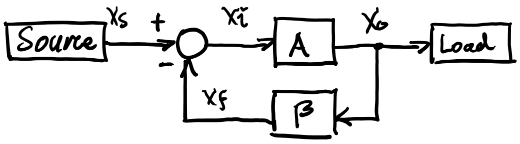
Stability

November 23, 2017 15:28

Mark scaling: x+0.9*(x-0.01x^2)

Recall Basic Feedback:



$$A_f(s) = \frac{A(s)}{1+A(s)\beta(s)} = \frac{A(j\omega)}{1+A(j\omega)\beta(j\omega)}$$

loop gain: $L(j\omega) = A(j\omega)\beta(j\omega)$

$$= |A(j\omega)\beta(j\omega)|\, e^{j\phi(\omega)}$$

phase of loop gain

When $\angle(\phi) = 180°$ then

① $1+A\beta$ is positive (positive)

② $1+A\beta = 0$ (oscillate)

③ $1+A\beta$ is negative (unstable)

Poles of feedback amplifier:

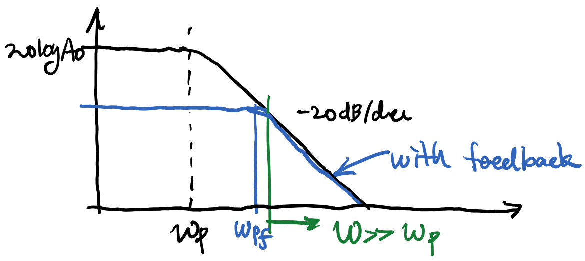
Characteristic Equation: $\boxed{1+A(s)\beta(s)}$

Consider single pole amp.:

$$A(s) = \frac{A_0}{1+\left(\frac{s}{\omega_p}\right)}$$

$$\rightarrow A_f(s) = \frac{\left(\frac{A_0}{1+A_0\beta}\right)}{1+\left(\frac{s}{\omega_p(1+A_0\beta)}\right)}$$ (Bandwidth extension)

If $\omega \gg \omega_{pf}$ then $A_f(s) \approx A(s)$

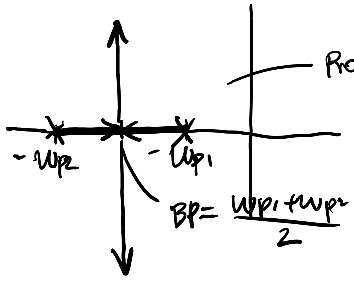


Consider two-pole amplifier

$$A(s) = \frac{A_0}{\left(1+\frac{s}{\omega_{p1}}\right)\left(1+\frac{s}{\omega_{p2}}\right)}$$

$$A_f(s) = \frac{A_0}{\left(1+\frac{s}{\omega_{p1}}\right)\left(1+\frac{s}{\omega_{p2}}\right)+A_0\beta}$$ → char. eqn: $0 = \left(1+\frac{s}{\omega_{p1}}\right)\left(1+\frac{s}{\omega_{p2}}\right)+A_0\beta$

$(1+\frac{s}{\omega_{p1}})(1+\frac{s}{\omega_{p2}})+A_0\beta$



Root Locus: As feedback gain changes.