Structured Electronic Design

Frequency Compensation:
the Phantom zero

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Phantom zeros

Design of the characteristic polynomial of the servo function

$$S(s) = \frac{-L(s)}{1-L(s)} = \frac{-L_{\mathrm{DC}}N(s)}{D(s)-L_{\mathrm{DC}}N(s)}$$ ← Characteristic polynomial of the servo function

$D(s) - L_{\mathrm{DC}}N(s) = 0 \Longrightarrow$ Poles of servo function

Loop gain with n poles:

1. Loop gain-poles product defines the coefficient of the highest order of s
2. n-1 zeros can be inserted in the loop to adjust the other coefficients to those of desired filter characteristic
3. Those zeros are also zeros in the servo function
4. An all-pole source-to-load transfer can still be established if these zeros appear as poles in the asymptotic gain

$$A_f(s) = A_{f\infty}(s) \frac{-L(s)}{1-L(s)(1-s/z_1)}$$

↑ Phantom zero changes characteristic equation and thus the poles of the servo function

