ELEC 4700 Assignment-3 Monte-Carlo/Finite Difference Method

Assignment 3 - Joanna Abalos 100962263

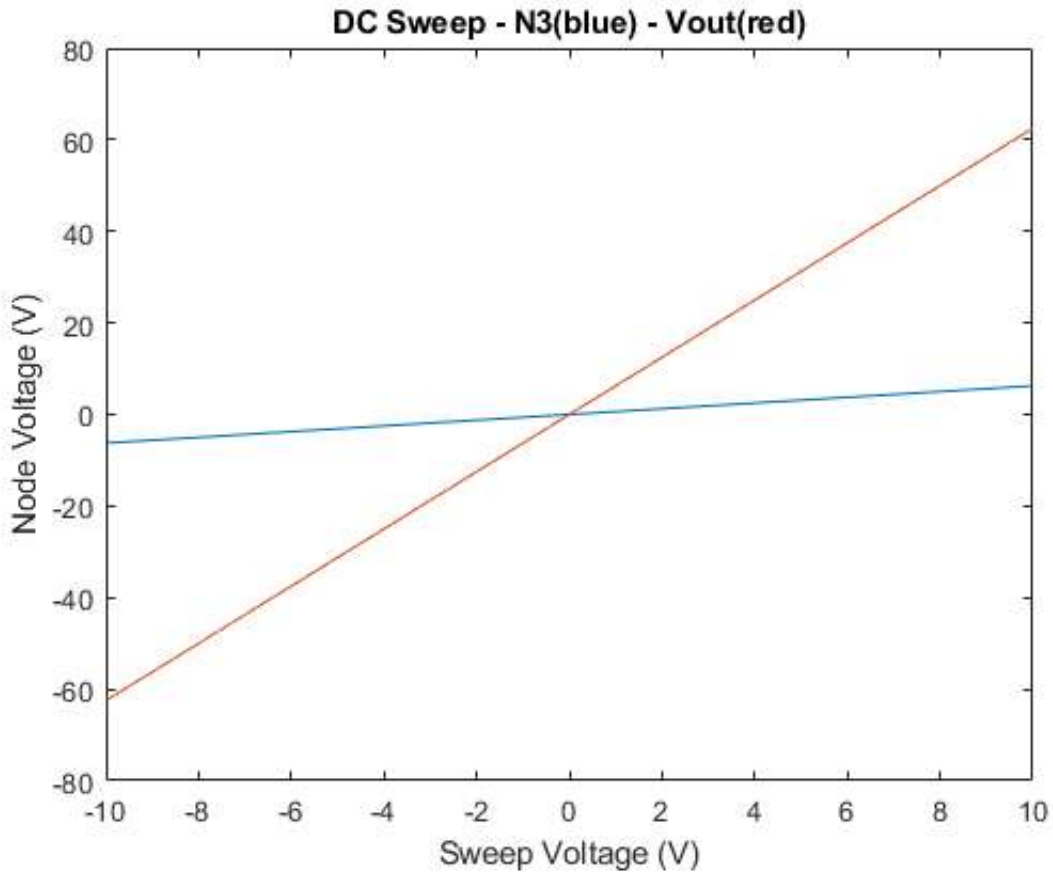
```
close all
clear
clc

global G;
global C;
global b;



% In this assignment, circuits are modelled and simulated using MNA and
% circuit simulation.

assignment4_1

% By inspection, this is a low pass filter and amplifier. This is known
% because the signal goes through the inductor and a resistor in resies
% goes to ground. In DC, the capacitor appears as an open circuit and the
% inductor appears as a short. Reading the output of the inductor will
% result in high frequencies being cutoff.

% The frequency response effectively passes low voltage and cuts off high
% frequencies.

assignment4_2
assignment4_2v

% Increasing the timestep reduces the accuracy of the model.

assignment4_3
% Adding noise the the circuit does not effect the frequency response
% because high frequency noise is filtered out. The noise is seen on the DC
% response but the general output is close to the circuit without noise.

%Varying values of Cn increases the bandwidth of passing frequencies. At
%higher values of Cn, the circuit becomes overdamped as shown by the peak
%when C = 1. At low values of Cn, the circuit is underdamped as shown by
%the lowest C value. The cutoff varies slightly, but mostly the amplitude
%response of the frequeny plot is effected by Cn. This stamp was written
%when I took ELEC4609 last semester.

% If the votlage source was replaces by the transconductance equation, the
% voltage source would need to be converted into the current controlled
% voltage source. The stamp of that is used to implemented is as shown
% below:

%   ni1 -------o+          |----------o nd1
%                          |
%                         /+\
%                      | /   \    Vnd1 - Vnd2 = val*(Vni1 - Vni2)
```

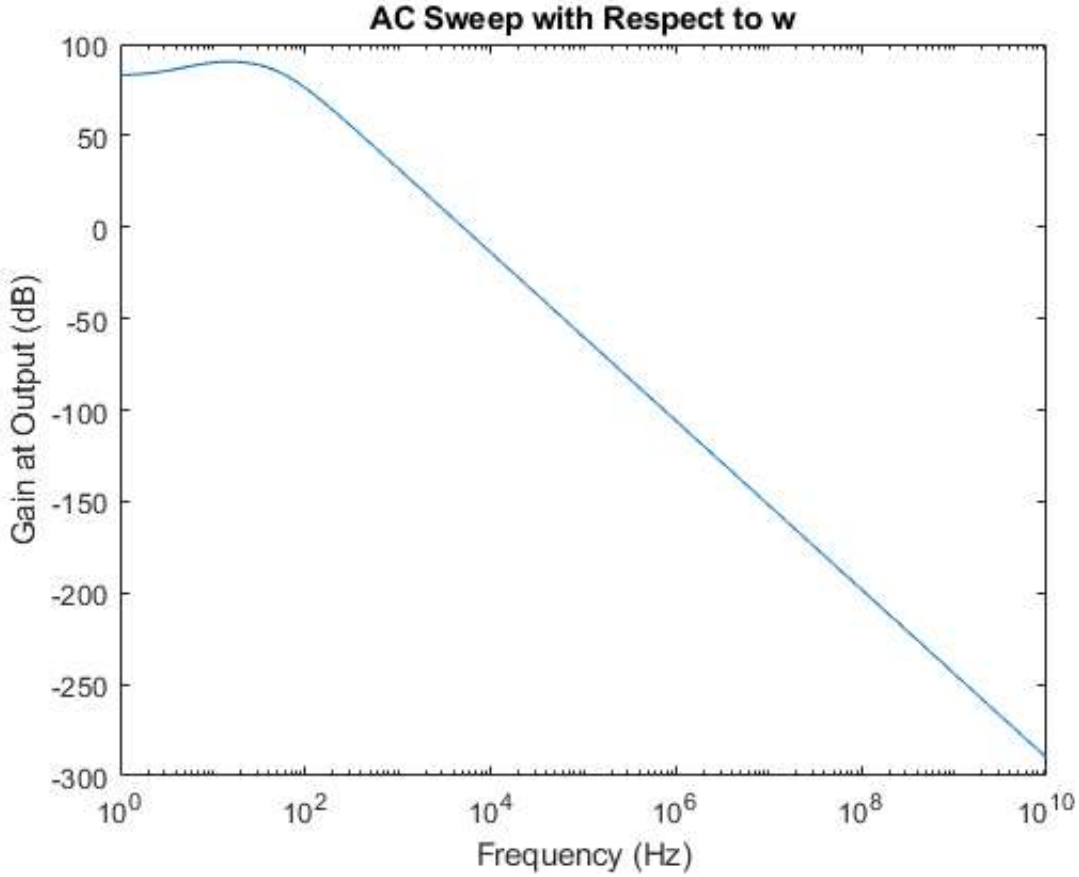
```
%                Ivcvs | \   /
%                      V  \-/
%                         |
%   ni2 -------o-         |----------o nd2
%
% The nodes across the dependent source are nd1 and nd2 (positive voltage at nd1)
% The independent nodes are ni1 and ni2 (positive voltage at ni1).
%   Vnd1 - Vnd2 = val*(Vni1 - Vni2)
```

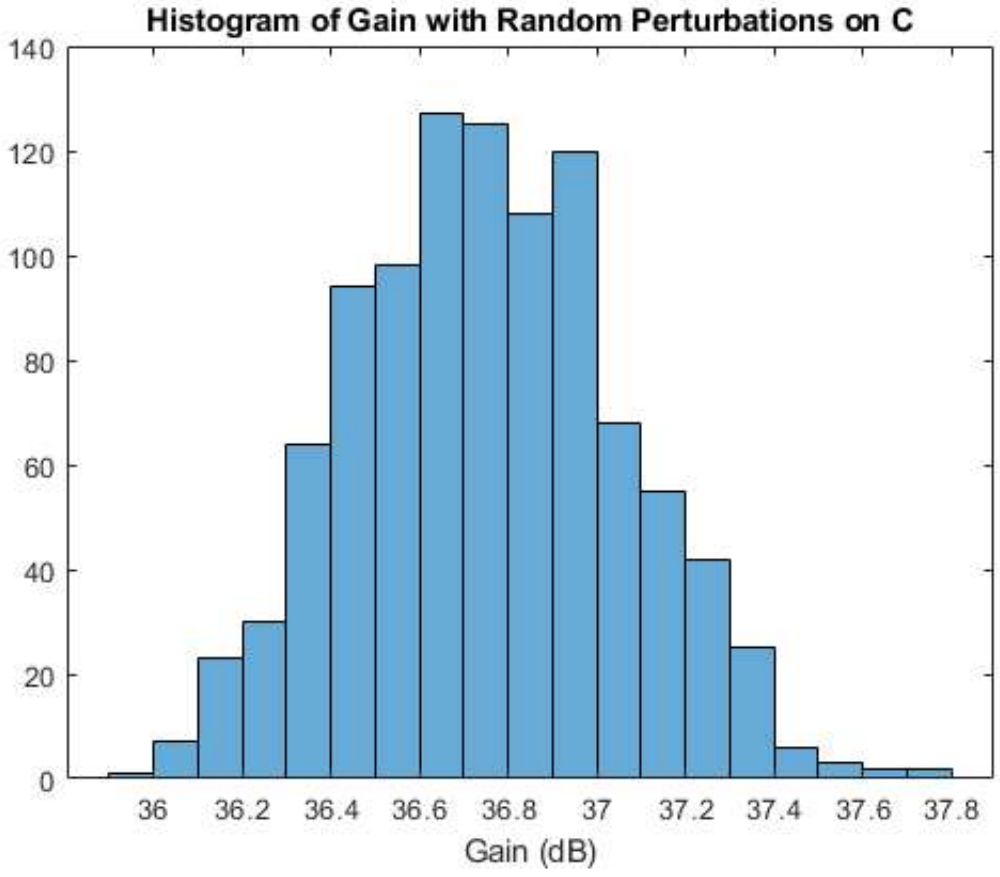
```
Part 1.
C =

  Columns 1 through 7

    0.2500   -0.2500         0         0         0         0         0
   -0.2500    0.2500         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0   -0.2000
         0         0         0         0         0         0         0

  Column 8

         0
         0
         0
         0
         0
         0
         0
         0


G =

  Columns 1 through 7

    1.0000   -1.0000         0         0         0    1.0000         0
   -1.0000    1.5000         0         0         0         0    1.0000
         0         0    0.1000         0         0         0   -1.0000
         0         0         0   10.0000  -10.0000         0         0
         0         0         0  -10.0000   10.0010         0         0
    1.0000         0         0         0         0         0         0
         0    1.0000   -1.0000         0         0         0         0
         0         0  -10.0000    1.0000         0         0         0

  Column 8

         0
         0
         0
    1.0000
         0
```

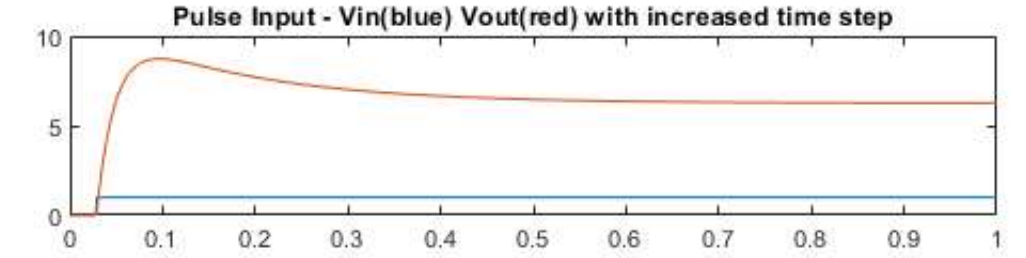
```
         0
         0
         0


C after applying random values.
C =

  Columns 1 through 7

    0.2051   -0.2051         0         0         0         0         0
   -0.2051    0.2051         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0   -0.2000
         0         0         0         0         0         0         0

  Column 8

         0
         0
         0
         0
         0
         0
         0
         0


Part 3.
Updated C matrix:
C =

  Columns 1 through 7

    0.2500   -0.2500         0         0         0         0         0
   -0.2500    0.2500         0         0         0         0         0
         0         0    0.0000   -0.0000         0         0         0
         0         0   -0.0000    0.0000         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0

  Columns 8 through 10

         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
         0         0         0
```

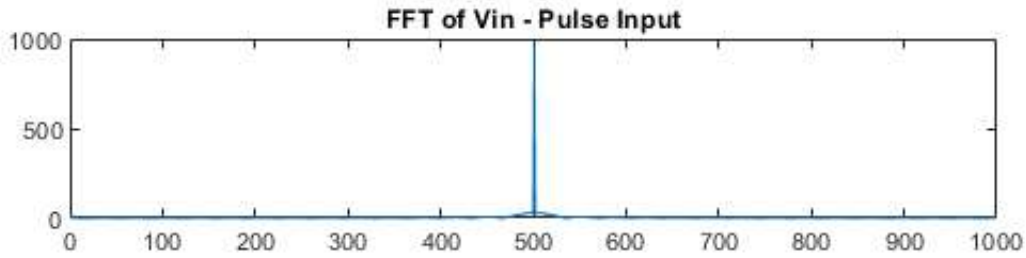
```
-0.2000         0         0
         0         0         0
         0         0         0
```

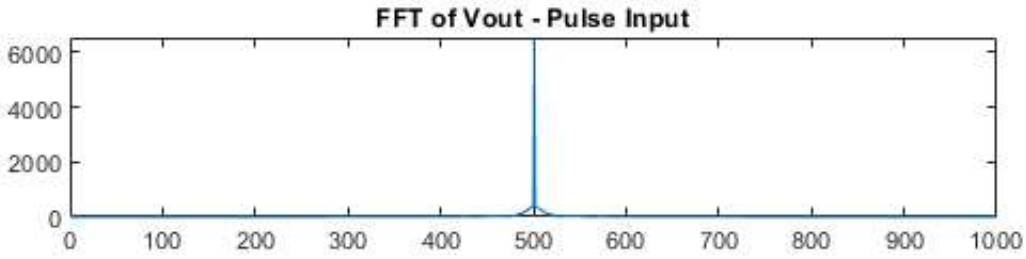


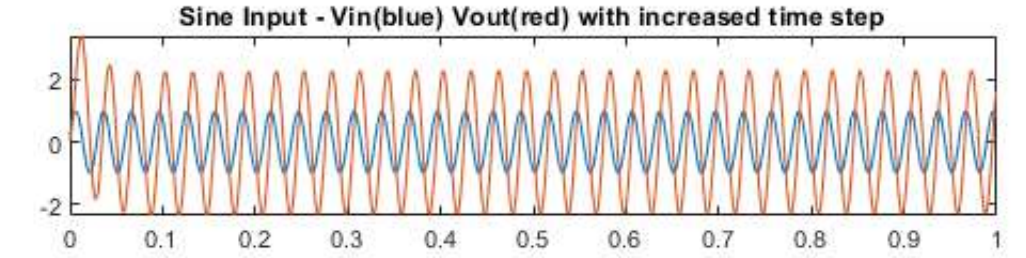

AC Sweep with Respect to w
Gain at Output (dB)
100
50
0
-50
-100
-150
-200
-250
-300
10^0
10^2
10^4
10^6
10^8
10^{10}
Frequency (Hz)

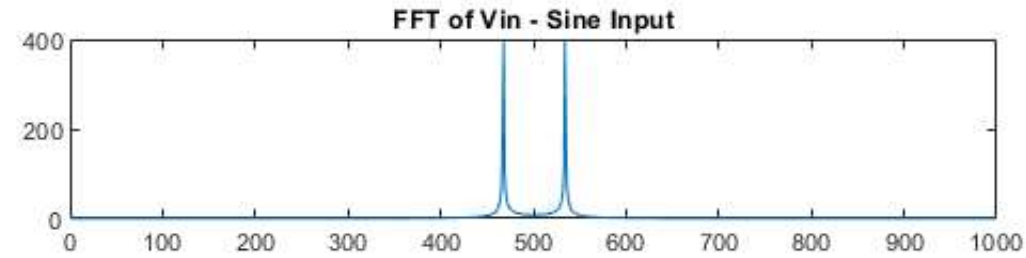

Histogram of Gain with Random Perturbations on C
140
120
100
80
60
40
20
0
36
36.2
36.4
36.6
36.8
37
37.2
37.4
37.6
37.8
Gain (dB)

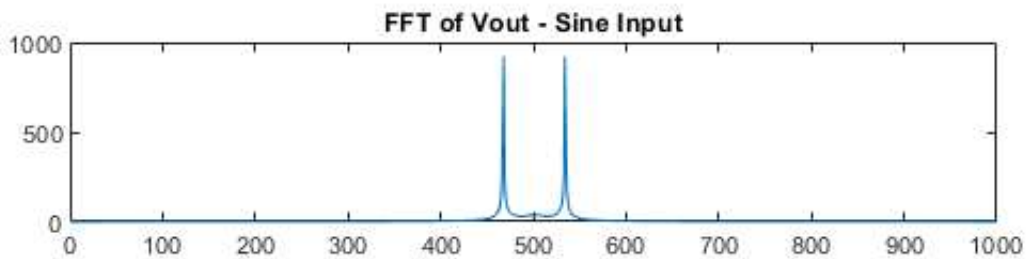

Pulse Input - Vin(blue) Vout(red) with increased time step
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

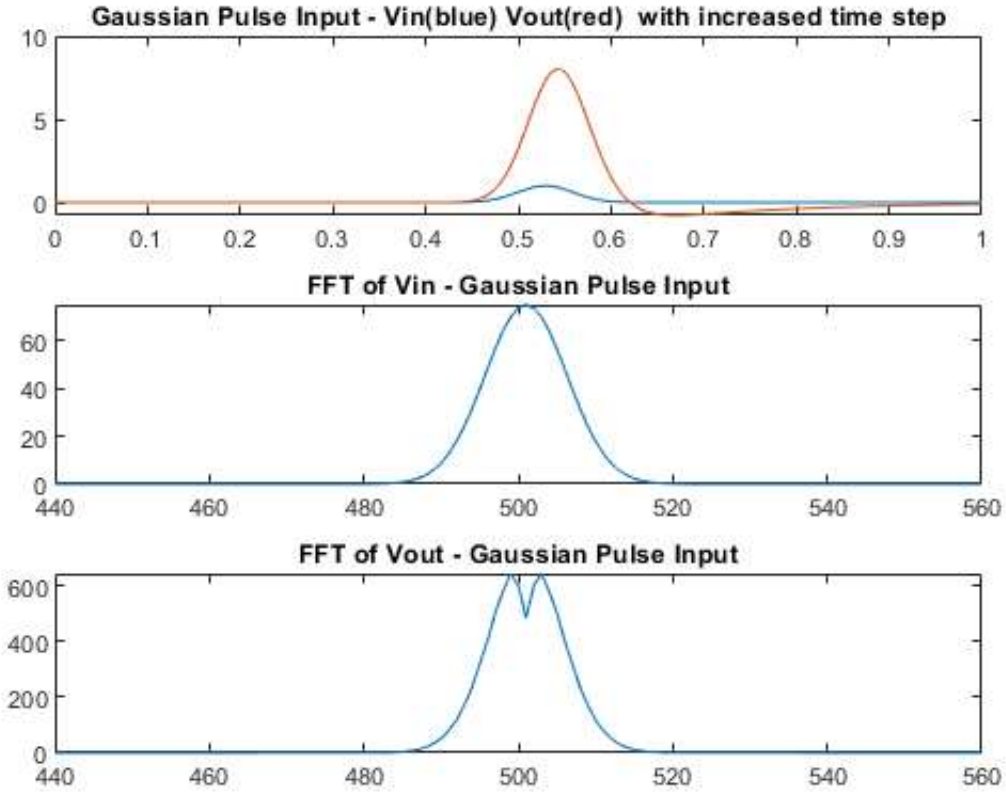

FFT of Vin - Pulse Input
1000
500
0
0
100
200
300
400
500
600
700
800
900
1000

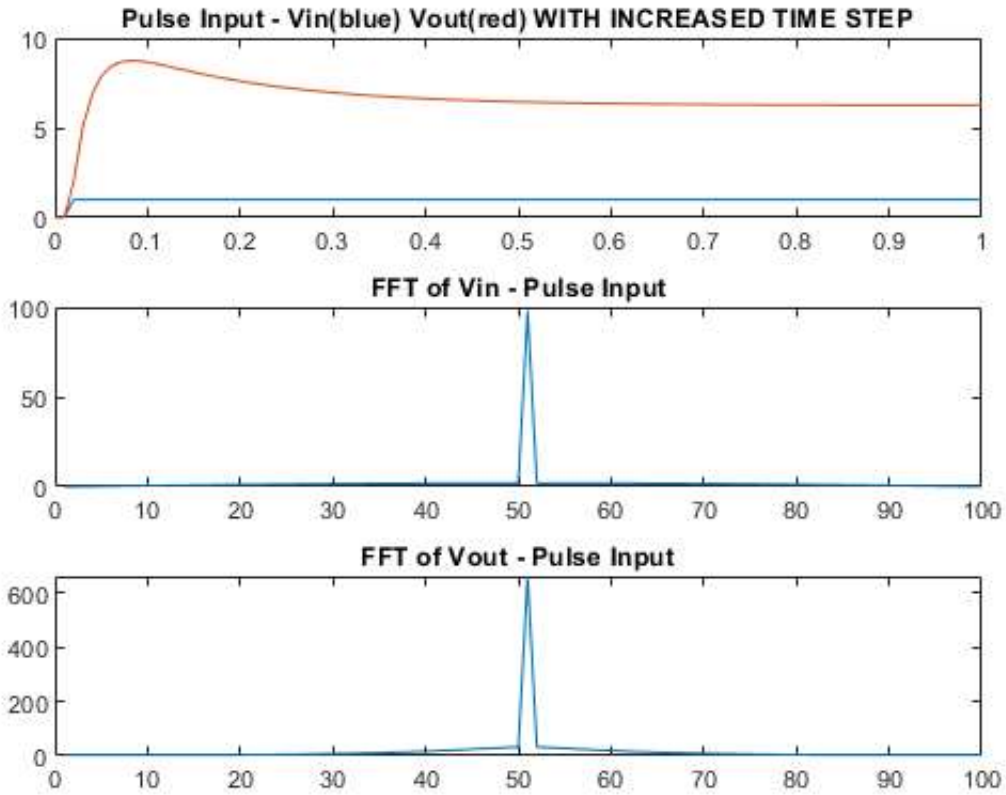

FFT of Vout - Pulse Input
6000
4000
2000
0
0
100
200
300
400
500
600
700
800
900
1000

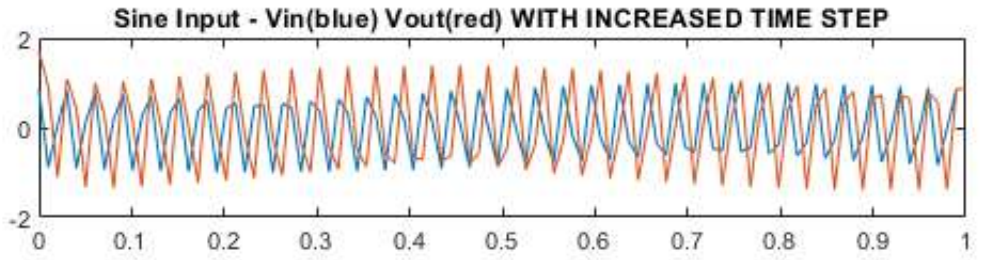

Sine Input - Vin(blue) Vout(red) with increased time step
2
0
-2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

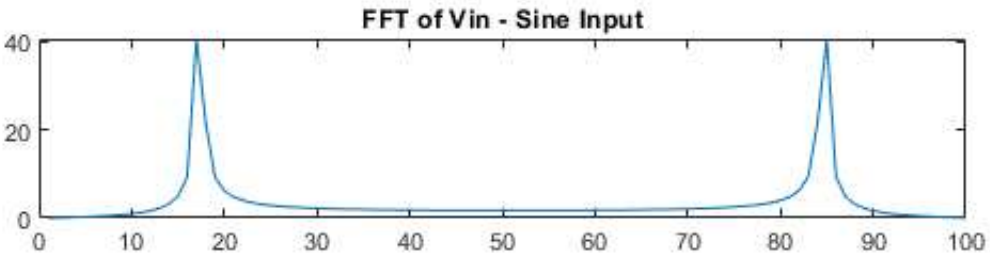

FFT of Vin - Sine Input
400
200
0
0
100
200
300
400
500
600
700
800
900
1000

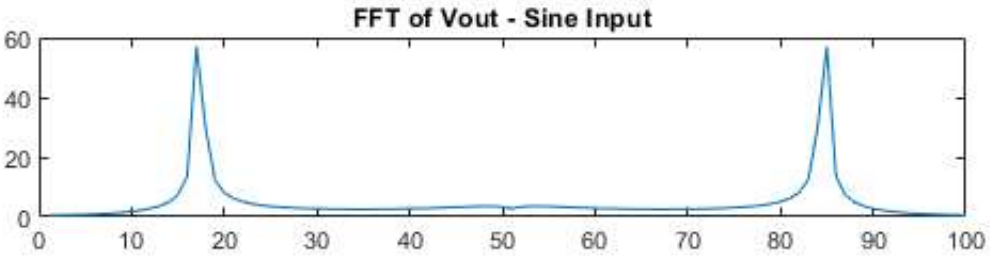

FFT of Vout - Sine Input
1000
500
0
0
100
200
300
400
500
600
700
800
900
1000

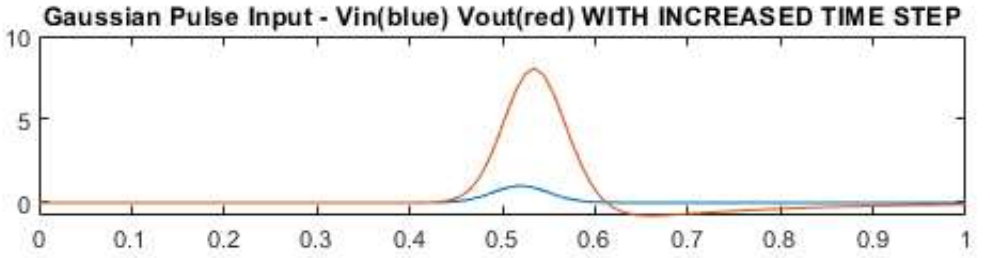

Gaussian Pulse Input - Vin(blue) Vout(red) with increased time step
10
5
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
FFT of Vin - Gaussian Pulse Input
60
40
20
0
440 460 480 500 520 540 560
FFT of Vout - Gaussian Pulse Input
600
400
200
0
440 460 480 500 520 540 560

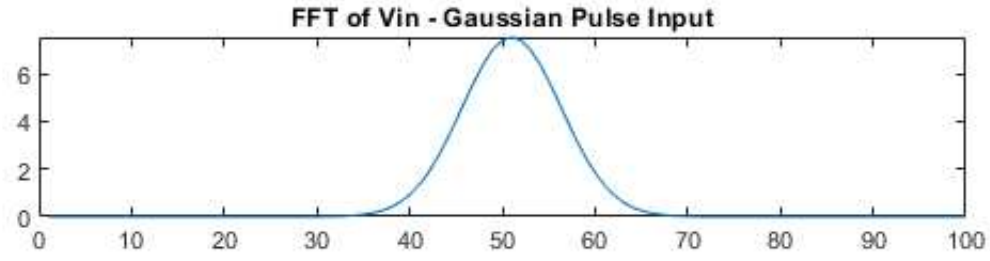

Pulse Input - Vin(blue) Vout(red) WITH INCREASED TIME STEP
10
5
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
FFT of Vin - Pulse Input
100
50
0
0 10 20 30 40 50 60 70 80 90 100
FFT of Vout - Pulse Input
600
400
200
0
0 10 20 30 40 50 60 70 80 90 100

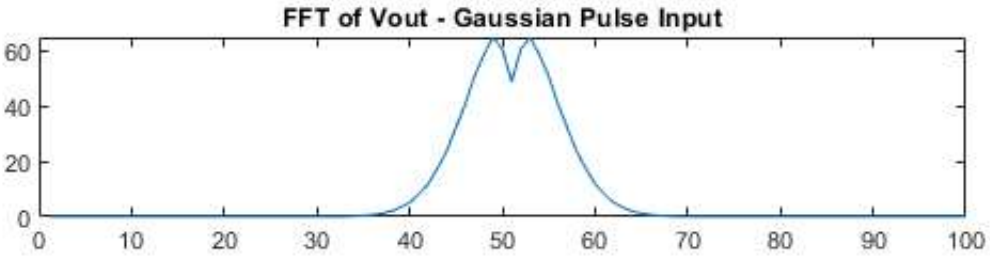

Sine Input - Vin(blue) Vout(red) WITH INCREASED TIME STEP
2
0
-2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

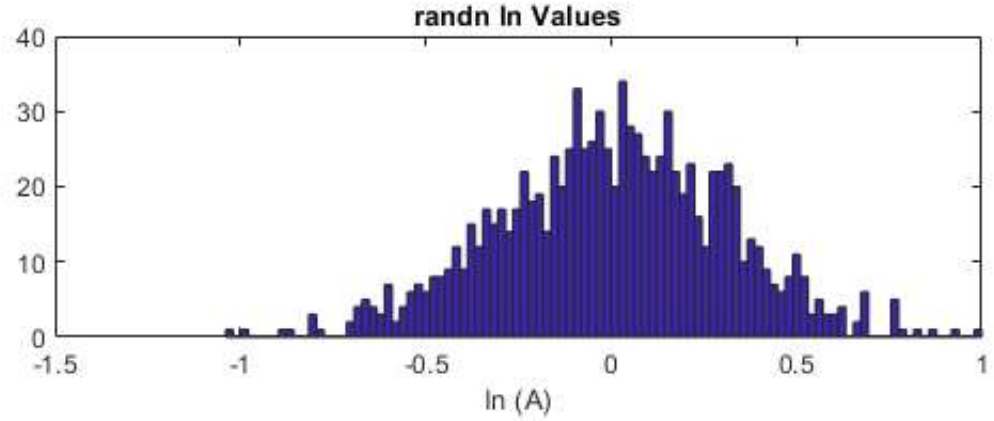

FFT of Vin - Sine Input
40
20
0
0
10
20
30
40
50
60
70
80
90
100

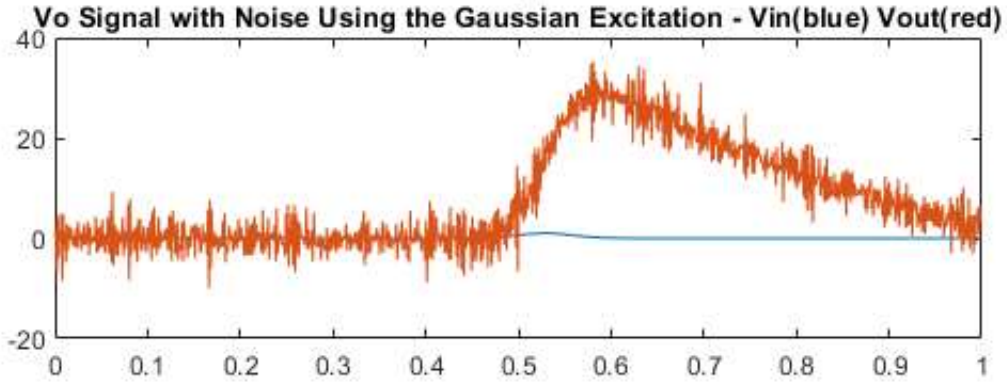

FFT of Vout - Sine Input
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100

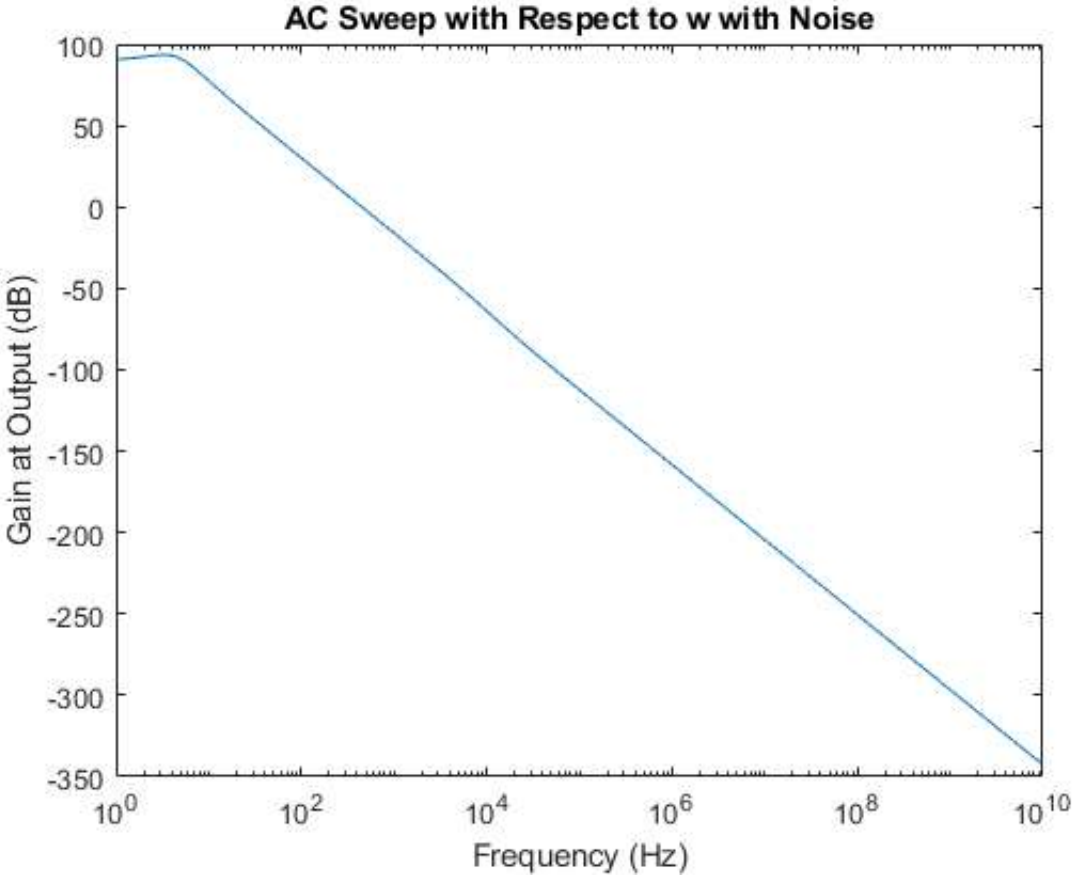

Gaussian Pulse Input - Vin(blue) Vout(red) WITH INCREASED TIME STEP
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

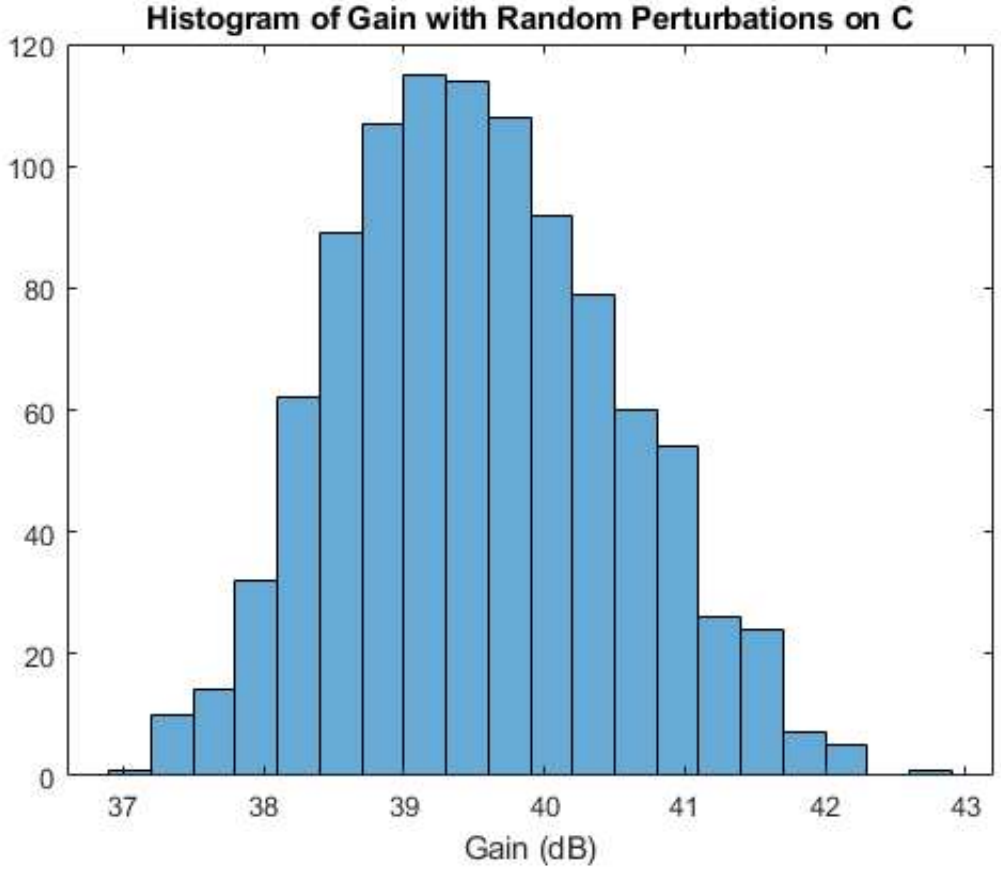

FFT of Vin - Gaussian Pulse Input
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100

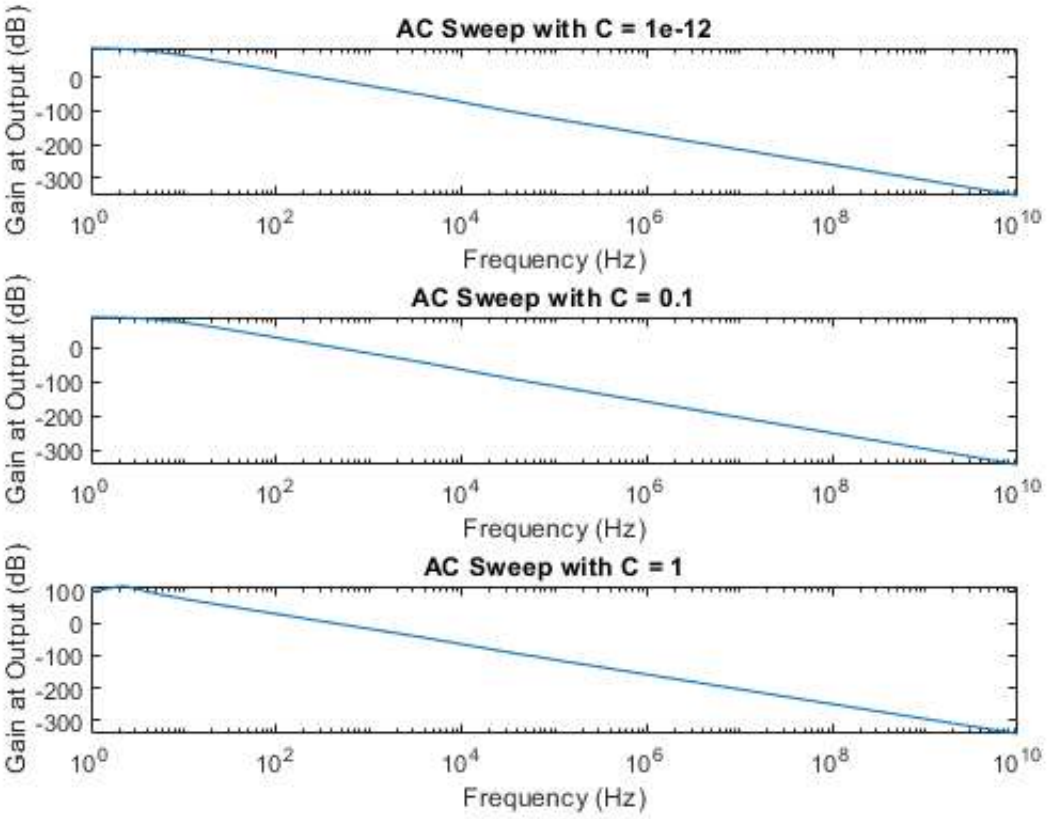

FFT of Vout - Gaussian Pulse Input
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100


randn In Values
40
30
20
10
0
-1.5
-1
-0.5
0
0.5
1
In (A)


Vo Signal with Noise Using the Gaussian Excitation - Vin(blue) Vout(red)
40
20
0
-20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


AC Sweep with Respect to w with Noise
100
50
0
-50
-100
-150
-200
-250
-300
-350
Gain at Output (dB)
10^0
10^2
10^4
10^6
10^8
10^{10}
Frequency (Hz)


Histogram of Gain with Random Perturbations on C
120
100
80
60
40
20
0
37
38
39
40
41
42
43
Gain (dB)


AC Sweep with C = 1e-12
Gain at Output (dB)
0
-100
-200
-300
10^0
10^2
10^4
10^6
10^8
10^{10}
Frequency (Hz)
AC Sweep with C = 0.1
Gain at Output (dB)
0
-100
-200
-300
10^0
10^2
10^4
10^6
10^8
10^{10}
Frequency (Hz)
AC Sweep with C = 1
Gain at Output (dB)
100
0
-100
-200
-300
10^0
10^2
10^4
10^6
10^8
10^{10}
Frequency (Hz)

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