```
R1 = 1;
C = 0.25;
R2 = 2;
L = 0.2;
R3 = 10;
a = 100;
R4 = 0.1;
Ro = 1000;
Y1 = 1/R1;
Y2 = 1/R2;
Y3 = 1/R3;
Y4 = 1/R4;

% V = [V1    V2             V3   V4     V5           i1  iL  i3];
G = [-1/R1  1/R1            0    0       0            1   0   0;
      1/R1 (-1/R1)-(1/R2)   0    0       0            0  -1   0;
      0      0            -1/R3  0       0             0   1   0;
      0      0            0   -1/R4  1/R4           0   0   1;
      0      0            0    1/R4 (-1/R4)-(1/Ro)  0  0   0;
      1      0            0     0       0            0   0   0;
      0      1            -1     0       0             0   0   0;
      0      0            a/R3  1       0            0   0   0]

% V = [V1 V2 V3 V4 V5 i1 iL i3];
Cm =   [-C  C 0  0  0  0  0  0;
        C -C 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 -L  0;
        0  0 0  0  0  0  0  0]
    %%%%%%%%%%%%%%%% Remember to output the matrices above %%%%%%%%%%%%%%

 n = 0;
%  VinTest = -10:10;
for Vin = -10:10
    n = n + 1;
    F = [0 0 0 0 0 Vin 0 0];
    V = G\F';
    V3(n) = V(3);
    Vo(n) = V(5);
end

vin = -10:1:10;
figure(1)
plot(vin,V3)
title('V3')
figure(2)
plot(vin,Vo)
title('Vo')

% w = linspace(1,1e6);
w = logspace(-3, 5, 100);
for n = 1:100
```

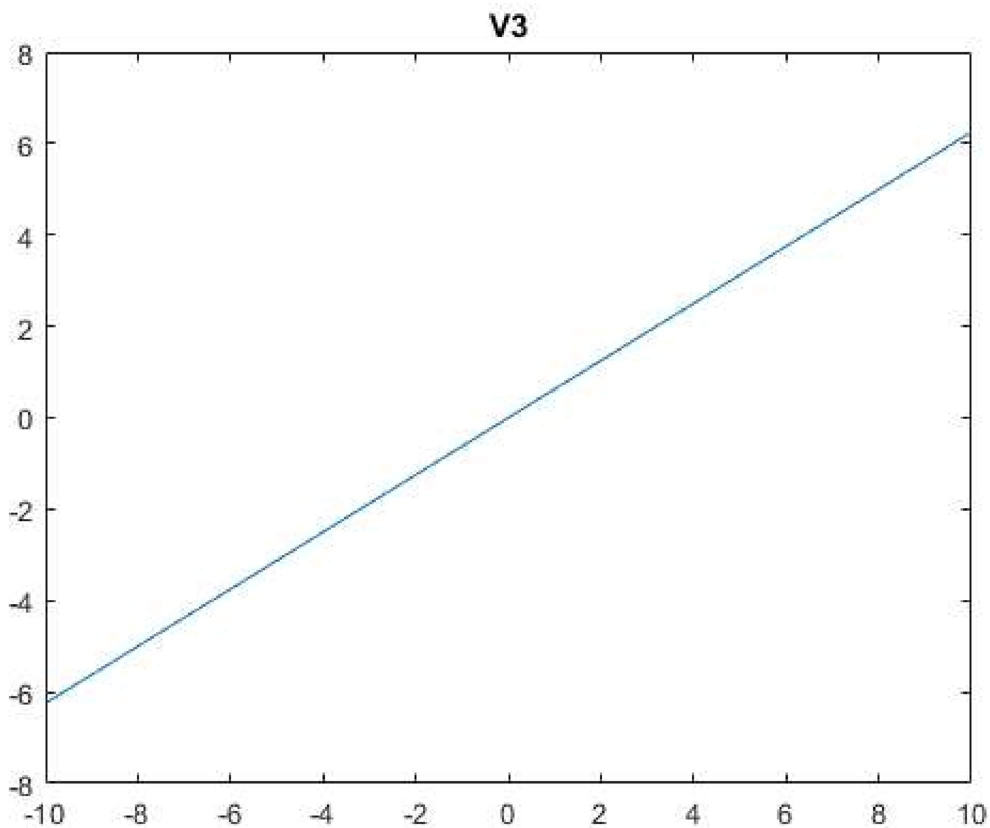
```
    F = [0 0 0 0 0 1 0 0];
    V = (G+(1i*w(n)*Cm))\F';
    Voii(n) = V(5);
    Adb(n) = 20*log10(Voii(n));
end

v1 = 1;
figure(3)
%%subplot(4,1,3)
semilogx(w,Voii)
title('Vo func of w')
grid on
figure(4)
semilogx(w,Adb)
title('Gain in dB')
grid on


figure(5)
Cnd = 0.25 + 0.05*randn(1,100);

for n = 1:100
    F = [0 0 0 0 0 1 0 0];
    Cmnd =   [-Cnd(n)  Cnd(n) 0   0   0   0   0   0;
        Cnd(n) -Cnd(n) 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   L   0;
        0   0 0   0   0   0   0   0];
    V = (G+(pi*Cmnd))\F';
    Voiii(n) = V(5);
end

hist(Voiii)
title('Hist of Gain')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%Q2

VPulse = zeros(8,1);
VSin = zeros(8,1);
VGauss = zeros(8,1);
tstep = 0.001;
time =0;
VinPulse = 0;
deltat = 0.001;
w2 = 2*pi*(1/0.03);
figure(6);
clf;
figure(7);
clf;

for n = 1:1000 %each step represents a milisecond

    if time == 0.03
```

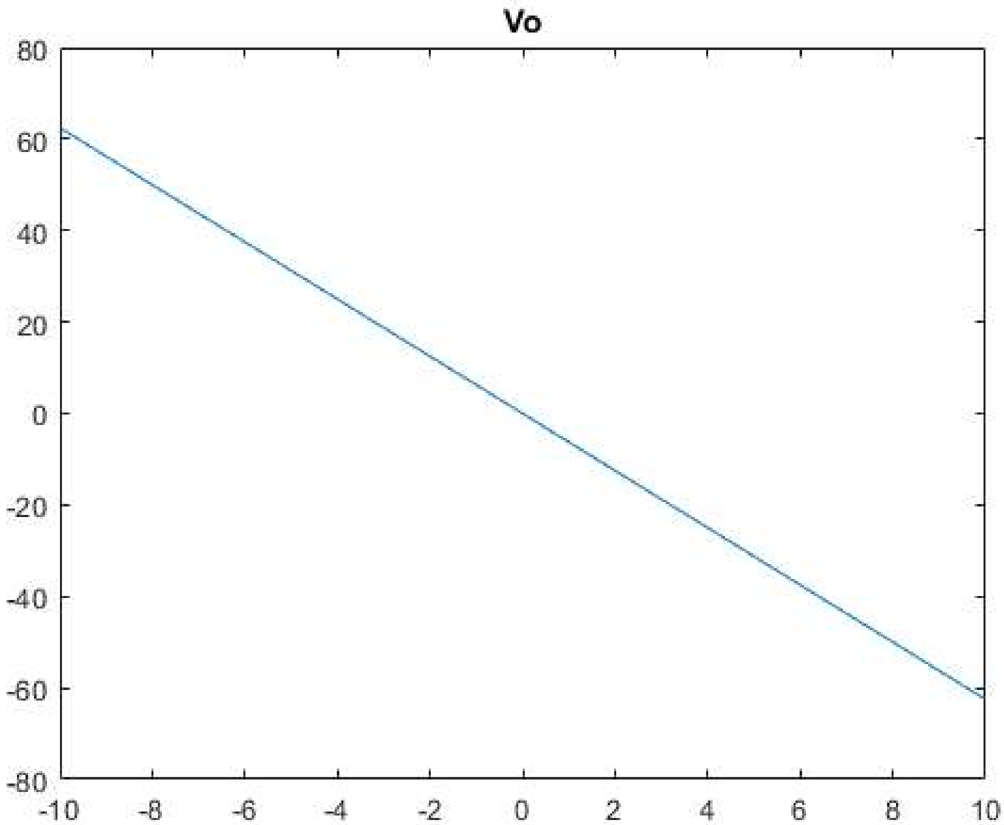
```
        VinPulse = 1;
    end

   VinSin = sin(w2*time);

   VinGauss = exp(-(time-0.06).^2/(2*(0.03)^2));

    FPulse = [0 0 0 0 0 VinPulse 0 0];
    FSin = [0 0 0 0 0 VinSin 0 0];
    FGauss = [0 0 0 0 0 VinGauss 0 0];
    A = G+(Cm/deltat);

%     V2 = A\(0*(V2/deltat)+F2.');
    VPulse = A\(Cm*(VPulse/deltat)+FPulse.');
    VSin = A\(Cm*(VSin/deltat)+FSin.');
    VGauss = A\(Cm*(VGauss/deltat)+FGauss.');

    time = tstep*n;

    VinPulseIn(n,1) = VinPulse;
    VinSinIn(n,1) = VinSin;
    VinGaussIn(n,1) = VinGauss;

    VPulseO(n,1) = VPulse(5);
    VSinO(n,1) = VSin(5);
    VGaussO(n,1) = VGauss(5);

end

figure(6)
subplot(3,1,1)
title('Blue-input Red-output')
plot(deltat:deltat:time,VinPulseIn,deltat:deltat:time,VPulseO)
subplot(3,1,2)
plot(deltat:deltat:time,VinSinIn,deltat:deltat:time,VSinO)
subplot(3,1,3)
plot(deltat:deltat:time,VinGaussIn,deltat:deltat:time,VGaussO)


figure(7)
XPulse = abs(fft(VinPulseIn));%fft(Vin11,length(Vin11));
XSin = abs(fft(VinSinIn));
XGauss = abs(fft(VinGaussIn));
XPulseOut = abs(fft(VPulseO));
XSinOut = abs(fft(VSinO));
XGaussOut = abs(fft(VGaussO));
subplot(3,1,1)
plot(-(time/2-deltat):deltat:time/2,XPulse,-(time/2-deltat):deltat:time/2,XPulseOut)%plot(1./
(deltat:deltat:time),X)
title('fft Blue-input Red-output')
grid on
subplot(3,1,2)
plot(-(time/2-deltat):deltat:time/2,XSin,-(time/2-deltat):deltat:time/2,XSinOut)
grid on
subplot(3,1,3)
plot(-(time/2-deltat):deltat:time/2,XGauss,-(time/2-deltat):deltat:time/2,XGaussOut)
grid on
```

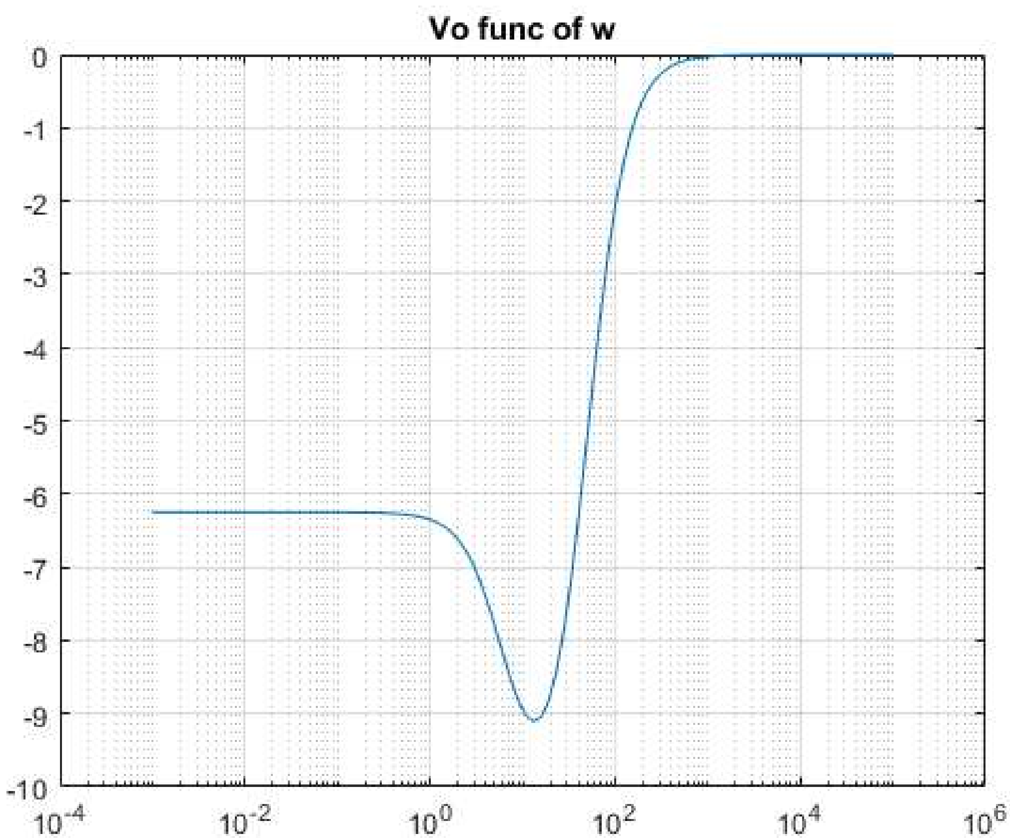
```
figure(8)
XshiftPulse = fftshift(XPulse);
XshiftSin = fftshift(XSin);
XshiftGauss = fftshift(XGauss);
XshiftPulseOut = fftshift(XPulseOut);
XshiftSinOut = fftshift(XSinOut);
XshiftGaussOut = fftshift(XGaussOut);
subplot(3,1,1)
grid on
title('fftshift Blue-input Red-output')
plot(-(time/2-deltat):deltat:time/2,XshiftPulse,-(time/2-deltat):deltat:time/2,XshiftPulseOut
)
subplot(3,1,2)
grid on
plot(-(time/2-deltat):deltat:time/2,XshiftSin,-(time/2-deltat):deltat:time/2,XshiftSinOut)
subplot(3,1,3)
plot(-(time/2-deltat):deltat:time/2,XshiftGauss,-(time/2-deltat):deltat:time/2,XshiftGaussOut
)
grid on


%%%%%%% It should be noted that as the time step increases the smoother the
%%%%%%% fourier transform plot becomes. Which would mean it is more
%%%%%%% precises.
```

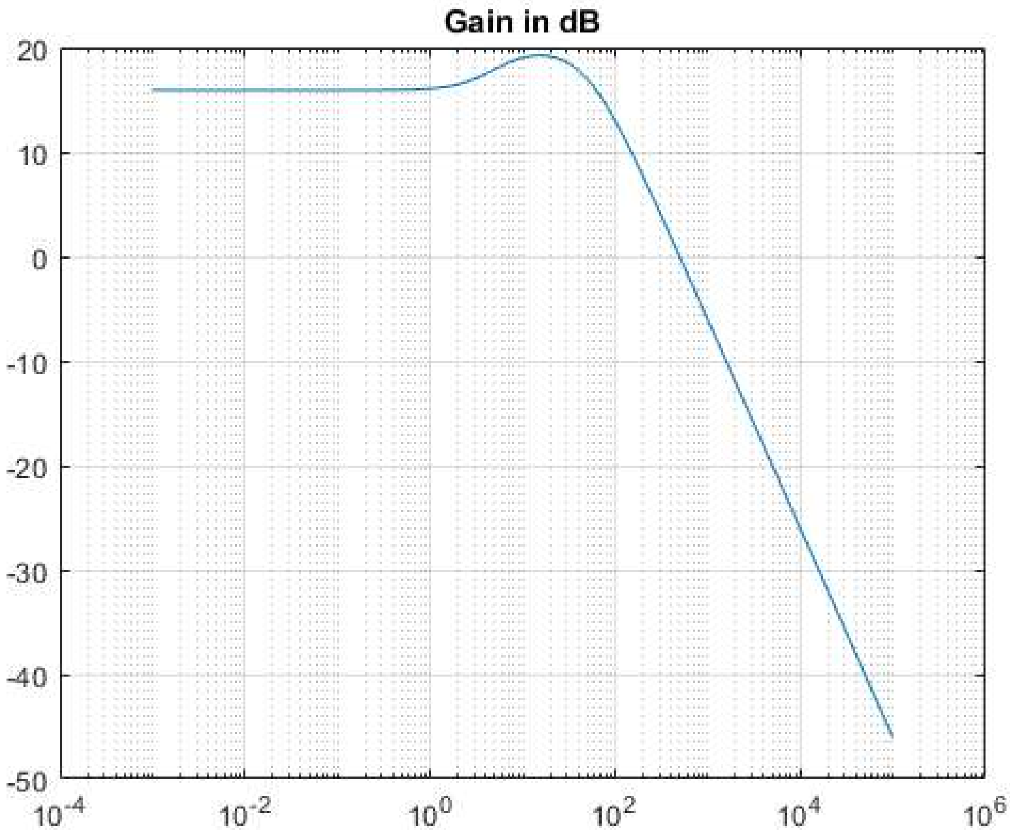
```
G =

  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


Cm =

  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

Warning: Imaginary parts of complex X and/or Y arguments ignored
Warning: Imaginary parts of complex X and/or Y arguments ignored
```

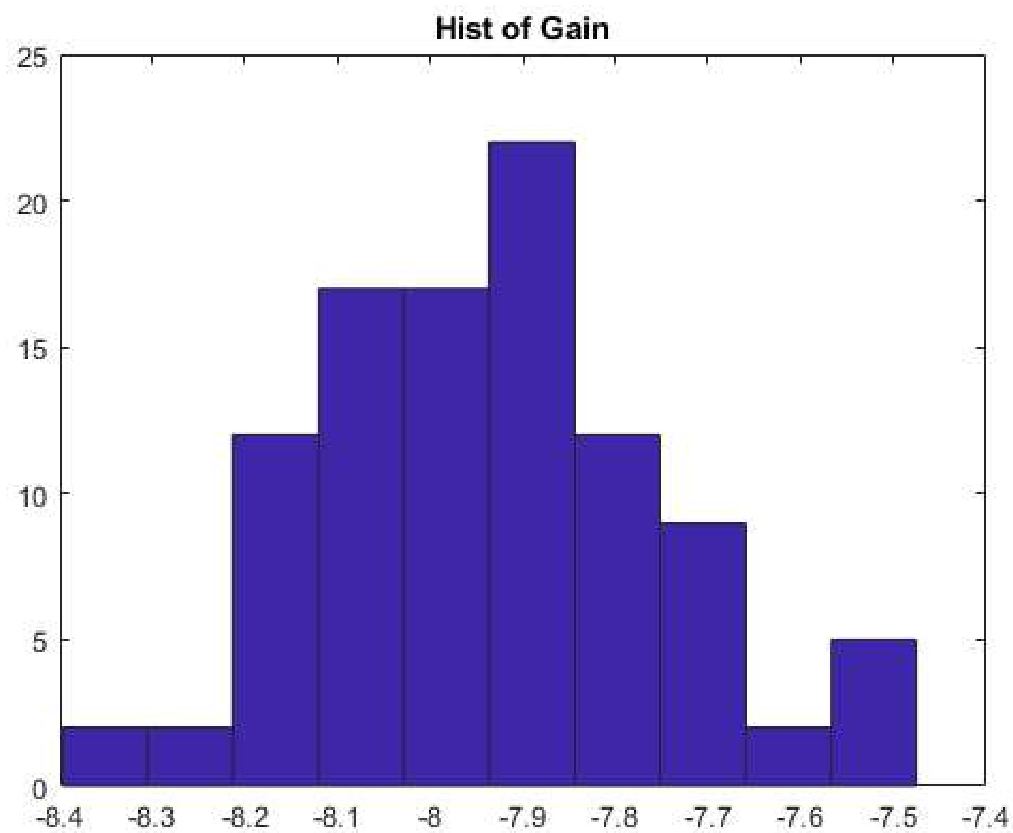



Vo
80
60
40
20
0
-20
-40
-60
-80
-10
-8
-6
-4
-2
0
2
4
6
8
10

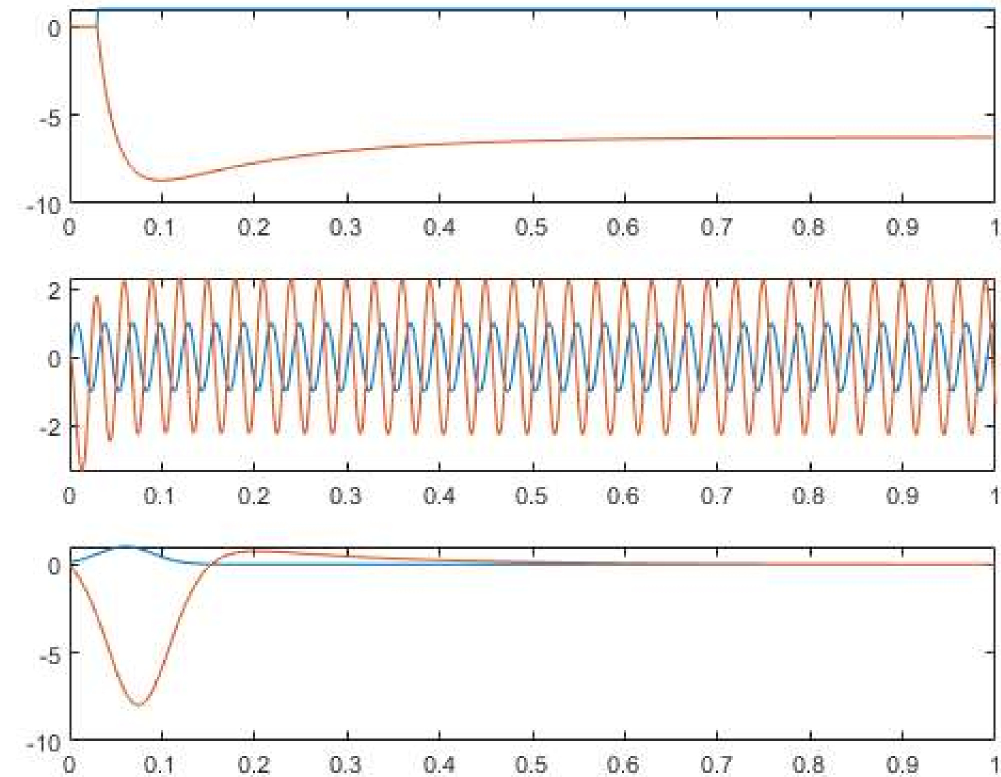

Vo func of w
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
10^-4
10^-2
10^0
10^2
10^4
10^6

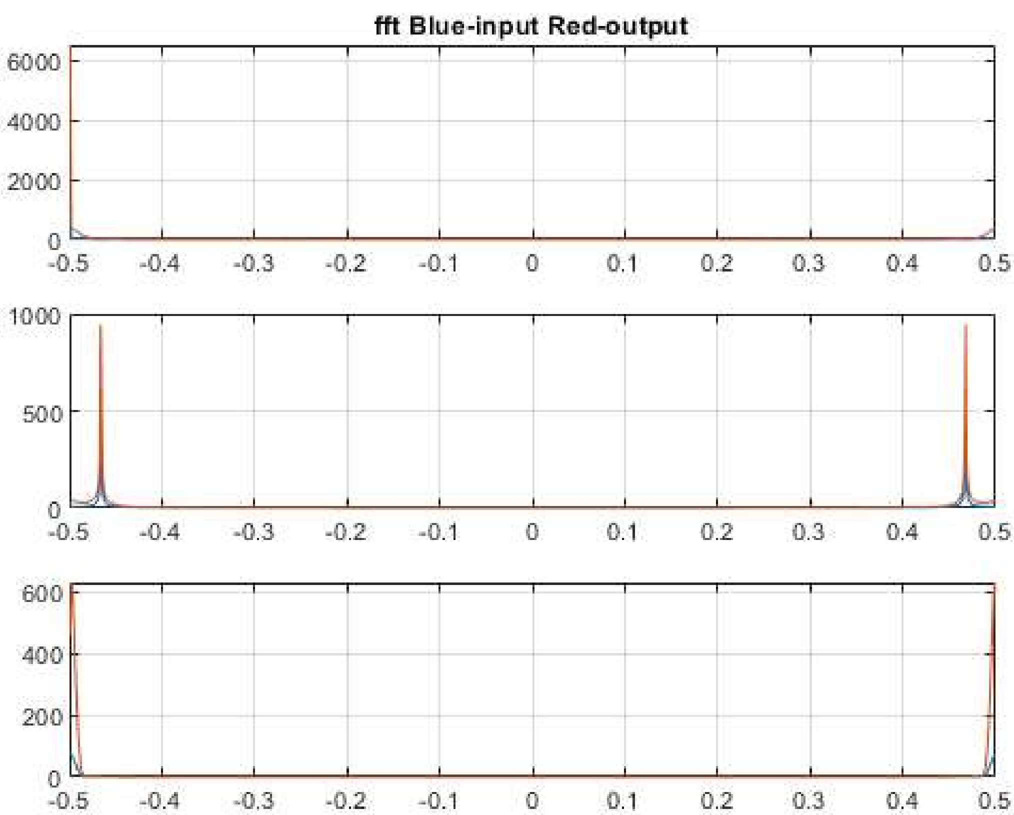


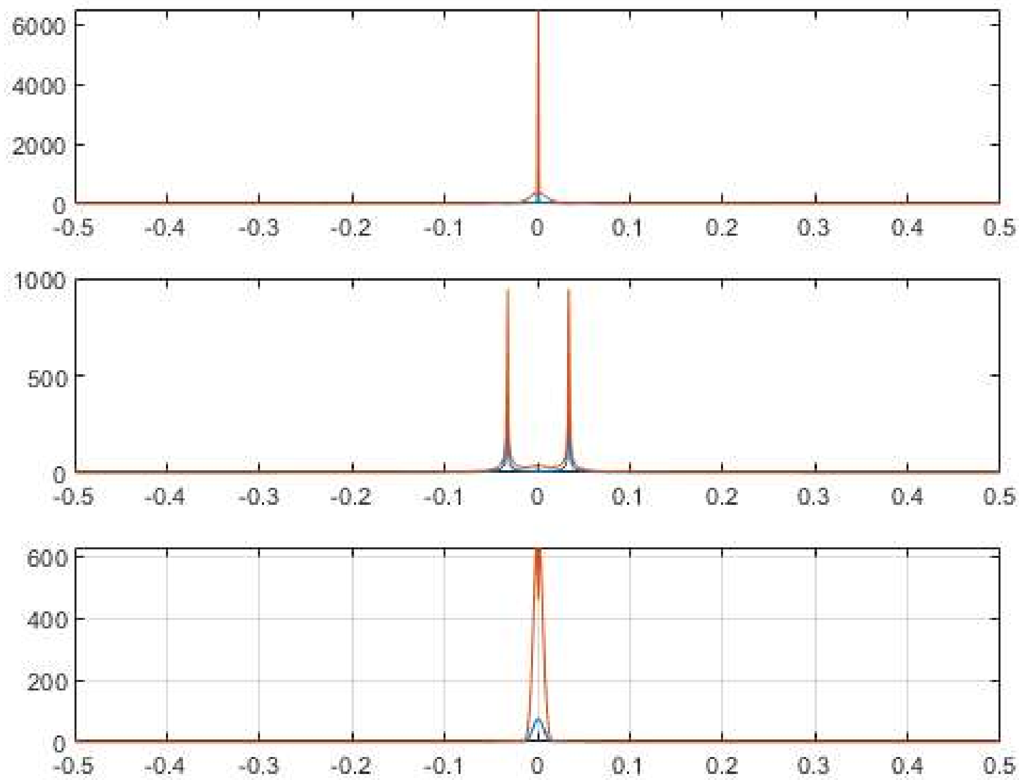
Gain in dB
20
10
0
-10
-20
-30
-40
-50
10^{-4}
10^{-2}
10^{0}
10^{2}
10^{4}
10^{6}



Hist of Gain
25
20
15
10
5
0
-8.4
-8.3
-8.2
-8.1
-8
-7.9
-7.8
-7.7
-7.6
-7.5
-7.4




fft Blue-input Red-output


6000
4000
2000
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
1000
500
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
600
400
200
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5