Structured Electronic Design

Application of Negative Feedback in Amplifier Design

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Application of negative feedback

1. Amplification mechanism found in biased amplifying devices suffers from numerous imperfections

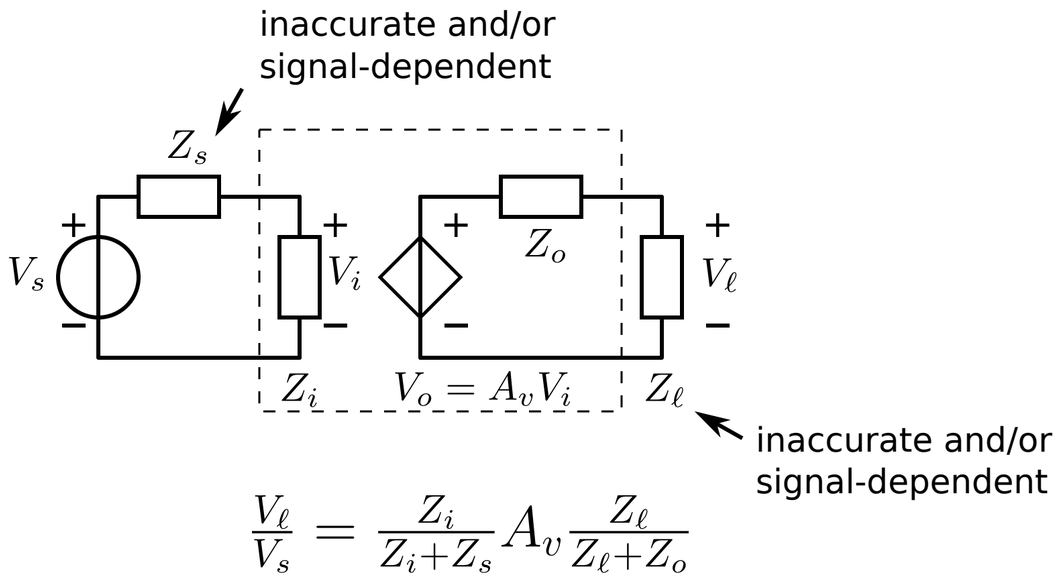
2. We need error reduction techniques to improve the performance-to-cost ratio

Negative 😠 feedback?

Negative (corrective 😁) feedback can be regarded as an error reduction technique that:

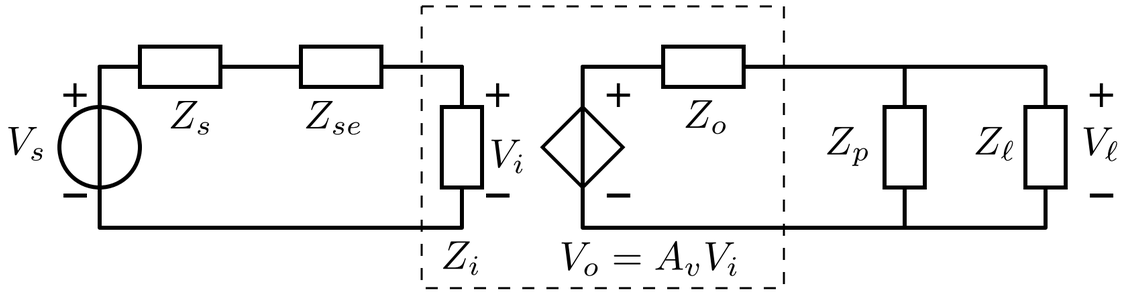
- Makes the properties of the amplifier less dependent on those of the biased amplifying devices
- Uses an accurate feedback network as reference for the transfer
- Allows the use of a feedback network with an available power gain equal or less than unity
    - Accurate (passive) components available for the feedback network
- Strongly facilitates **orthogonal** design of performance aspects

Example: **Brute-force** reduction of the influence of source and load impedance variations on the accuracy of the transfer of a voltage amplifier



$$\frac{V_\ell}{V_s} = \frac{Z_i}{Z_i+Z_s} A_v \frac{Z_\ell}{Z_\ell+Z_o}$$

Brute-force: Insert dominant, high-accuracy and linear impedances in the signal path:



$$\frac{V_\ell}{V_s} = \frac{Z_i}{Z_i+Z_s+Z_{se}} A_v \frac{Z_\ell \| Z_p}{Z_\ell \| Z_p + Z_o} \approx \frac{Z_i}{Z_i+Z_{se}} A_v \frac{Z_p}{Z_p+Z_o}$$

Remember: Thou shalt not insert impedances in series or in parallel with the signal path

Conclusion: Strong interaction between:
- accuracy and noise addition
- accuracy and power inefficiency
- accuracy and source-to-load transfer

Orthogonality: See: "orthogonalDesignNegativeFeedbackAmplifiers.svg"

☹ At the source:
reduction of the signal to noise ratio

☹ At the load:
decrease of power efficiency

☹ Source-to-load transfer:
reduced as a result of attenuation

