Structured Electronic Design

Implementation of Phantom Zeros

Anton J.M. Montagne

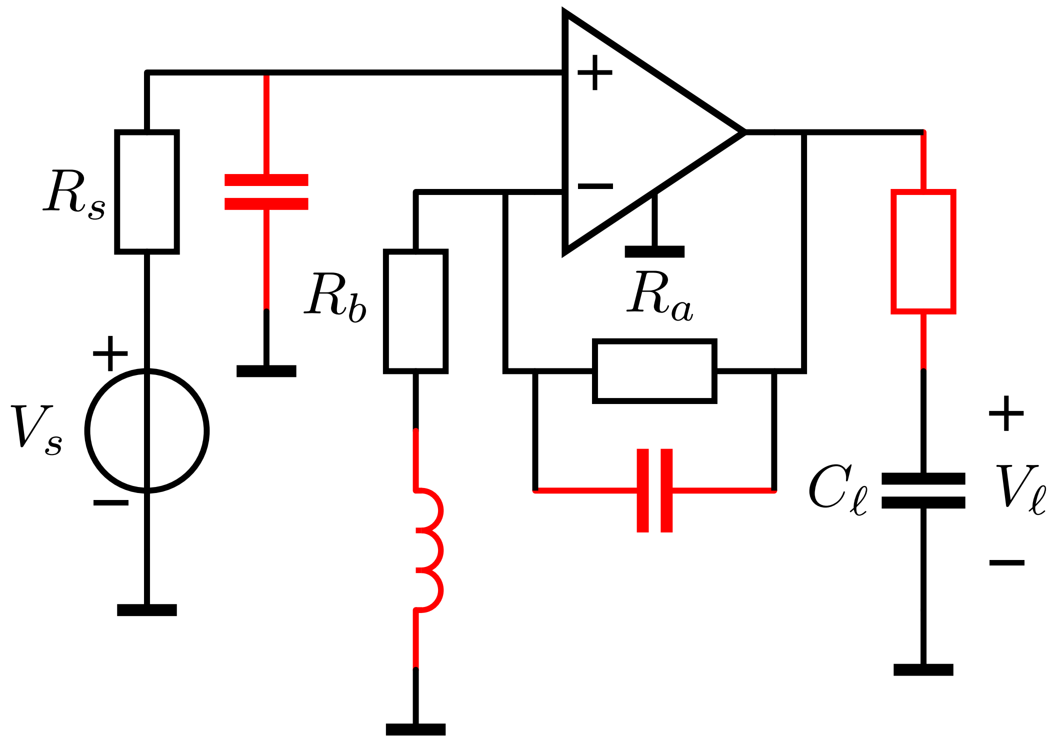
Circuit implementation of phantom zeros

1. Poles in the ideal gain can only be found in circuitry outside the controller
   a. A pole in the transfer from the source to the input of the amplifier
   b. A pole in the transfer from the output of the amplifier to the load
   c. A zero in the transfer of the feedback network

2. The pole in the ideal gain is an 'effective' zero in the loop gain if
   a. It does not add a new dominant pole in the loop gain
   b. It does not significantly change the position of a dominant pole of the loop gain

   This is the case if, for frequencies above that of the zero,
   the zero significantly reduces an existing attenuation in the loop gain

Circuit implementation of phantom zeros



Possible phantom zero implementations in a voltage amplifier with resistive source capacitive load and resistive feedback

Pole in the asymptotic gain:

a. Low-pass transfer from source and input

b. Low-pass transfer from output and load

c. Zero in feedback network

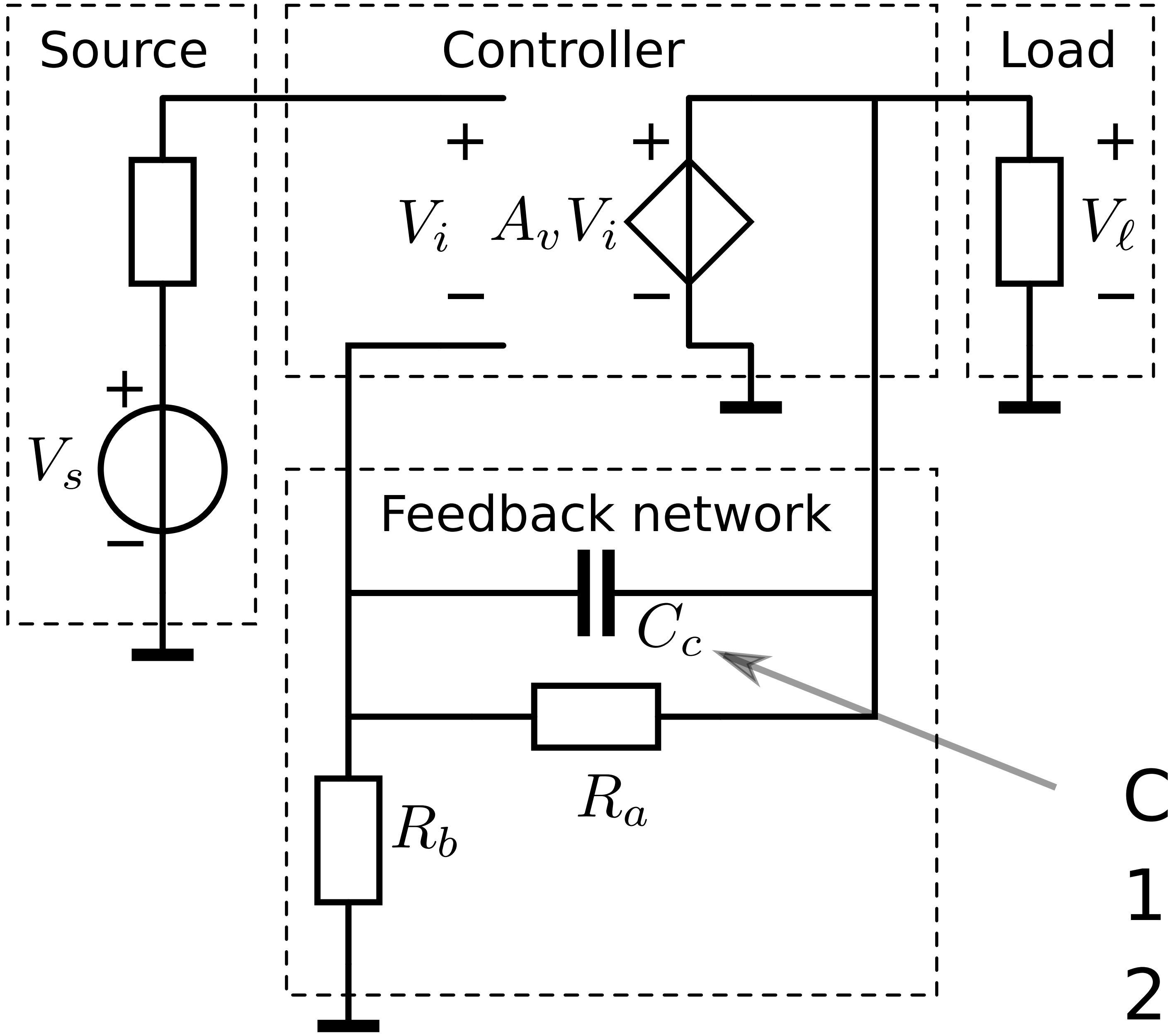
Zero in the loop gain:

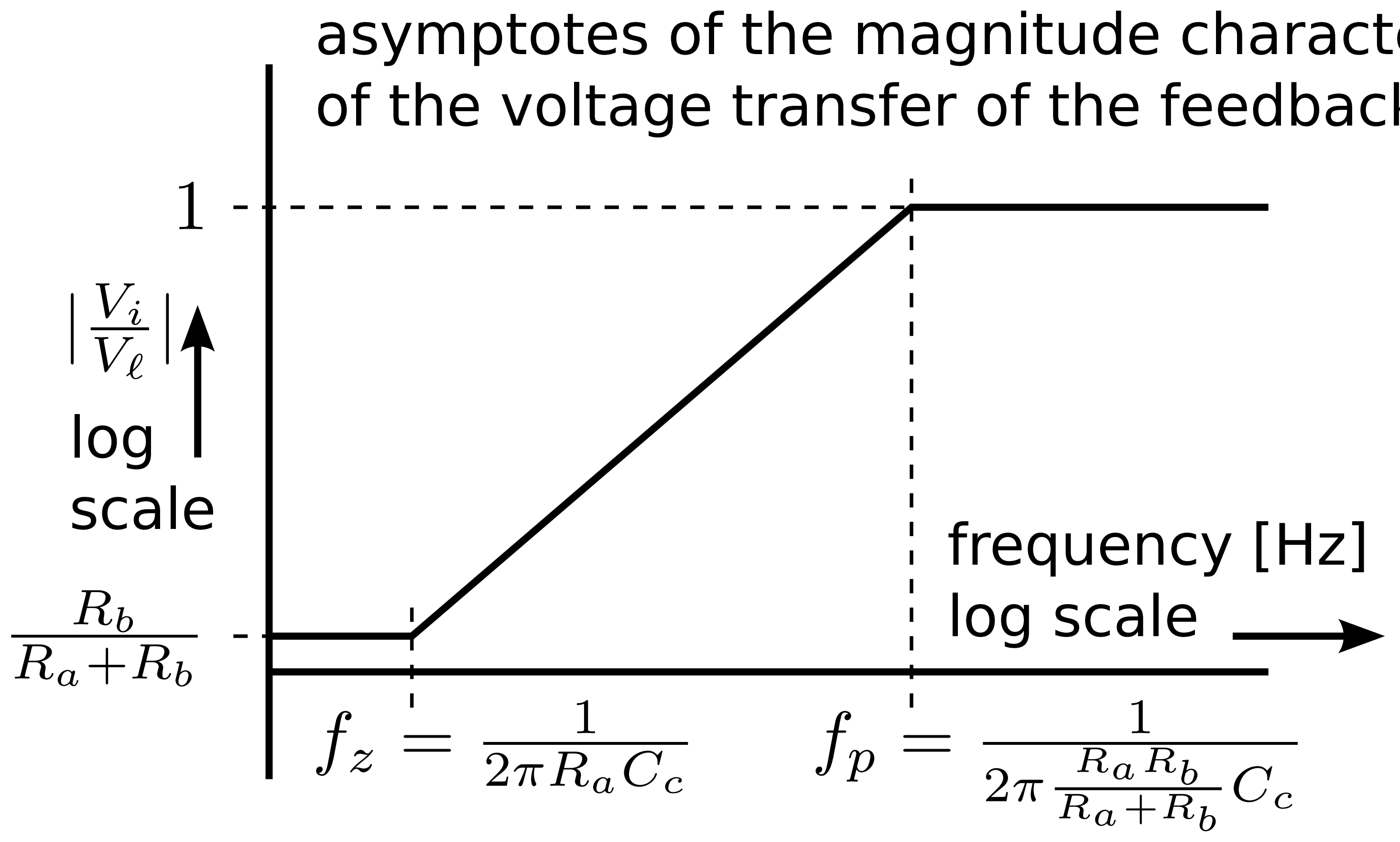
a. The compensation element establishes an open circuit in series with the signal path (of the loop gain) at the frequency of the zero

b. The compensation element establishes a short circuit in parallel with the signal path (of the loop gain) at the frequency of the zero

c. This zero is effective

Effectiveness of phantom zeros





Compensation capacitance causes:

1. A pole in the asymtotic gain
2. A zero in the loop gain

} $s = -\frac{1}{2\pi R_a C_c}$

3. A zero in the asymtotic gain
4. A pole in the loop gain

} $s = -\frac{1}{2\pi \frac{R_a R_b}{R_a+R_b} C_c}$

Effective phantom zero (in this case, not a rule!) if: $R_a \gg R_b$

