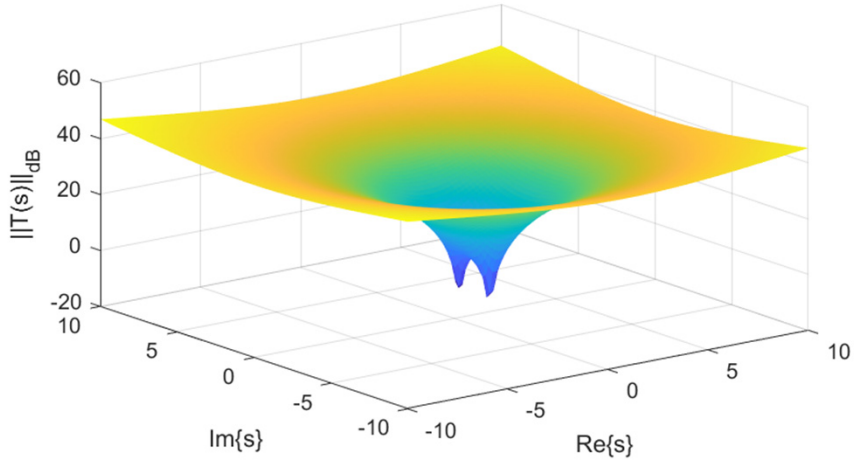
S-plane plots

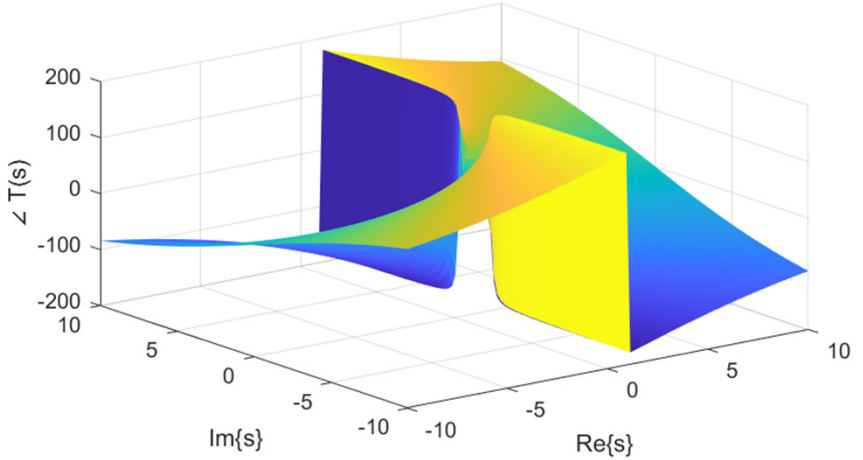
$T(s) = (s - 1)$



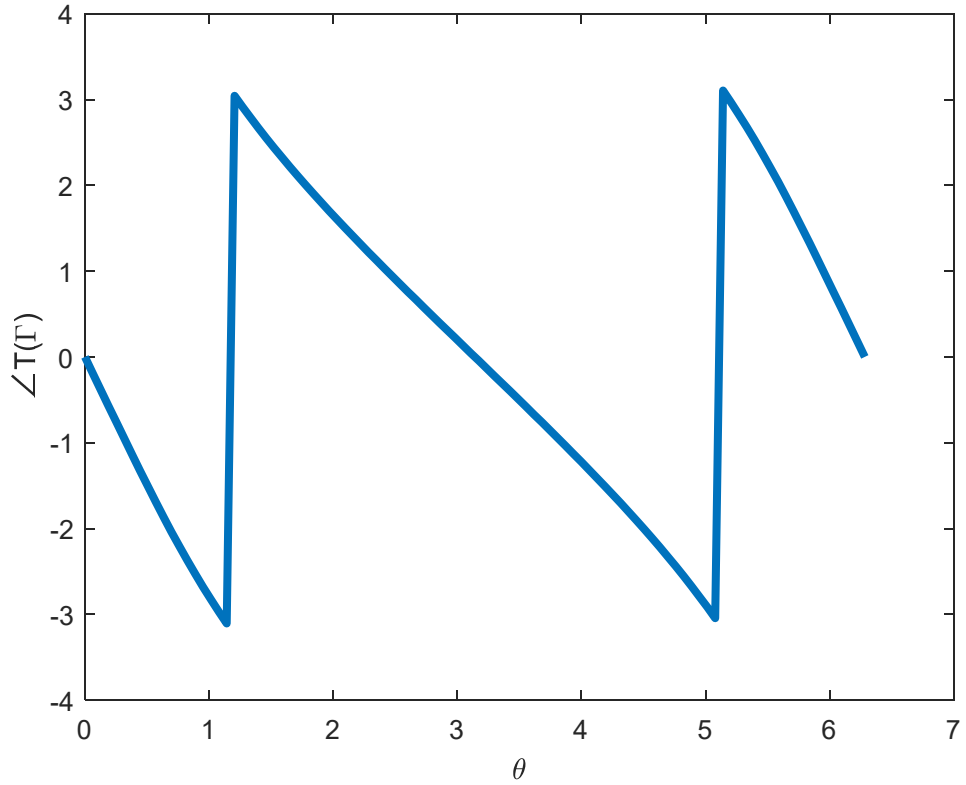


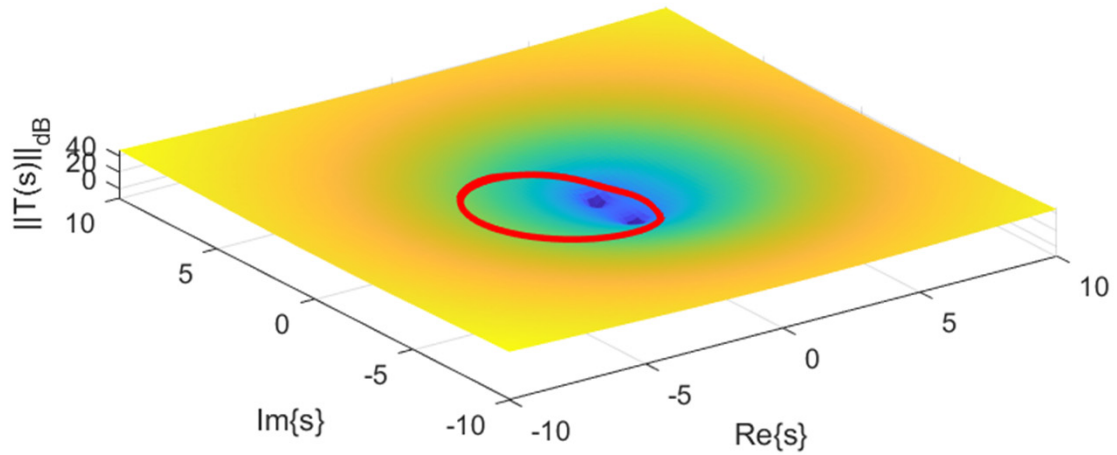
$T(s) = (s - s_1)(s - s_1^*)$

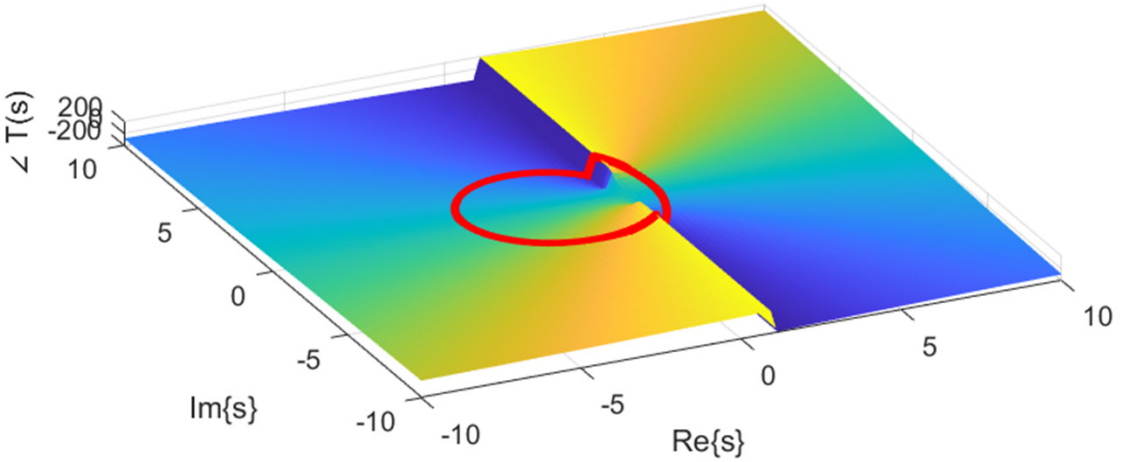




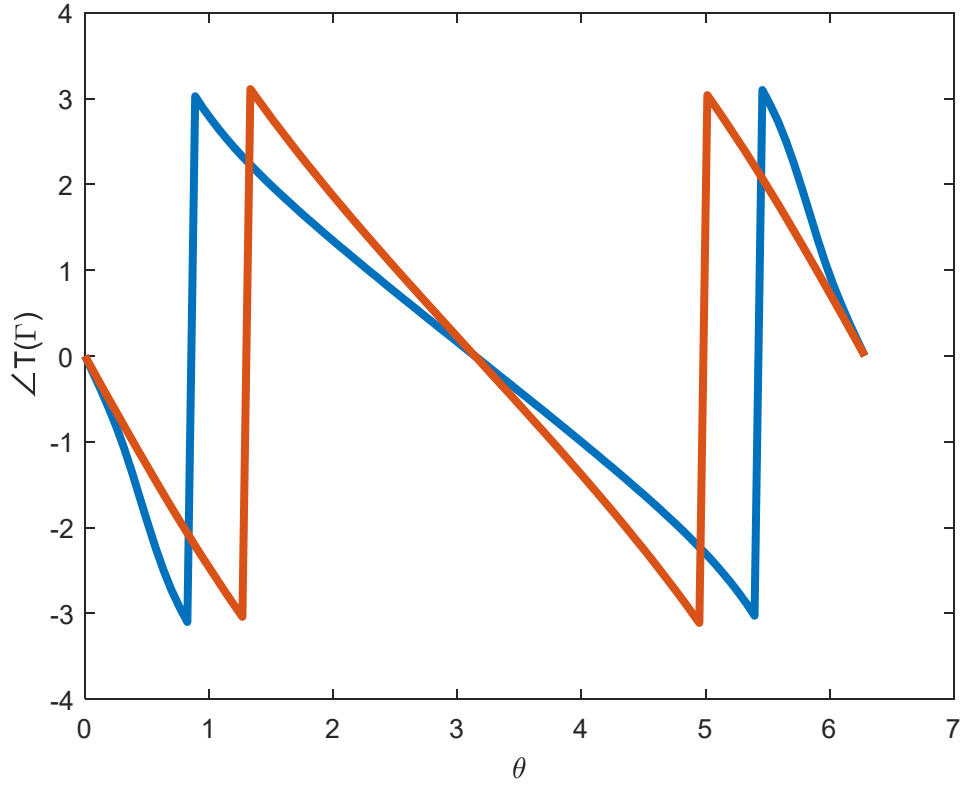
Cauchy’s Principle

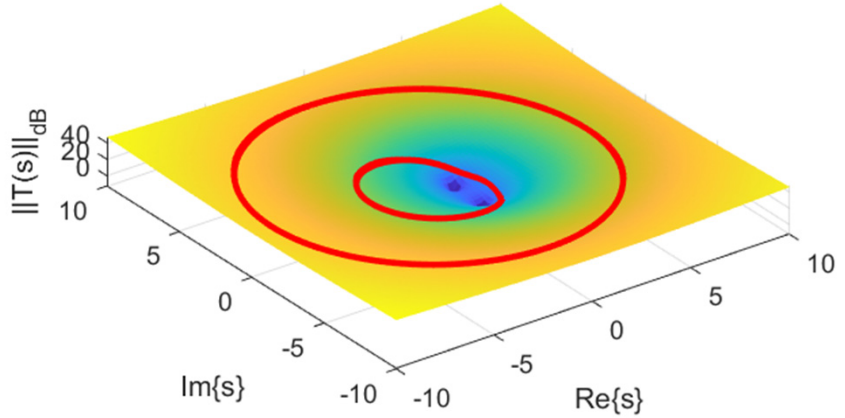

∠T(Γ)
θ

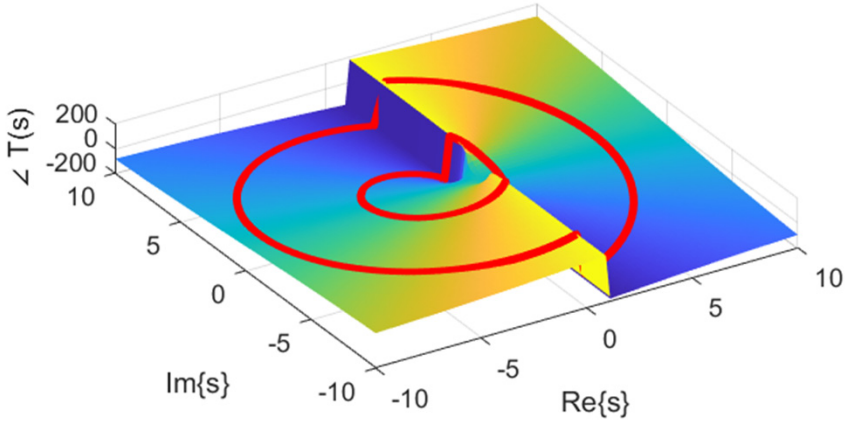

||T(s)||dB
Im{s}
Re{s}


∠ T(s)
Im{s}
Re{s}

$$T(s) = (s - s_1)(s - s_1^*)$$

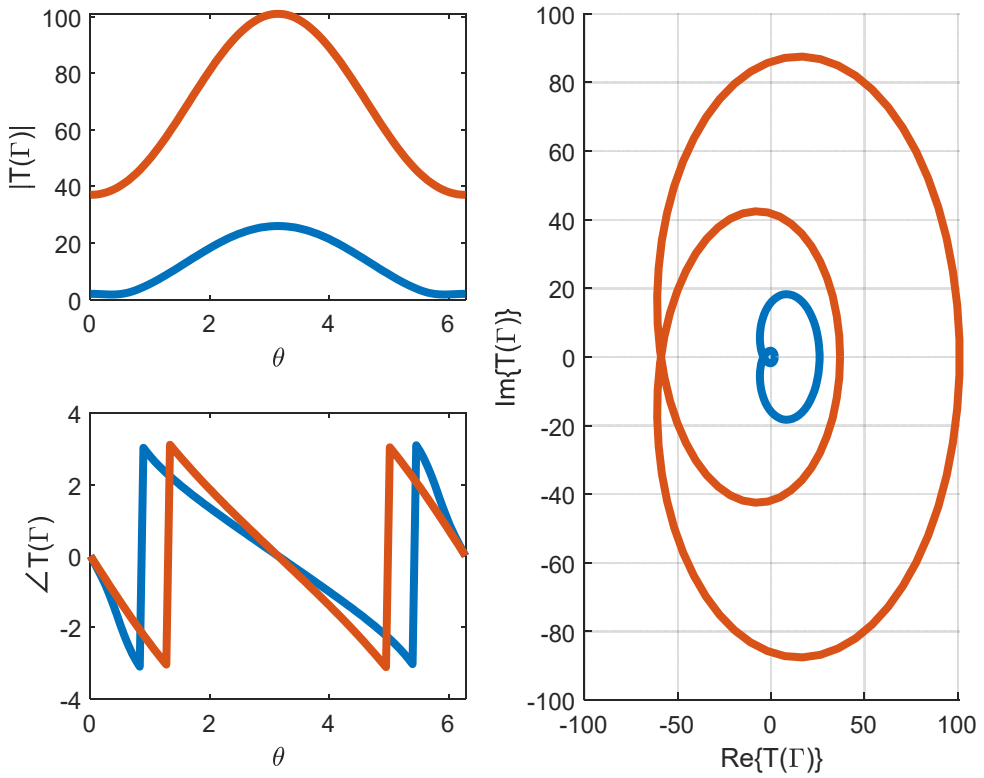


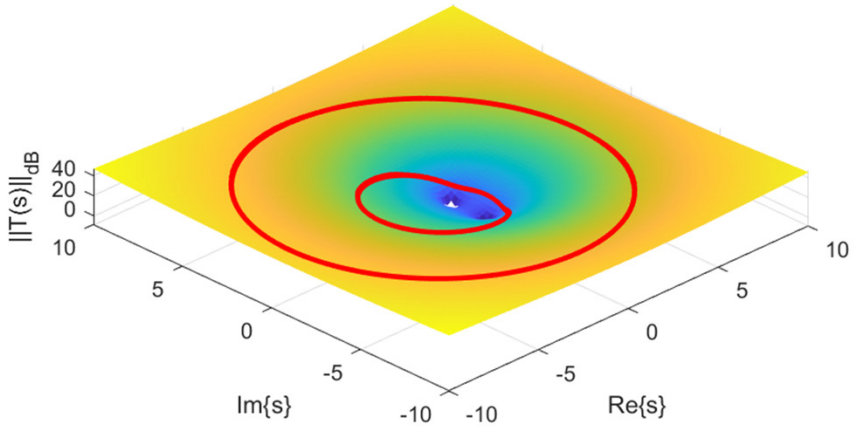


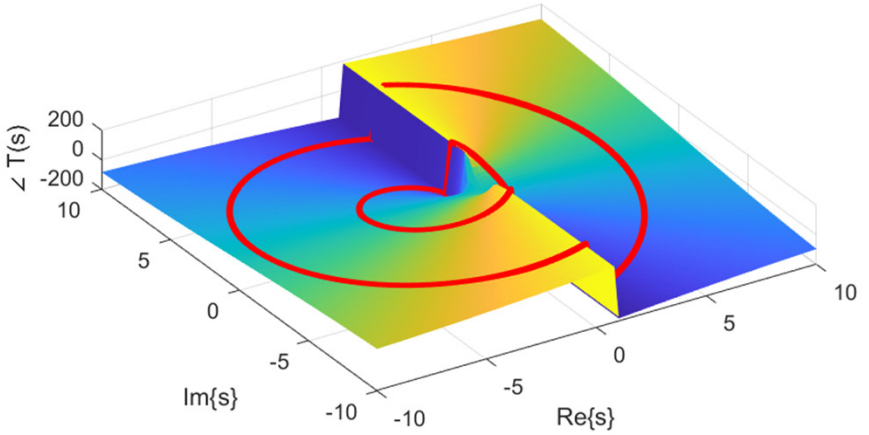


Nyquist Contour

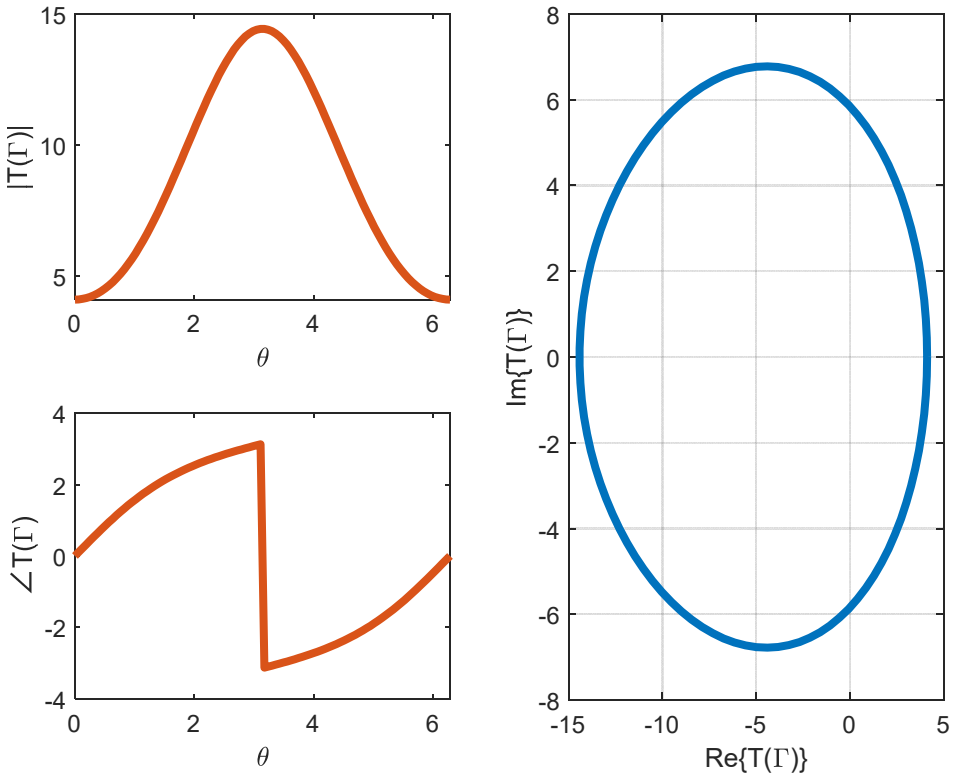
$$T(s) = (s - s_1)(s - s_1^*)$$

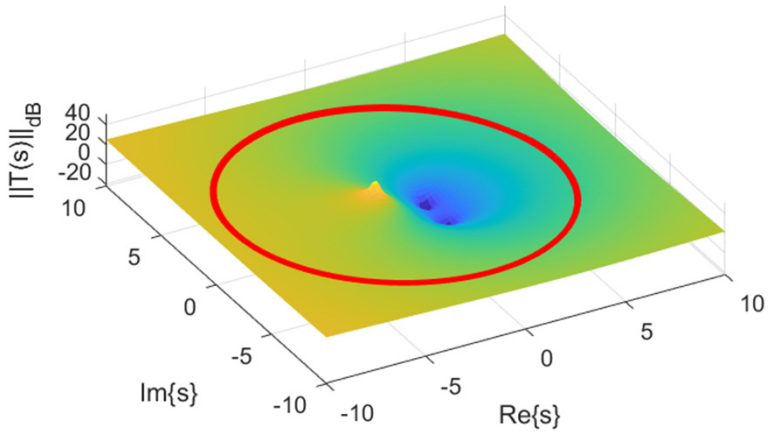


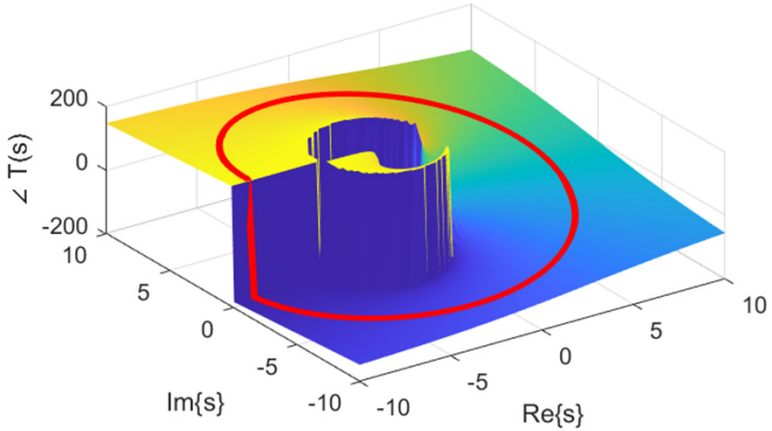




$$T(s) = \frac{(s - s_1)(s - s_1^*)}{s - p_1}$$

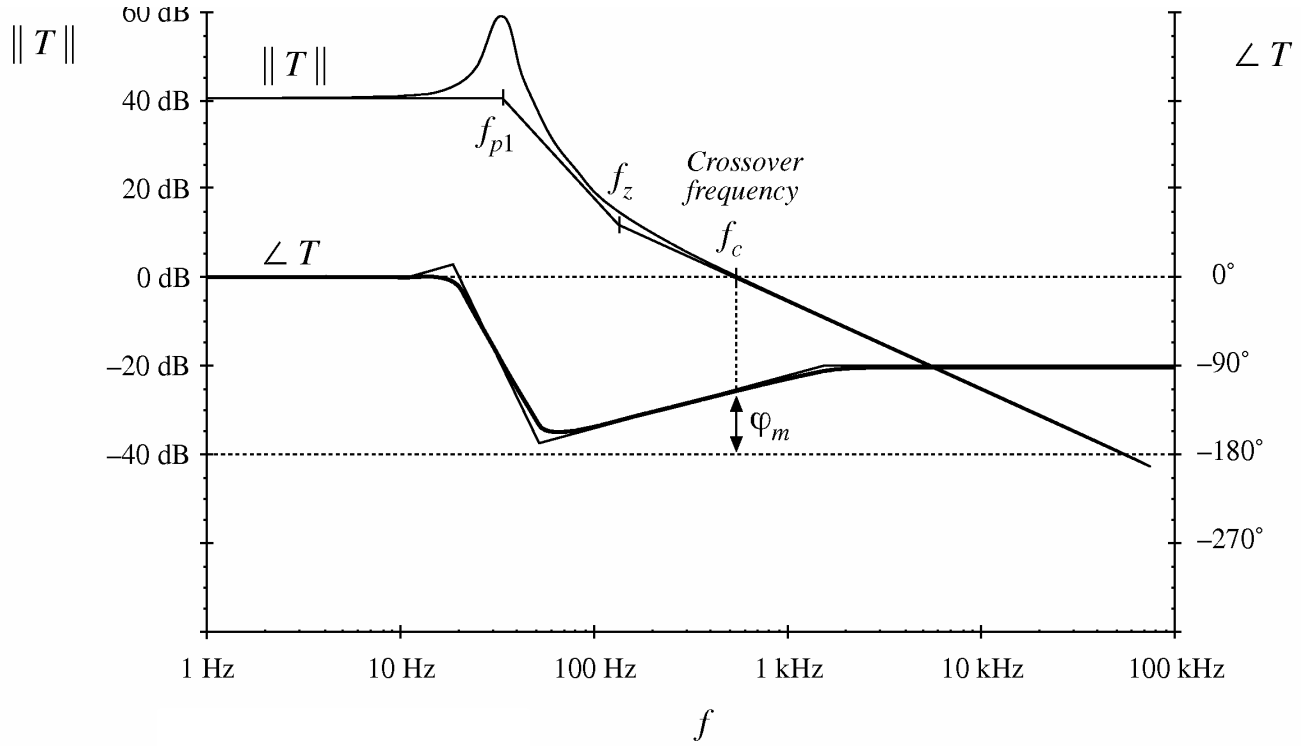




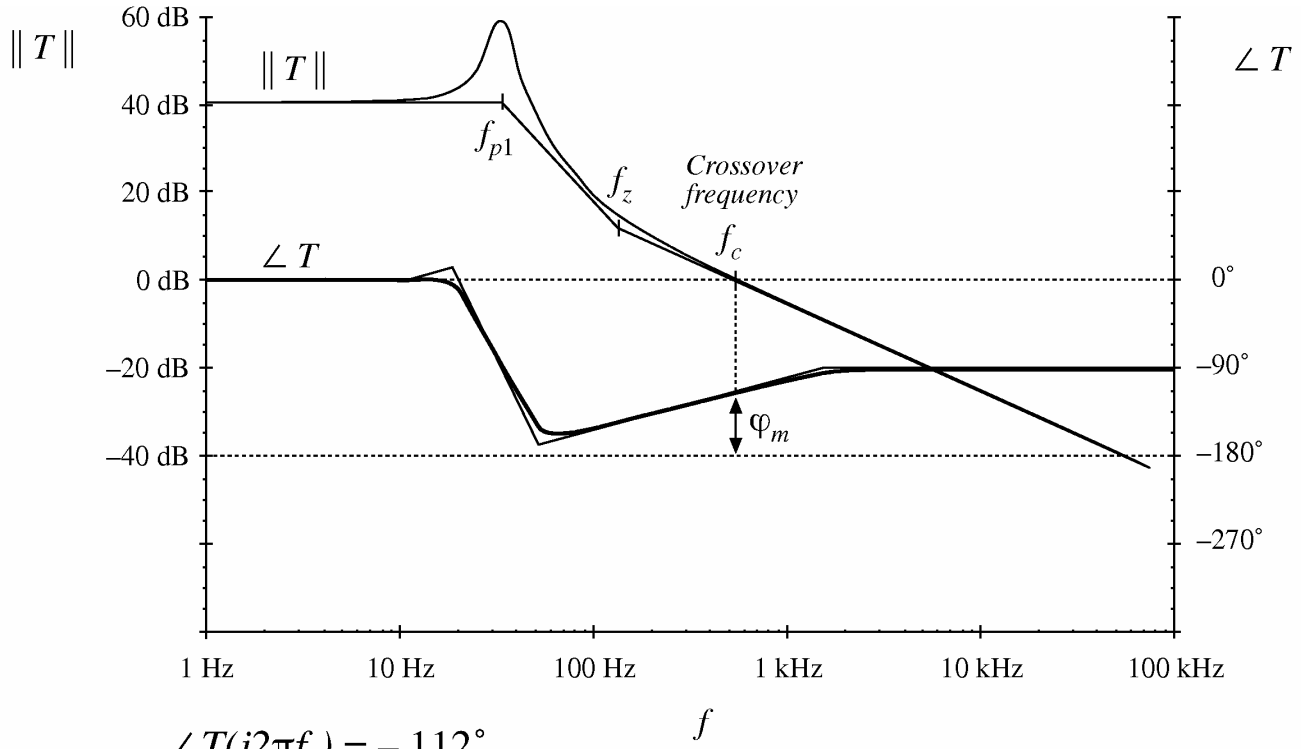


Nyquist Contour & Stability Test

Alternative: The Phase Margin Test



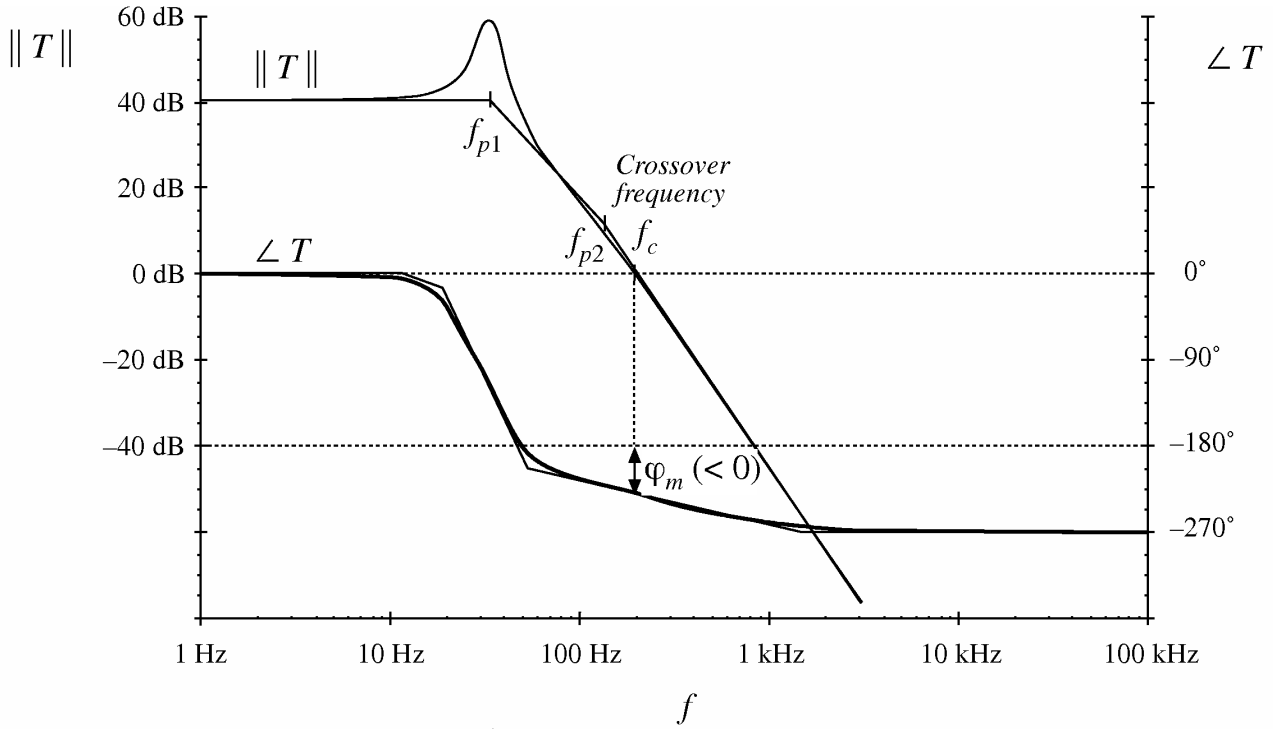
Example: Stable System



$$\angle T(j2\pi f_c) = -112^\circ$$

$$\varphi_m = 180^\circ - 112^\circ = +68^\circ$$

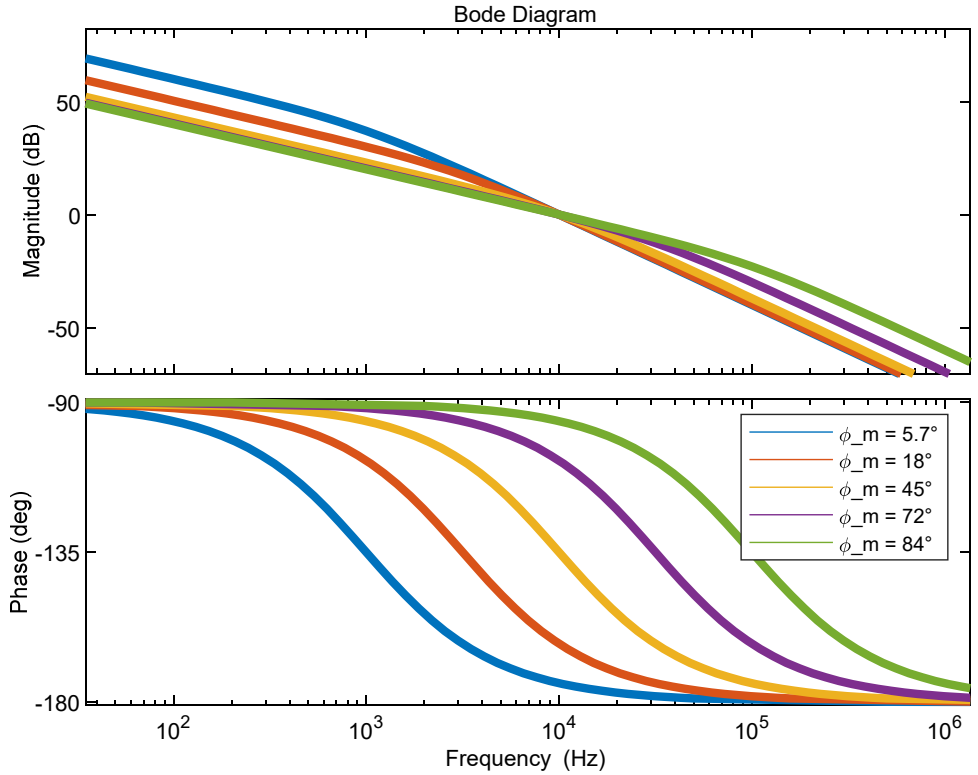
Example: Unstable System

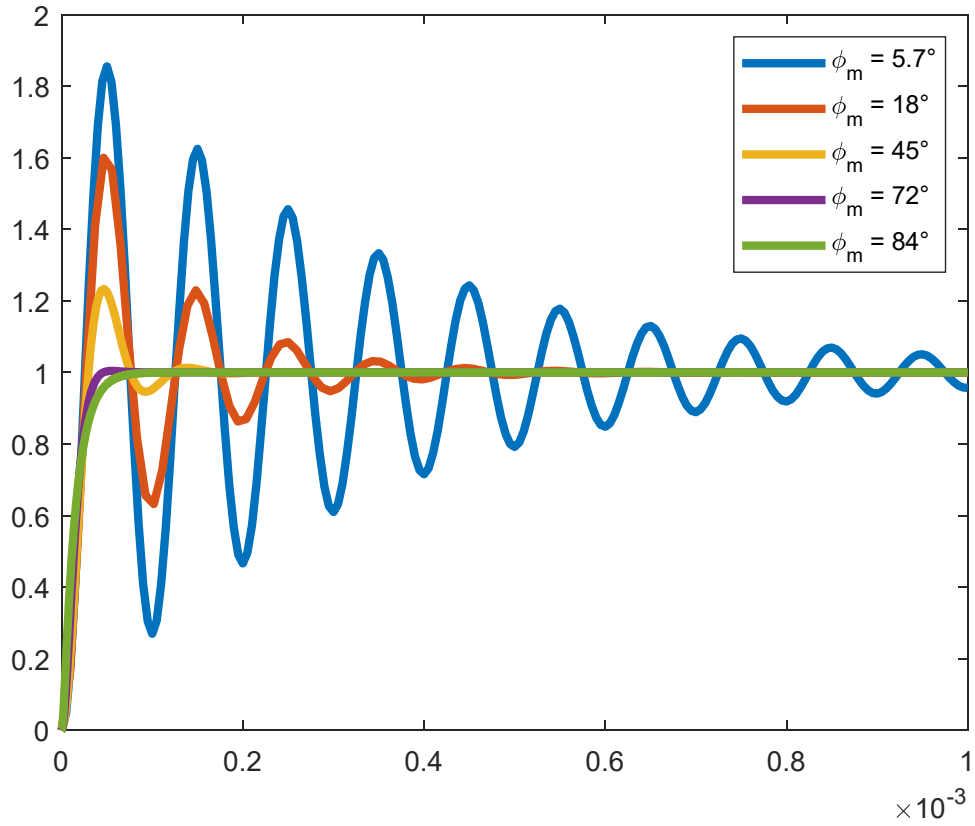


$$\angle T(j2\pi f_c) = -230^\circ$$

$$\varphi_m = 180^\circ - 230^\circ = -50^\circ$$

Design of Phase Margin





Closed-Loop Step Response vs. Q_{CL}