EE223 Analog Integrated Circuits
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Lecture 20: Feedback

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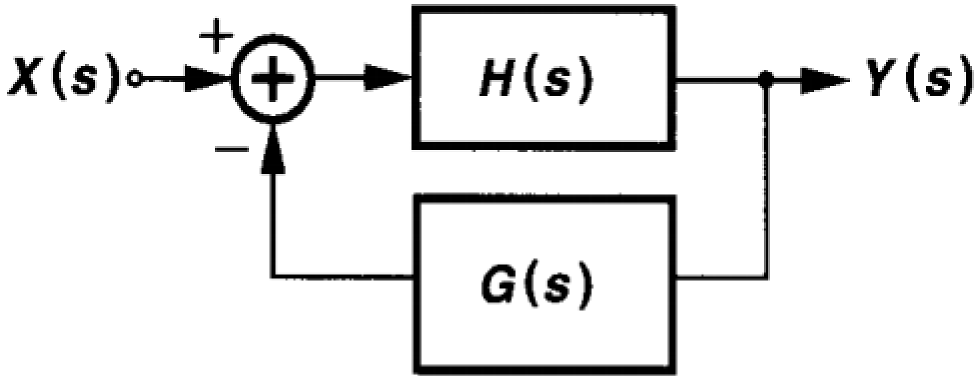
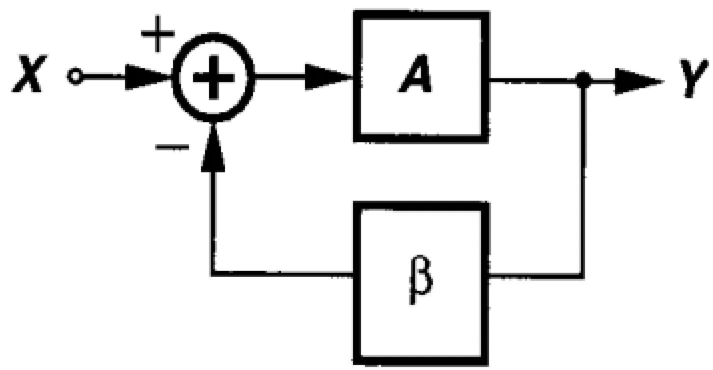
General Feedback System



$$Y(s) = H(s)[X(s) - G(s)Y(s)]$$

$$\frac{Y(s)}{X(s)} = \frac{H(s)}{1 + G(s)H(s)}$$

Simple Feedback System



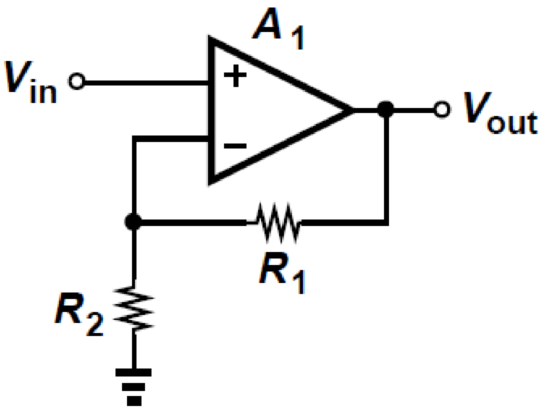
$$\frac{Y}{X} = \frac{A}{1+\beta A}$$

$$\approx \frac{1}{\beta}\left(1 - \frac{1}{\beta A}\right)$$

where we have assumed $\beta A \gg 1$

OPAMP Gain Requirement

The circuit has a nominal gain of 10. i.e.,$1+R_1/R_2=10$.
Determine the minimal value of A_1 for a gain error 1%:



Solution:

$$\frac{V_{out}}{V_{in}} = \frac{A_1}{1+\frac{R_2}{R_1+R_2}A_1} = \frac{R_1+R_2}{R_2}\frac{A_1}{\frac{R_1+R_2}{R_2}+A_1}$$

$$\frac{V_{out}}{V_{in}} \approx \left(1+\frac{R_1}{R_2}\right)\left(1-\frac{R_1+R_2}{R_2}\frac{1}{A_1}\right)$$

$$\mathit{Gain\ error} = \frac{1}{\beta A}$$

Properties of Feedback System

- Gain Desensitization
- Bandwidth Modification
- Terminal Impedance Modification
- Nonlinearity Reduction