EE2703 : Applied Programming Lab
Experiment 7

Mukhesh Pugalendhi Sudha
EE18B114

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Abstract

The problem is to use sympy to analyse and find response of circuits in Laplace domain

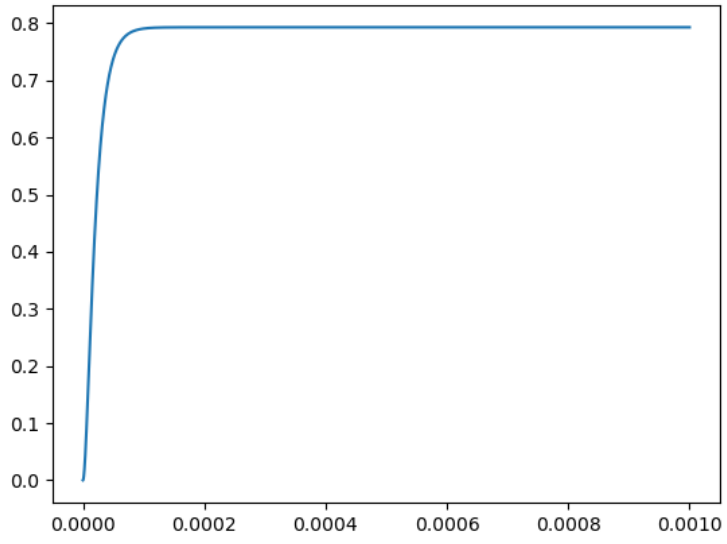
Introduction

Scimpy is used along with `scipy.signal` package to analyse more complicated signals. High pass and low pass filters are defined and analysed for input signals of various frequencies using `scipy.signal.lsim()`. Bode plot of the network is drawn and step response is also found.

Results

1. Step response of lowpass filter

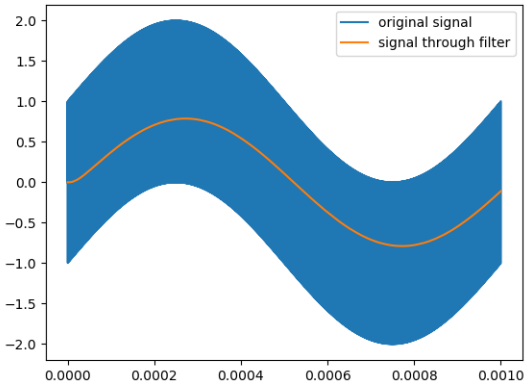
To compute step response, the expression should be converted into an LTI object. This is done using the methods `fraction()` and `Poly()`. $\frac{1}{s}$ is given as input and impulse response is found. Figure is plotted below.



Low pass filter suppresses sudden change in input.

2. Output of given signal

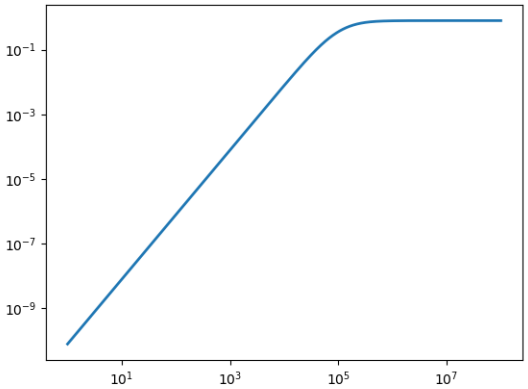
The given signal is $(sin(2000\pi t) + cos(2 \times 10^6 \pi t))u_0(t)$. The LTI function in 1. is used here with lsim to obtain the response of the given signal.



All the high frequency noise(sinusoid) is removed. Only the low frequency component is present.

3. Bode plot of high pass filter

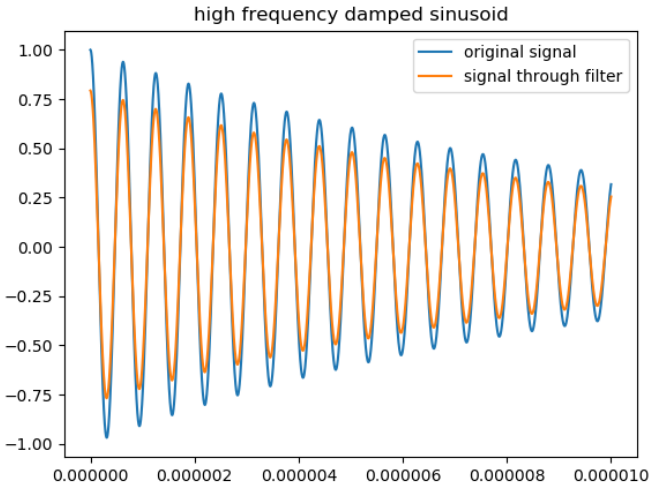
To draw the Bode plot, `lambdify()` is used to convert the LTI function into a lambda function. The magnitude plot is drawn for frequencies in `logspace(0, 8, 801)`. The plot is shown below.

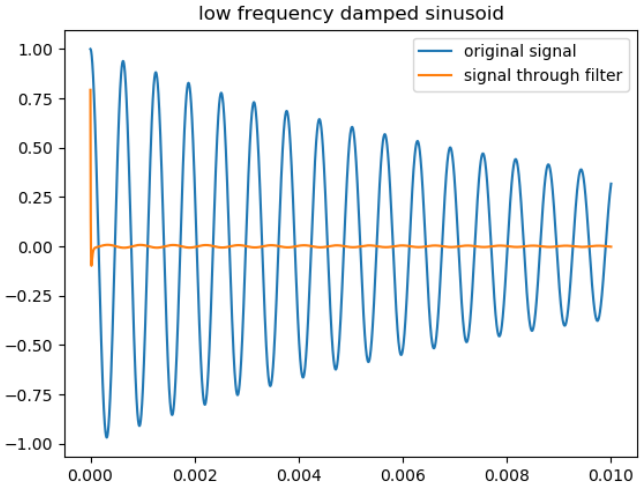


It is evident that the network is a high pass filter.

4. Response of damped sinusiod

Section 2 is repeated with the high pass filter but with a different set of inputs. The inputs given are $cos(1e7 \times t) \times exp(-1e5 \times t)$ and $cos(1e4 \times t) \times exp(-1e2 \times t)$. The outputs are as follows.

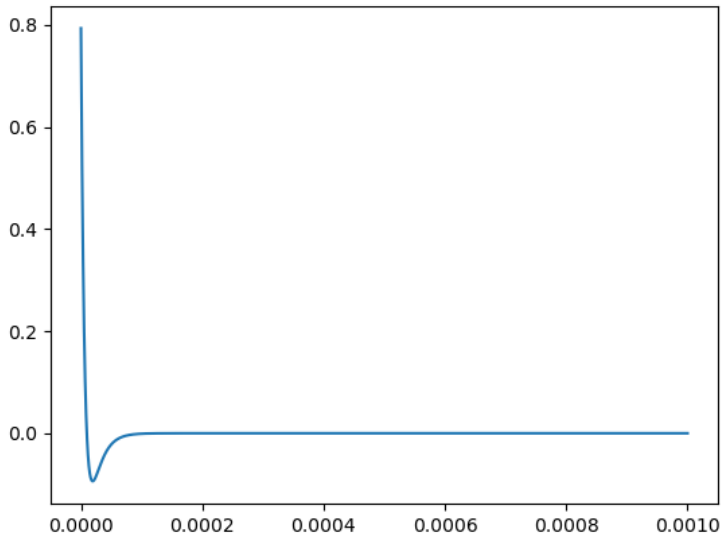




When the frequency is high, the amplitude is decreased a little bit. When the frequency is low, signal is completely suppressed.

5. Step response of highpass filter

Section 1 is repeated with the highpass filter. Response is as follows.



Highpass filter only respondsto sudden changes in the input signal. The response is 0 whenever the input is constant.

Conclusion

Symbolic python and signal toolbox are used sensibly to solve for complex circuits. Various inputs are given to them and responses are computed and plotted.