Homework 5 supplement; Physics 120: David Kleinfeld, Spring 2017

Let's build circuitc to form the second derivative of an input, so that

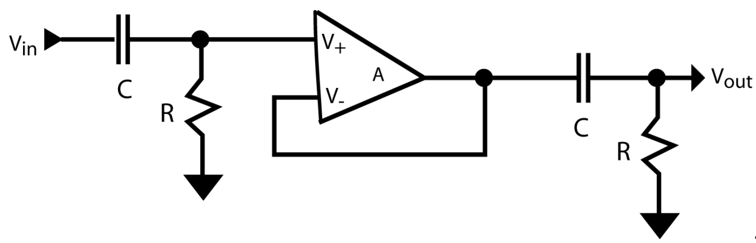
$$V_{Out}(t) \propto \frac{d^2V_{in}(t)}{dt^2}$$

or

$$\hat{V}_{Out}(\omega) \propto \omega^2 \ \hat{V}_{in}(\omega)$$

We include a cut-off frequency, or frequencies, in our design so that

$$\hat{V}_{Out}(\omega) \rightarrow \text{constant for } \omega \rightarrow \infty \ .$$

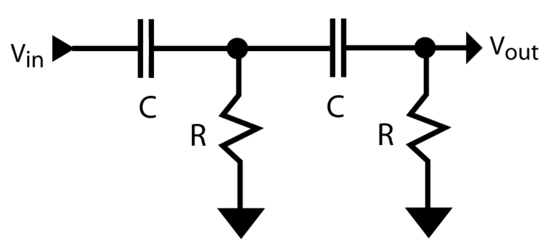


(1) With reference to the circuit above, find the closed-loop gain function $\hat{G}(\omega) \equiv \frac{\hat{V}_{Out}(\omega)}{\hat{V}_{in}(\omega)}$.

Determine the single cut-off frequency ω_{HP} in terms of R and C.

Calculate and make Bode plots of the magnitude and phase of $\hat{G}(\omega)$.

Note the asymptotic power-law dependence of the magnitude of the gain for $\omega << \omega_{HP}$ and for $\omega >> \omega_{HP}$.



(2) With reference to the circuit above, find the closed-loop gain function $\hat{G}(\omega) \equiv \frac{\hat{V}_{Out}(\omega)}{\hat{V}_{in}(\omega)}$.

Is there a single cut-off frequency? Find the value or values for the frequency breaks. Calculate and make Bode plots of the magnitude and phase of $\hat{G}(\omega)$.

(3) Why are the closed-loop gain functions found for the circuits in (1) and (2) not the same?