Homework G.10 - Solution

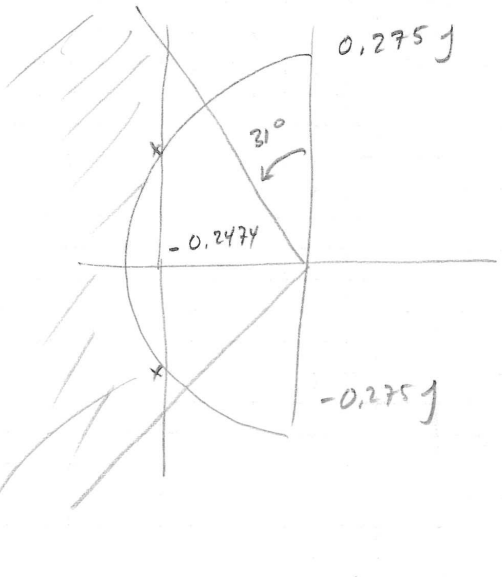
6.10

$t_r < 8 \Rightarrow \omega_n > \frac{2.2}{8} = 0.2750$

$M_p < 15\% \Rightarrow \theta > \sin^{-1}\sqrt{\frac{\ln^2(\frac{100}{15})}{\pi^2+\ln^2(\frac{100}{15})}} = 31^\circ$

$t_s < 90 \Rightarrow \sigma > \frac{1}{20}\ln\left(\frac{4\%}{1}\right) = 0.2474$

The possible pole locations are



pick location to minimize distance to origin:

roots at $-0.2475 \pm jm$

when $\sqrt{(-0.2475)^2+m^2} = 0.275$

$\Rightarrow m = 0.1199$

∴ pick roots at

$-0.2475 \pm j0.1191$

6.10

The desired closed loop char polynomial is

$$\Delta_{cl}^{d} = (s + 0.2475 + j0.1191)(s + 0.2475 - j0.1191)$$

$$= s^2 + 0.495\,s + 0.0754$$

From the solution of problem 6.8, the closed loop polynomial is

$$\Delta_{cl} = s^2 + \left(\frac{k_D}{m_c + 2m_r}\right) s + \left(\frac{k_P}{m_c + 2m_r}\right)$$

Equating terms gives

$$k_D = (0.495)(m_c + 2m_r) = 0.7425$$

$$k_P = (0.0754)(m_c + 2m_r) = 0.1132$$