Scilab Manual for Signal Processing by Mrs S. Chaya Electronics Engineering AIKTC [1]

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Experiment: 1

Image Sampling and Quantization

check Appendix AP 1 for dependency:

cameraman.jpeg

Scilab code Solution 1.1 Exp1a

```
1  //Image Quantization
2  clear;
3  clc;
4  I = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\cameraman.jpeg');
5  quanta = 50;
6  J = double(I)/255;
7  J = uint8(J*quanta);
8  J = double(J)/quanta;
9  figure
10 ShowImage(I,'Original Image')
11 figure
12 ShowImage(J,'Quantized Image')
```

Figure 1.1: Exp1a

check Appendix AP 1 for dependency:

`cameraman.jpeg`

Scilab code Solution 1.2 Exp1b

```
1  //Image Sampling
2  clear;
3  clc;
4  I = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\cameraman.jpeg');
5  J = imresize(I,0.5); //Reducing the sampling rate
6  K1 = imresize(J,2,'nearest'); //Increasing the
       sampling rate
7  K2 = imresize(J,2,'bilinear');
8  K3 = imresize(J,2,'bicubic');
9  figure
10 ShowImage(I,'Original Image')
11 figure
12 ShowImage(J,'Reducing the Sampling Rate by 2')
13 figure
14 ShowImage(K1,'Increasing the Sampling Rate by 2
       nearest neighbour method')
15 figure
16 ShowImage(K2,'Increasing the Sampling Rate by 2
       bilinear method')
17 figure
18 ShowImage(K3,'Increasing the Sampling Rate by 2
       bicubic method')
```

Figure 1.2: Exp1a

Figure 1.3: Exp1b

Figure 1.4: Exp1b

Experiment: 2

Understanding basic relationship between pixel

check Appendix AP 1 for dependency:

`cameraman.jpeg`

check Appendix AP 2 for dependency:

`rice.jpg`

Scilab code Solution 2.1 Exp2a

```
1 //Image Arithmetic -division, multiplication, image
    subtraction and image addition
2 clc;
3 clear;
4 close;
5 I  = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab
    \scilab\cameraman.jpeg'); //SIVP toolbox
6 J = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
    scilab\rice.jpg');//SIVP toolbox
7 IMA = imadd(I,J); //SIVP toolbox
8 figure
9 ShowImage(IMA,'Image Addition')//IPD toolbox
```

```
10 IMS = imabsdiff(I,J);//SIVP toolbox
11 figure
12 ShowImage(IMS,'Image Subtraction');//IPD toolbox
13 IMD = imdivide(I,J);//SIVP toolbox
14 IMD = imdivide(IMD,0.01);//SIVP toolbox
15 figure
16 ShowImage(uint8(IMD),'Image Division');//IPD toolbox
17 IMM = immultiply(I,I);//SIVP toolbox
18 figure
19 ShowImage(uint8(IMM),'Image Multiply');//IPD toolbox
```

---

check Appendix AP 1 for dependency:

`cameraman.jpeg`

check Appendix AP 4 for dependency:

`lenna.jpg`

Scilab code Solution 2.2 Exp2b

```
1 //Image Arithmetic- Distance and Connectivity: To
     understand the notion of connectivity
2 //and neighborhood defined for a point in an image.
3 clc;
4 clear;
5 close;
6 //function to convert gray to binary
7 function X = gray2bin(x)
8     xmean = mean2(x);
9     [m,n]= size(x);
10    X = zeros(m,n);
11    for i = 1:m
```

Figure 2.1: Exp2a

Figure 2.2: Exp2a

```
12          for j = 1:n
13              if x(i,j)> xmean then
14                  X(i,j) = 1;
15              end
16          end
17      end
18  endfunction
19  //function to find total length of two dimensional
       matrix
20  function n = numdims(X)
21      n = length(size(X));
22  endfunction
23  ////////////////////////////////////
24  //Funtion to pad zeros in columns and rows at both
       ends of an binary image
25  function B = padarray(b)
26      //pad zeros in columns and rows at both ends of
          an binary image
27  [m,n] = size(b);
28  num_dims = length(size(b));
29  B = zeros(m+num_dims,n+num_dims);
30  for i = num_dims:m+num_dims-1
31      for j = num_dims:m+num_dims-1
32          B(i,j) = b(i-1,j-1);
33      end
34  end
35  endfunction
36  ////////////////////////////////////
37  //[1].Euclidean Distance between images and their
       histograms
38  I = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\lenna.jpg');
39  J = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\cameraman.jpeg')
40  h_I = CreateHistogram(I);//IPD toolbox
41  h_J = CreateHistogram(J);//IPD toolbox
42  I = double(I);
43  J = double(J);
```

```
44 E_dist_Hist = sqrt(sum((h_I-h_J).^2));//Euclidean
      Distance between histograms of two images
45 E_dist_images = sqrt(sum((I(:)-J(:)).^2));//
      Euclidean Distance between two images
46 disp(E_dist_images,'Euclidean Distance between two
      images');
47 disp(E_dist_Hist,'Euclidean Distance between
      histograms of two images')
48 //[2]. Connectivity - 8 connected to the background
49 //exec(gray2bin)
50 Ibin = gray2bin(I);
51 Jbin = gray2bin(J);
52 //conversion of gray image into binary image
53 conn = [1,1,1;1,1,1;1,1,1];//8-connectivity
54 //exec('C:\Users\senthilkumar\Desktop\Gautam_PAL_Lab
      \numdims.sci')
55 num_dims = numdims(I);
56 //exec('C:\Users\senthilkumar\Desktop\Gautam_PAL_Lab
      \padarray.sci')
57 B = padarray(Ibin);
58 global FILTER_ERODE;
59 StructureElement = CreateStructureElement('square',
      3);
60 B_eroded = MorphologicalFilter(B,FILTER_ERODE,
      StructureElement.Data);//IPD toolbox
61 //note:StructureElement.Data and conn both are same
      values
62 //except that StructureElement.Data is boolean
      either true or false
63 p = B&~B_eroded;
64 [m,n] = size(p);
65 for i = num_dims:m+num_dims-2
66     for j = num_dims:n+num_dims-2
67         pout(i-1,j-1) = p(i,j);
68     end
69 end
70 figure
71 ShowImage(uint8(I),'Gray Lenna Image')
```

```
72 figure
73 ShowImage(Ibin,'Binary Lenna Image')
74 figure
75 ShowImage(pout,'8 neighbourhood connectiviy in Lenna
       Image')
76 //RESULT
77 //Euclidean Distance between two images
78 //
79 //     19797.433
80 //
81 // Euclidean Distance between histograms of two
      images
82 //
83 //     5770.7
```

Figure 2.3: Exp2b

Figure 2.4: Exp2b

Experiment: 3

Program for Image sharpening.

Scilab code Solution 3.1 Exp3a

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 //2.Program to sharpen image
7 //Read image and display it.
8 //For Colour Image
9 clc;
10 clear all;
11 close;
12 a = imread('C:\Users\senthilkumar\Desktop\
     signal_processing_lab\hestian.jpg');
13 ShowColorImage(a,'Original Image')
14 title('Original Image');
15 //Sharpen the image and display it.
16 //b = imsharpen(a);
17 //figure, imshow(b), title('Sharpened Image');
18
19
```

```
radius =1;
amount = 0.8000;
threshold = 0;
// Gaussian blurring filter
filtRadius = ceil(radius*2);
filtSize = 2*filtRadius + 1;
gaussFilt = fspecial('gaussian',[filtSize filtSize],
   radius);
// High-pass filter
sharpFilt = zeros(filtSize,filtSize);
sharpFilt(filtRadius+1,filtRadius+1) = 1;
sharpFilt = sharpFilt - gaussFilt;
sharpFilt = amount*sharpFilt;
sharpFilt(filtRadius+1,filtRadius+1) = sharpFilt(
   filtRadius+1,filtRadius+1) + 1;
B = imfilter(a,sharpFilt);
figure
ShowColorImage(B,'Sharpened Image');
```

---

check Appendix AP 3 for dependency:

hestian.jpg

Scilab code Solution 3.2 Exp3b

```
//Note: Details of scilab software version and OS
   version used:
//OS: Windows 7
//Scilab version: 5.4.1
//IPD Atom version:8.3.1-2
//SIVP Atom version:0.5.3.1-2
//2.b.Program to sharpen image
```

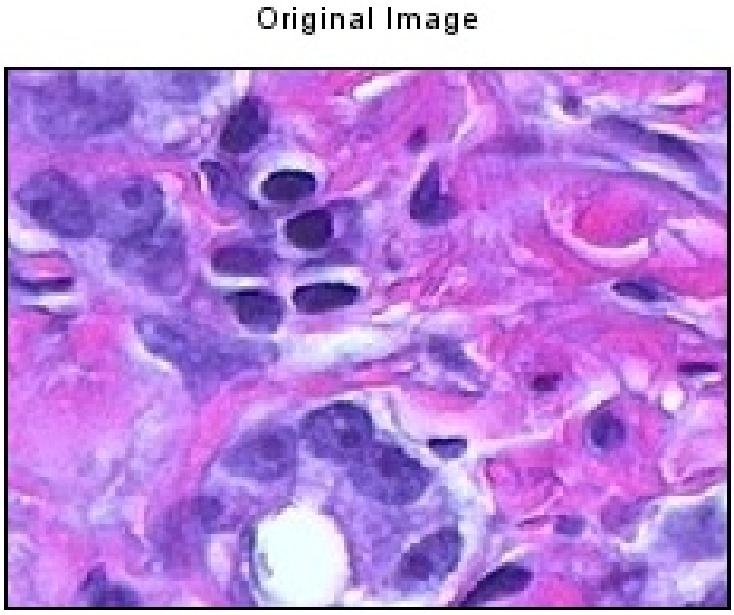


Figure 3.1: Exp3a

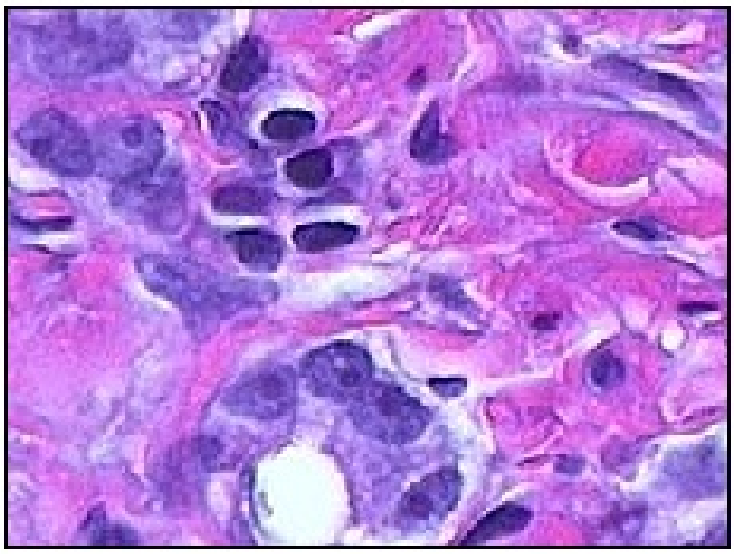


Figure 3.2: Exp3a

```
7  //Read image and display it.
8  //For Gray Image
9  clc;
10 clear all;
11 close;
12 a = imread('C:\Users\senthilkumar\Desktop\
       signal_processing_lab\rice.jpg');//SIVP toolbox
13 ShowImage(a,'Original Image')//SIVP toolbox
14 title('Original Image');
15 //Sharpen the image and display it.
16 //b = imsharpen(a);
17 //figure, imshow(b), title('Sharpened Image');
18
19
20 radius =1;
21 amount = 0.8000;
22 threshold = 0;
23 // Gaussian blurring filter
24 filtRadius = ceil(radius*2);
25 filtSize = 2*filtRadius + 1;
26 gaussFilt = fspecial('gaussian',[filtSize filtSize],
       radius);
27 // High-pass filter
28 sharpFilt = zeros(filtSize,filtSize);
29 sharpFilt(filtRadius+1,filtRadius+1) = 1;
30 sharpFilt = sharpFilt - gaussFilt;
31 sharpFilt = amount*sharpFilt;
32 sharpFilt(filtRadius+1,filtRadius+1) = sharpFilt(
       filtRadius+1,filtRadius+1) + 1;
33 B = imfilter(a,sharpFilt);
34 figure
35 ShowImage(B,'Sharpened Image');//IPD toolbox
```

---

check Appendix AP 2 for dependency:

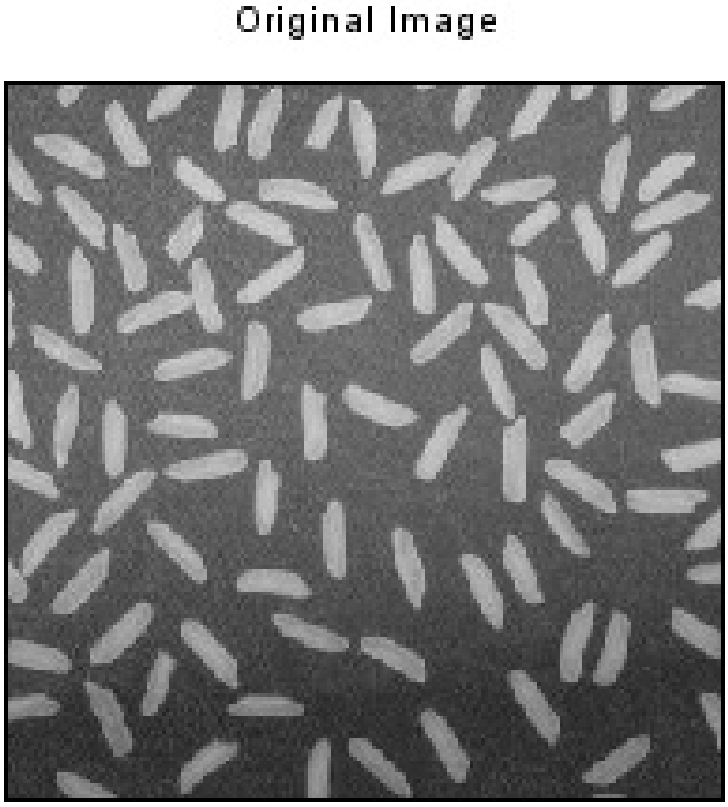


Figure 3.3: Exp3b

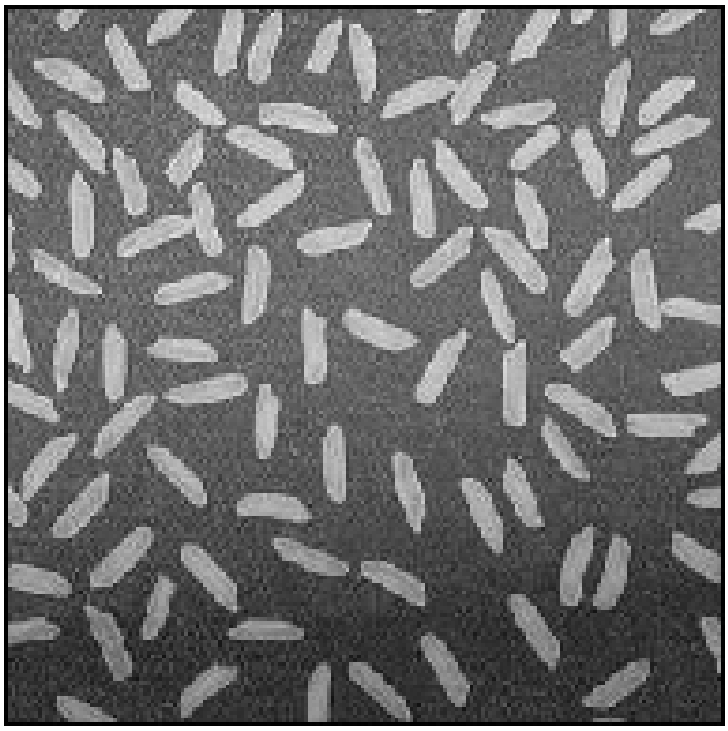


Figure 3.4: Exp3b

rice.jpg

Experiment: 4

Program for lossless Image Compression.

Scilab code Solution 4.1 Exp4

```
1 // Lossless Image Compression- Implementation of
    arithmetic coding for images
2 //Note 1: In order to run this program download
    Huffman toolbox from
3 //scilab atoms
4 //Note 2: The Huffman atom is used to encode images
```

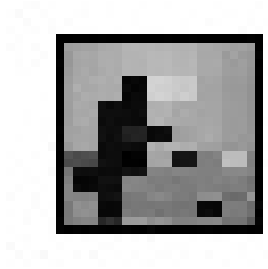


Figure 4.1: Exp4

```
    of small size only
//Software version
//OS Windows7
//Scilab5.4.1
//Image Processing Design Toolbox 8.3.1-1
//Scilab Image and Video Proccessing toolbox
    0.5.3.1-2
clear;
clc;
close;
a = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
    scilab\cameraman.jpeg');
A = imresize(a,[16 16]); //Only Image of small size
    is possible to call huffcode
B = size(A);
A=A(:).';
A = double(A);
[QT,QM]=huffcode(A); //Huffman Encoding
disp('compressed Bit sequence:');
disp(QT);
disp('Code Table:');
disp(QM);
// Now, the reverse operation
C = huffdeco(QT,QM); //Huffman Decoding
for i=1:B(1)
    E(i,1:B(2))= C((i-1)*B(2)+1:i*B(2));
end
D = E';
E = imresize(D,[32,32]);
figure
ShowImage(a,'Original cameraman Image 256x256')
figure
ShowImage(E,'Reconstructed cameraman Image 32x32');
```

check Appendix AP 1 for dependency:

`cameraman.jpeg`

Experiment: 5

Program for lossy Image Compression.

Scilab code Solution 5.1 Exp5

```
1  //Lossy Image Compression-Block Truncation Coding
2  //Note: Details of scilab software version and OS
       version used:
3  //OS: Windows 7
4  //Scilab version: 5.4.1
5  //IPD Atom version:8.3.1-2
6  //SIVP Atom version:0.5.3.1-2
7  clc;
8  clear;
9  close;
10 function out_put = btcimage(in_put,block_size)
11     //Note: Details of scilab software version and
         OS version used:
12 //OS: Windows 7
13 //Scilab version: 5.4.1
14 //IPD Atom version:8.3.1-2
15 //SIVP Atom version:0.5.3.1-2
16 X= imread(in_put);
17 Y=imfinfo(in_put);
```

```
18 K=block_size;
19 X1=double(X);
20 y1=size(X);
21 n=y1(1);
22 m=y1(2);
23 k=1;l=1;
24
25
26     if (Y.ColorType=='grayscale')
27
28     //                          IMAGE ENCODING
29
30     //
31     //                    FOR GRAY SCALE IMAGES
32     //
33         figure(1)
34         ShowImage(X,'Original')
35         title('ORIGINAL');
36         for i=1:K:n
37             for j=1:K:m
38                 tmp([1:K],[1:K])=X1([i:i+(K-1)],[j:j
                       +(K-1)]);
39                 mn=mean(mean(tmp));
40                 tmp1([i:i+(K-1)],[j:j+(K-1)])=tmp>mn
                       ;
41                 Lsmat=(tmp<mn);
42                 Mrmat=(tmp>=mn);
43                 Lsmn=sum(sum(Lsmat));
44                 Mrmn=sum(sum(Mrmat));
45                 Mu(k)=sum(sum(Lsmat.*tmp))/(Lsmn+.5)
                       ;k=k+1;
46                 Mi(l)=sum(sum(Mrmat.*tmp))/Mrmn;l=l
                       +1;
47             end
48         end
49         figure(2)
50         ShowImage(tmp1,'Encoded Image')
51         title('ENCODED');
```

```
52
53          //                          IMAGE DECODING
54
55          k=1;l=1;
56          for i=1:K:n
57              for j=1:K:m
58                  tmp21([1:K],[1:K])=tmp1([i:i+(K-1)
                        ],[j:j+(K-1)]);
59                  tmp22=(tmp21*round(Mu(k)));k=k+1;
60                  tmp21=((tmp21==0)*round(Mi(l)));l=l
                        +1;
61                  tmp21=tmp21+tmp22;
62                  out_put([i:i+(K-1)],[j:j+(K-1)])=
                        tmp21;
63              end
64          end
65          figure(3)
66          ShowImage(uint8(out_put),'Decoded Image')
67          title('DECODED');
68
69      //
70      //                      FOR COLORED IMAGES
71      //
72
73      elseif (Y.ColorType=='truecolor')
74          R=X(:,:,1);
75          G=X(:,:,2);
76          B=X(:,:,3);
77          //                      IMAGE ENCODING
78          figure(1)
79          ShowColorImage(X,'Original')
80          title('ORIGINAL');
81          for b=1:3
82              for i=1:K:n
83                  for j=1:K:m
84                      tmp([1:K],[1:K])=X1([i:i+(K-1)
                            ],[j:j+(K-1)],b);
85                      mn=mean(mean(tmp));
```

```
86                          tmp1([i:i+(K-1)],[j:j+(K-1)],b)=
                               tmp>mn;
87                          Lsmat=(tmp<mn);
88                          Mrmat=(tmp>=mn);
89                          Lsmn=sum(sum(Lsmat));
90                          Mrmn=sum(sum(Mrmat));
91                          Mu(b,k)=sum(sum(Lsmat.*tmp))/(
                               Lsmn+.5);k=k+1;
92                          Mi(b,l)=sum(sum(Mrmat.*tmp))/
                               Mrmn;l=l+1;
93                      end
94                  end
95              end
96          end
97  endfunction
98
99  //MAIN PROGRAM
100 I = 'C:\Users\senthilkumar\Desktop\Chaya_Lab\scilab\
       cameraman.jpeg';
101 block_size = 2;
102 //exec('btcimage.sci')
103 //exec('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\btcimage.sci');
104 out_put = btcimage(I,block_size);
```

check Appendix AP 1 for dependency:

cameraman.jpeg

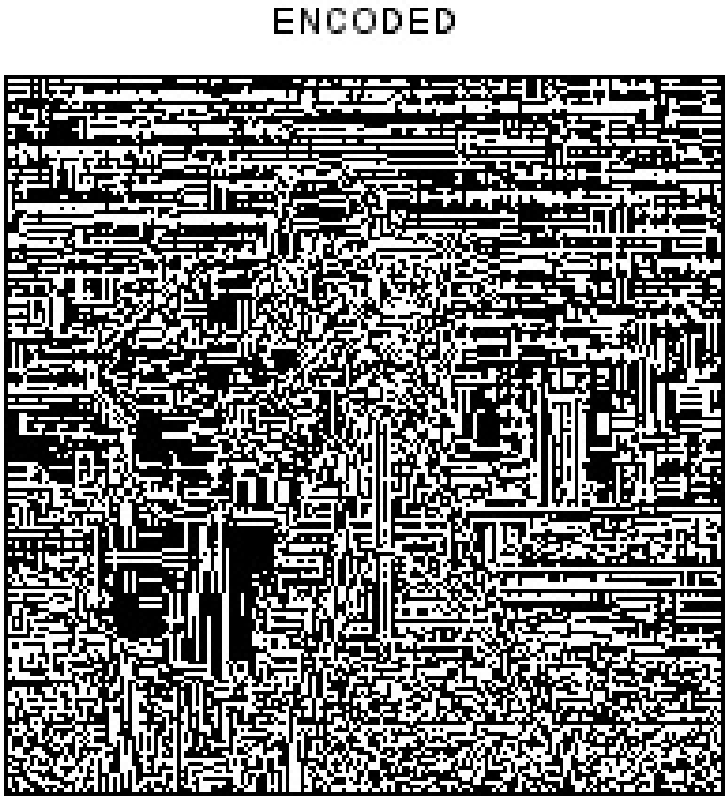


Figure 5.1: Exp5

Figure 5.2: Exp5

Experiment: 6

Program for generation and Manipulation of signal.

Scilab code Solution 6.1 Exp6a

```
1 //Caption: Program to generate and plot different
     basic sequences
2 clear all;
3 clc;
4 close;
5 //Generation of Unit Impulse signal
6 L = 4;  //Upperlimit
7 n = -L:L;
8 x = [zeros(1,L),1,zeros(1,L)];
9
10 b = gca();
11 b.y_location = "middle";
12 plot2d3('gnn',n,x)
13 a=gce();
14 a.children(1).thickness =4;
15 xtitle('Graphical Representation of Unit Sample
     Sequence','n','x[n]');
16 //Generation of Unit Step Signal
17 L = 10;  //Upperlimit
```

```
18 t = -L:L;
19 x = [zeros(1,L),ones(1,L+1)];
20 figure(1)
21 subplot(2,1,1)
22 a=gca();
23 a.thickness =2;
24 a.y_location = "middle";
25 plot2d2(t,x)
26 xtitle('Graphical Representation of Unit Step Signal
      ','t','x(t)');
27 //Generation of Unit Step Sequence
28 L = 4;  //Upperlimit
29 n = -L:L;
30 x = [zeros(1,L),ones(1,L+1)];
31 subplot(2,1,2)
32 a=gca();
33 a.thickness = 2;
34 a.y_location = "middle";
35 plot2d3('gnn',n,x)
36 xtitle('Graphical Representation of Unit Step
      Sequence','n','x[n]');
37 //Generation of Ramp Sequence
38 L = 4;  //Upperlimit
39 n = -L:L;
40 x = [zeros(1,L),0:L];
41 figure(2)
42 subplot(2,1,1)
43 b = gca();
44 b.y_location = 'middle';
45 plot2d3('gnn',n,x)
46 a=gce();
47 a.children(1).thickness =2;
48 xtitle('Graphical Representation of Discrete Unit
      Ramp Sequence','n','x[n]');
49 //Generation of Ramp Signal
50 L = 4;  //Upperlimit
51 t = -L:L;
52 x = [zeros(1,L),0:L];
```

```
53 subplot(2,1,2)
54 b = gca();
55 b.y_location = 'middle';
56 plot2d(n,x)
57 a=gce();
58 a.children(1).thickness =2;
59 xtitle('Graphical Representation of Discrete Unit
      Ramp Sequence','t','x(t)');
60 //Generation of Exponentially Increasing signal
61 a =1.5;
62 n = 0:10;
63 x = (a)^n;
64 figure(3)
65 subplot(2,1,1)
66 a=gca();
67 a.thickness = 2;
68 a.x_location = "origin";
69 a.y_location = "origin";
70 plot2d3('gnn',n,x)
71 xtitle('Graphical Representation of Exponential
      Increasing Signal','n','x[n]');
72 //Generation of Exponentailly Decreasing Signal
73 a =0.5;
74 n = 0:10;
75 x = (a)^n;
76 subplot(2,1,2)
77 a=gca();
78 a.thickness = 2;
79 a.x_location = "origin";
80 a.y_location = "origin";
81 plot2d3('gnn',n,x)
82 xtitle('Graphical Representation of Exponential
      Decreasing Signal','n','x[n]');
```

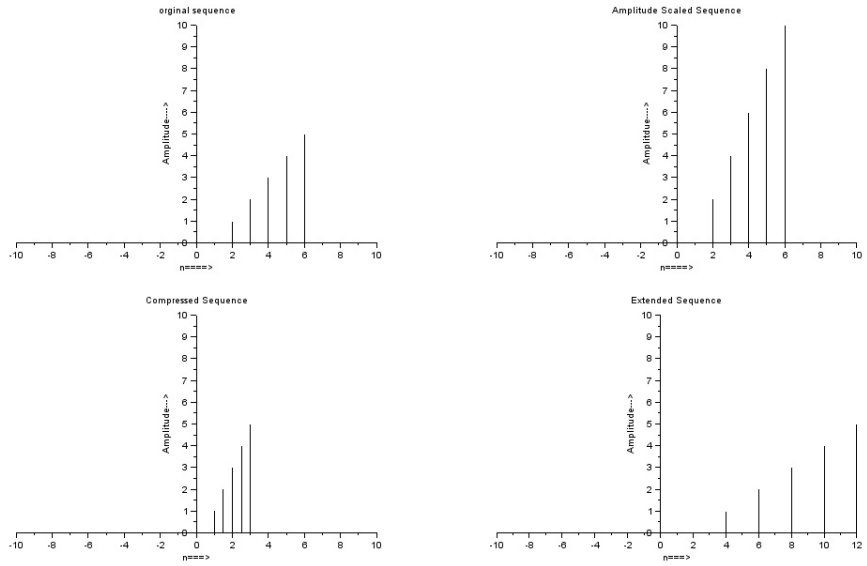


Figure 6.1: Exp6a

Scilab code Solution 6.2 Exp6b

```
1  //Caption: Program to Demonstrate the signal Folding
2  clc;
3  clear;
4  x = input('Enter the input sequence:=');
5  m = length(x);
6  lx = input('Enter the starting point of original
       signal=');
7  hx = lx+m-1;
8  n = lx:1:hx;
9  subplot(2,1,1)
10 a = gca();
11 a.x_location = "origin";
```

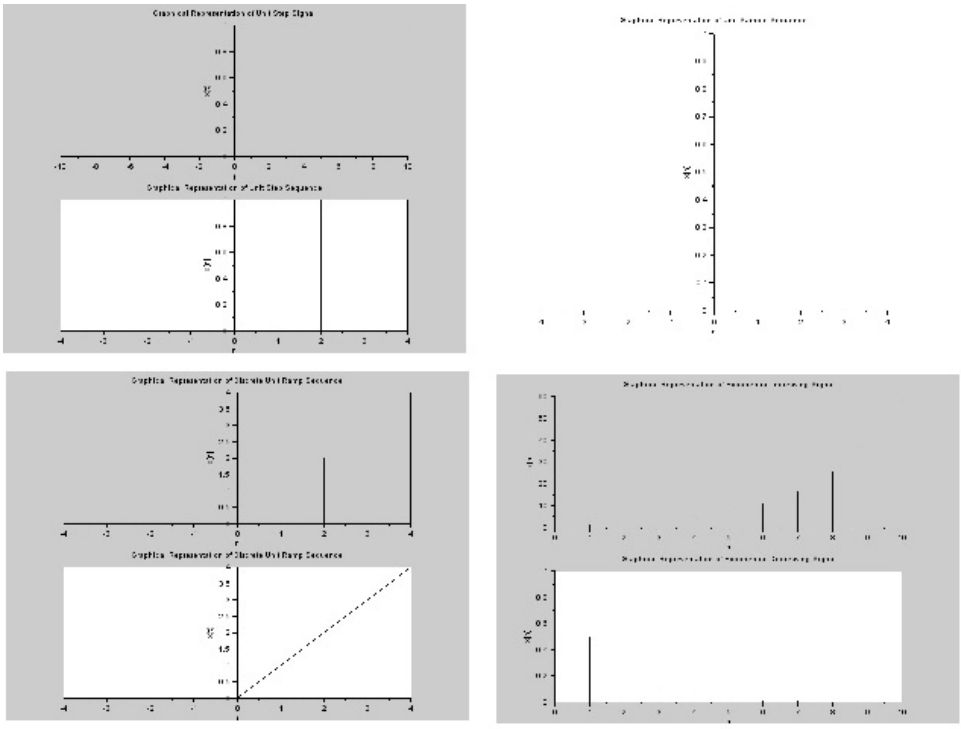


Figure 6.2: Exp6a

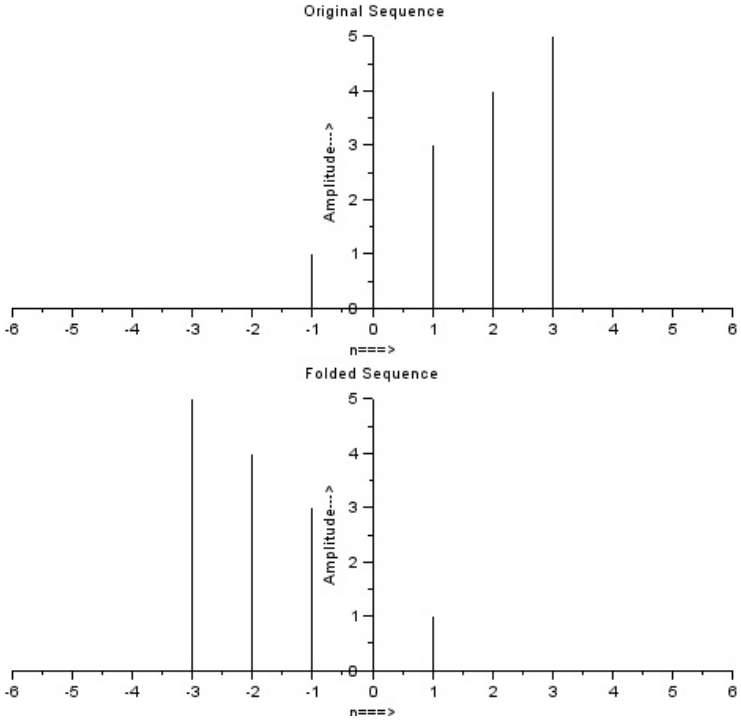


Figure 6.3: Exp6b

```
12 a.y_location = "origin";
13 a.data_bounds = [-5,0;5,5];
14 plot2d3('gnn',n,x)
15 xlabel('n===>')
16 ylabel('Amplitude-->')
17 title('Original Sequence')
18 subplot(2,1,2)
19 a = gca();
20 a.x_location = "origin";
21 a.y_location = "origin";
22 a.data_bounds = [-5,0;5,5];
23 plot2d3(-n,x)
24 xlabel('n===>')
25 ylabel('Amplitude-->')
26 title('Folded Sequence')
27 //Example
28
29 //Enter the input sequence:=[1,2,3,2,5]
30 //
31 //Enter the starting point of original signal=-1
```

Scilab code Solution 6.3 Exp6c

```
1 //Caption: Program to demonstrate the Amplitude &
    Time Scaling of a signal
2 clc;
3 clear;
4 x = input('Enter input Sequence:=');
5 m = length(x);
6 lx = input('Enter starting point of original signal
    :=')
7 hx = lx+m-1;
8 n = lx:1:hx;
```

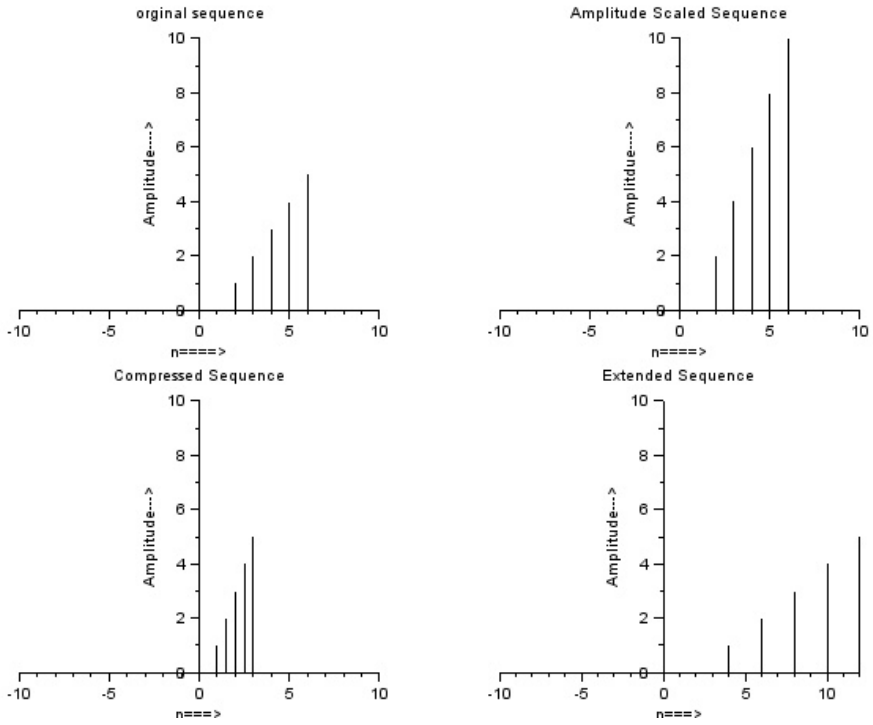


Figure 6.4: Exp6c

```
subplot(2,2,1)
a = gca();
a.x_location = "origin";
a.y_location = "origin";
a.data_bounds = [-10,0;10,10];
plot2d3('gnn',n,x)
xlabel('n====>')
ylabel('Amplitude---->')
title('orginal sequence')
//Amplitude Scaling
a = input('Amplitude Scaling Factor:=')
y =a*x;
subplot(2,2,2)
a = gca();
a.x_location = "origin";
a.y_location = "origin";
a.data_bounds = [-10,0;10,10];
plot2d3('gnn',n,y)
xlabel('n====>')
ylabel('Amplitdue---->')
title('Amplitude Scaled Sequence')
//Time Scaling-Compression
C = input('Enter Compression factor-Time Scaling
    factor')
n = lx/C:1/C:hx/C;
subplot(2,2,3)
a = gca();
a.x_location = "origin";
a.y_location = "origin";
a.data_bounds = [-10,0;10,10];
plot2d3('gnn',n,x)
xlabel('n===>')
ylabel('Amplitude--->')
title('Compressed Sequence')
//Time Scaling-Expansion
d = input('Enter Extension factor-Time Scaling
    factor')
n = lx*d:d:hx*d;
```

```
45 subplot(2,2,4)
46 a = gca();
47 a.x_location = "origin";
48 a.y_location = "origin";
49 a.data_bounds = [-10,0;10,10];
50 plot2d3('gnn',n,x)
51 xlabel('n===>')
52 ylabel('Amplitude-->')
53 title('Extended Sequence')
54 //Example
55 //Enter input Sequence:=[1,2,3,4,5]
56 //
57 //Enter starting point of original signal:= 2
58 //
59 //Amplitude Scaling Factor:= 2
60 //
61 //Enter Compression factor-Time Scaling factor 2
62 //
63 //Enter Extension factor-Time Scaling factor 2
```

Scilab code Solution 6.4 Exp6d

```
1 //Caption:Program to demonstrate the shifting of the
      discrete time signal
2 clc;
3 clear;
4 close;
5 x = input('Enter the input sequence:=')
6 m = length(x);
7 lx = input('Enter the starting point of original
     signal:=')
8 hx = lx+m-1;
9 n = lx:1:hx;
```

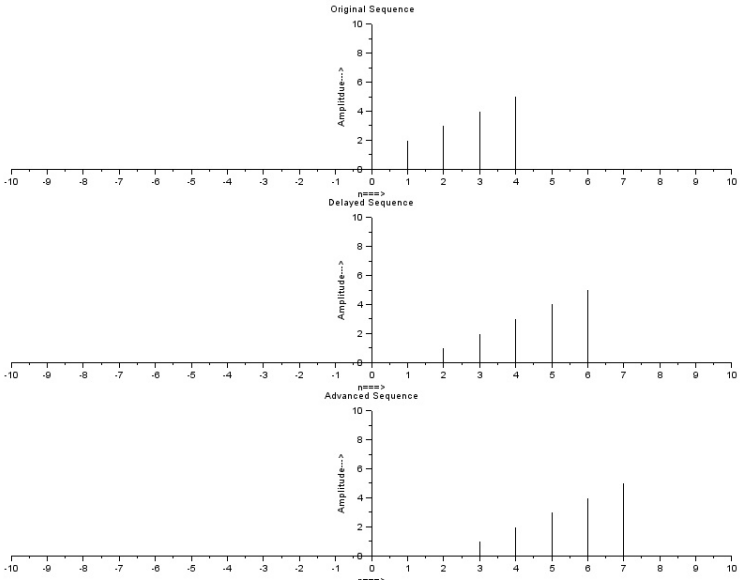


Figure 6.5: Exp6d

```
10 subplot(3,1,1)
11 a = gca();
12 a.x_location = "origin";
13 a.y_location = "origin";
14 a.data_bounds = [-10,0;10,10];
15 plot2d3('gnn',n,x);
16 xlabel('n===>')
17 ylabel('Amplitdue--->')
18 title('Original Sequence')
19 //
20 d = input('Enter the delay:=')
21 n = lx+d:1:hx+d;
22 subplot(3,1,2)
23 a = gca();
24 a.x_location = "origin";
25 a.y_location = "origin";
26 a.data_bounds = [-10,0;10,10];
27 plot2d3('gnn',n,x)
28 xlabel('n===>')
```

```
29 ylabel('Amplitude---->')
30 title('Delayed Sequence')
31 //
32 a = input('Enter the advance:=')
33 n = lx-a:1:hx-a;
34 subplot(3,1,3)
35 a = gca();
36 a.x_location = "origin";
37 a.y_location = "origin";
38 a.data_bounds = [-10,0;10,10];
39 plot2d3('gnn',n,x)
40 xlabel('n===>')
41 ylabel('Amplitude---->')
42 title('Advanced Sequence')
43 //Example
44 //Enter the input sequence:=[1,2,3,4,5]
45 //
46 //Enter the starting point of original signal:=0
47 //
48 //Enter the delay:=2
49 //
50 //Enter the advance:=3
```

Experiment: 7

Program for Discrete Fourier Transform

Scilab code Solution 7.1 Exp7

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 //5.PROGRAM TO IMPLEMENT DISCRETE FOURIER TRANSFORM
7 //DFT
8 clc;
9 close;
10 clear all;
11 N=input('Howmany point DFT  do you want?');
12 x2=input('Enter the sequence=');
13 n2=length(x2);
14 c= zeros(N);
15 x2=[x2 zeros(1,N-n2)];
16  for k=1:N
```

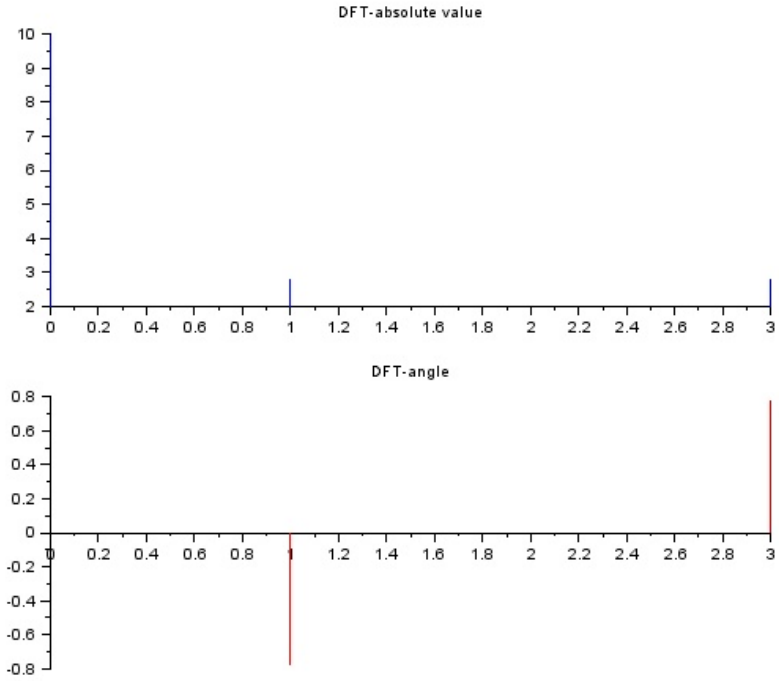


Figure 7.1: Exp7

```
17        for n=1:N
18            w=exp((-2*%pi*%i*(k-1)*(n-1))/N);
19            x(n)=w;
20            c(k,n)=x(n);
21        end
22
23     end
24     r=x2*c;
25    //plotting magnitude and angle
26    subplot(2,1,1)
27    plot2d3('gnn',0:N-1,abs(r),2);
28    title('DFT-absolute value');
29    subplot(2,1,2)
30    a = gca()
31    plot2d3('gnn',0:N-1,atan(imag(r)./(real(r)+0.0001))
      ,5);
32    a.x_location="origin";
33    title('DFT-angle');
34    disp(r,'Discrete Fourier Transform Result')
35    //RESULT
36    //Example 1
37    //Howmany point DFT  do you want? 4
38    //Enter the sequence=[1,2,3,4]
39    //Discrete Fourier Transform Result
40    //     10.  - 2. + 2.i  - 2. - 9.797D-16i  - 2. - 2.i
41    //
42    //Example 2
43    //Howmany point DFT  do you want?8
44    //Enter the sequence=[1,1,1,1,1,1,1,1]
45    //Discrete Fourier Transform Result
46    //           column 1 to 5
47    //
48    //     8.  - 5.551D-16 + 2.220D-16i  - 4.286D-16 -
      4.441D-16i  - 2.220D-16 + 8.882D-16i  - 4.899D-16
      i
49    //
50    //          column 6 to 8
51    //
```

```
52 //  - 2.109D-15 - 1.221D-15i  - 2.933D-15 - 6.661D
      -16i     3.553D-15 + 1.110D-15i
53 //
54 //Example 3
55 //Howmany point DFT  do you want? 8
56 //Enter the sequence= [0,1,2,3,4,5,6,7]
57 //Discrete Fourier Transform Result
58 //
59 //
60 //          column 1 to 7
61 //
62 //    28.  - 4. + 9.6568542i  - 4. + 4.i  - 4. +
      1.6568542i  - 4. - 3.429D-15i  - 4. - 1.6568542i
       - 4. - 4.i
63 //
64 //          column 8
65 //
66 //  - 4. - 9.6568542i
67 //
```

Experiment: 8

Simulation of FIR Filters

Scilab code Solution 8.1 Exp8

```
1  //Caption: To Design an Low Pass FIR Filter
2  //Filter Length =5, Order = 4
3  //Window = Rectangular Window
4  clc;
5  clear;
6  xdel(winsid());
7  fc = input("Enter Analog cutoff freq. in Hz=")
8  fs = input("Enter Analog sampling freq. in Hz=")
9  M = input("Enter order of filter =")
10 w = (2*%pi)*(fc/fs);
11 disp(w,'Digital cutoff frequency in radians.cycles/
       samples');
12 wc = w/%pi;
13 disp(wc,'Normalized digital cutoff frequency in
       cycles/samples');
14 [wft,wfm,fr]=wfir('lp',M+1,[wc/2,0],'re',[0,0]);
15 disp(wft,'Impulse Response of LPF FIR Filter:h[n]=')
       ;
16 //Plotting the Magnitude Response of LPF FIR Filter
```

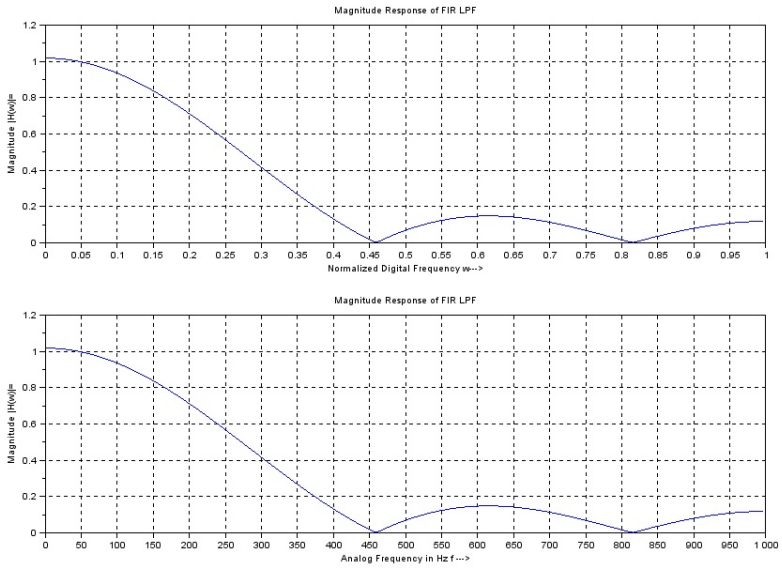


Figure 8.1: Exp8

```
17 subplot(2,1,1)
18 plot(2*fr,wfm)
19 xlabel('Normalized Digital Frequency w---->')
20 ylabel('Magnitude |H(w)|=')
21 title('Magnitude Response of FIR LPF')
22 xgrid(1)
23 subplot(2,1,2)
24 plot(fr*fs,wfm)
25 xlabel('Analog Frequency in Hz f ---->')
26 ylabel('Magnitude |H(w)|=')
27 title('Magnitude Response of FIR LPF')
28 xgrid(1)
29 //Example
30 //Enter Analog cutoff freq. in Hz= 250
31 //
32 //Enter Analog sampling freq. in Hz= 2000
33 //
34 //Enter order of filter = 4
35 //
```

```
36 // Digital cutoff frequency in radians.cycles/
   samples
37 //
38 //    0.7853982
39 //
40 // Normalized digital cutoff frequency in cycles/
   samples
41 //
42 //    0.25
43 //
44 // Impulse Response of LPF FIR Filter:h[n]=
45 //
46 //    0.1591549    0.2250791    0.25    0.2250791
      0.1591549
```

Experiment: 9

Generation and Quantization of Binary Numbers

Scilab code Solution 9.1 Exp9

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 //1.Quantization and sampling
7
8 //Quantize a signal to n bits. This code assumes
     the signal is between -1
9 //and +1.
10 clc;
11 clear all;
12 close;
13 n=8;                          //Number of bits;
14 m= 120;                        //Number of samples;
15 t = 2*%pi*[0:(m-1)]/m;
```

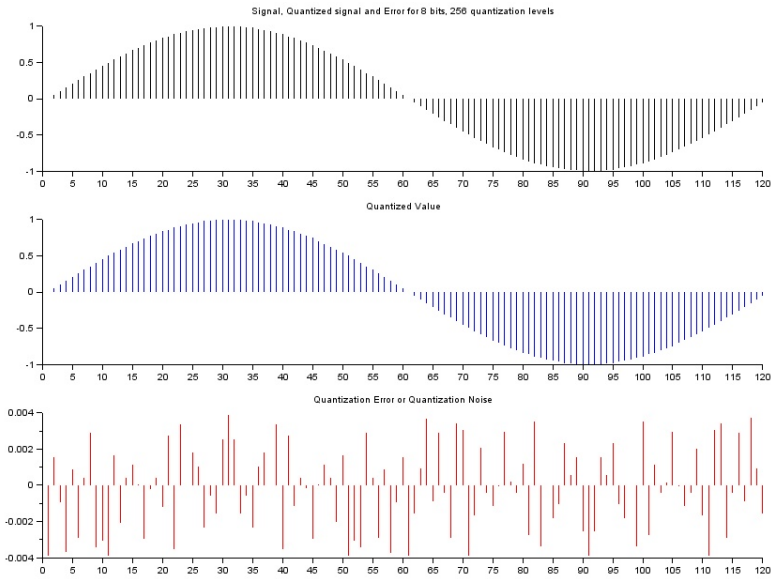


Figure 9.1: Exp9

```
16 x=sin(t);    //signal between -1 and 1.
17                                  //Trying "sin()"
                                       instead of "
                                       sawtooth"
18                                  //results in more
                                       interesting error
                                       (to the
19                                  //extent that error
                                       is interesting).
20 x(find(x>=1))=(1-%eps);       //Make signal from -1
      to just less than 1.
21 xq=floor((x+1)*2^(n-1));    //Signal is one of 2^n
      int values (0 to 2^n-1)
22 xq=xq/(2^(n-1));            //Signal is from 0 to 2 (
      quantized)
23 xq=xq-(2^(n)-1)/2^(n);      //Shift signal down (
      rounding)
24
25 xe=x-xq;                     //Error
```

```
26 subplot(3,1,1)
27 plot2d3('gnn',1:length(x),x);
28 title(sprintf('Signal, Quantized signal and Error
      for %g bits, %g quantization levels',n,2^n));
29 disp(x,'exact value')
30 subplot(3,1,2)
31 plot2d3('gnn',1:length(xq),xq,2);
32 title('Quantized Value')
33 disp(xq,'Quantized value')
34 subplot(3,1,3)
35 plot2d3('gnn',1:length(xe),xe,5);
36 title('Quantization Error or Quantization Noise')
37 disp(xe,'Quantization error or noise')
```

Experiment: 10

Introduction to Simulink Signal Analysis

Scilab code Solution 10.1 Exp10a

```
1 //Step response of discrete time systems
2 //Refer Exp10a.xcos file for simulink analysis
```

This code can be downloaded from the website wwww.scilab.in

Scilab code Solution 10.2 Exp10b

```
1 //Step response of Continuous time systems
2 //Refer Exp10b.xcos file for simulink analysis
```

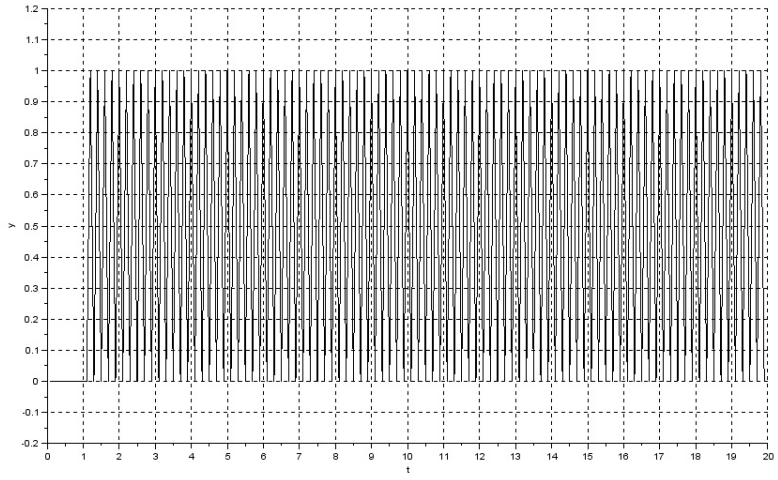


Figure 10.1: Exp10a

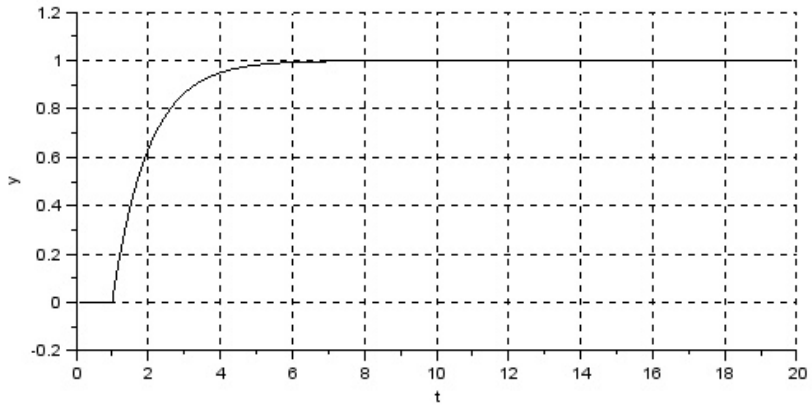


Figure 10.2: Exp10b

This code can be downloaded from the website wwww.scilab.in

Experiment: 11

Design and analysis of Butterworth Filter

Scilab code Solution 11.1 Exp11

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 clc;
7 clear all;
8 close;
9 n = 6; //filter order
10 Wn = [2.5e6,29e6]/500e6; //normalized cutoff
     frequencies[lower,upper]
11 ftype = 'bp'; //bandpass filter
12 fdesign = 'butt'; //Butterworth Filter
13 delta =[];
14 hz=iir(n,ftype,fdesign,Wn/2,delta)
15 [p,z,g]=iir(n,ftype,fdesign,Wn/2,delta)
```

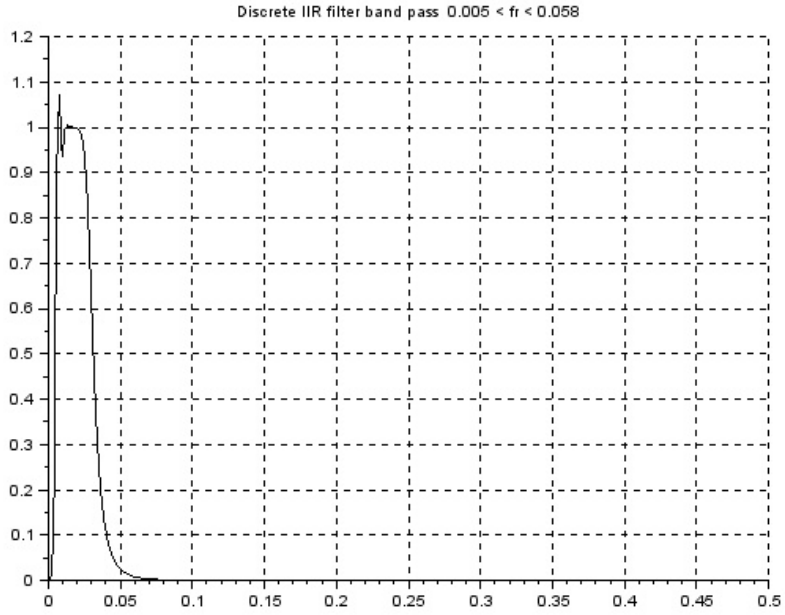


Figure 11.1: Exp11

```
[hzm,fr]=frmag(hz,256);
plot2d(fr',hzm');
xtitle('Discrete IIR filter band pass  0.005 < fr <
   0.058 ',' ',' ');
xgrid(1)
//Result

//-->hz(2)
// ans  =
//
//                              2             4
//     0.0000002 - 0.0000015z + 0.0000037z
//                             6             8
//             - 0.0000049z + 0.0000037z
//                             10            12
//             - 0.0000015z + 0.0000002z
//
//-->hz(3)
// ans  =
//
//                                           2
//     0.5250468 - 6.6287407z + 38.377802z
//                             3             4
//             - 134.73451z + 319.45814z
//                             5             6
//             - 538.91189z + 663.25134z
//                             7             8
//             - 600.03003z + 396.0233z
//                              9            10
//             - 185.96443z + 58.974503z
//                             11  12
//             - 11.340535z + z
//
//-->hz(1)
// ans  =
//
//!r  num  den  dt  !
//
```

```
53 //-->p
54 //  p   =
55 //
56 //      0.9964120 - 0.0154005 i
57 //      0.9892502 - 0.0129619 i
58 //      0.9822499 - 0.0060512 i
59 //      0.9822499 + 0.0060512 i
60 //      0.9892502 + 0.0129619 i
61 //      0.9964120 + 0.0154005 i
62 //      0.9464056 + 0.1686845 i
63 //      0.8907712 + 0.1177110 i
64 //      0.8651786 + 0.0429743 i
65 //      0.8651786 - 0.0429743 i
66 //      0.8907712 - 0.1177110 i
67 //      0.9464056 - 0.1686845 i
68 //
69 //-->z
70 //  z   =
71 //
72 //      1.
73 //      1.
74 //      1.
75 //      1.
76 //      1.
77 //      1.
78 //    - 1.
79 //    - 1.
80 //    - 1.
81 //    - 1.
82 //    - 1.
83 //    - 1.
84 //
85 //-->g
86 //  g   =
87 //
88 //      0.0000002
89 //
```

Experiment: 12

Impulse response of first order and second order system

Scilab code Solution 12.1 Exp12

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 clc;
7 clear all;
8 close;
9 s=poly(0,'s');
10 //The parameters 1.Angular Position 2. Angular
     Velocity of DC Motors
11 //are obtained from MATLAB demos file.
12 Angular_Position =(0.003127*s+0.9815)/(s^2+3.929*s
     +6.343e-05);
13 Angular_velocity = (1.04*s+0.2756)/(s^2+4.461*s
     +1.096);
```

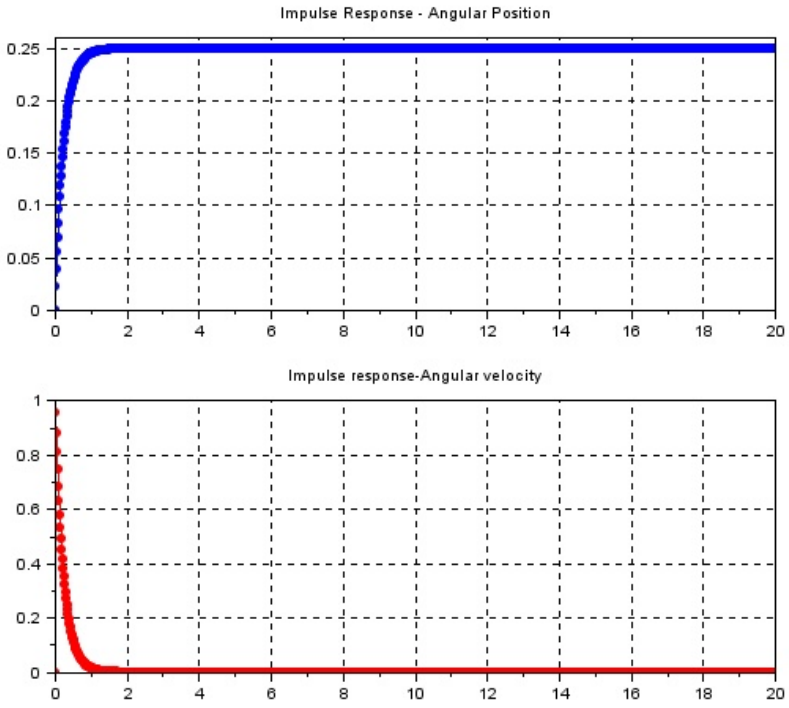


Figure 12.1: Exp12

```
model = [Angular_Position,Angular_velocity];
H1 = model(:,1); //Angular Position
H2 = model(:,2); //Angular velocity
np=20; //number of points
t = 0:0.02:20;
ysd1 = csim('impulse',t,model(:,1));
ysd2 = csim('impulse',t,model(:,2));
subplot(2,1,1)
plot(t,ysd1,'.-b')
title('Impulse Response - Angular Position')
xgrid(1)
subplot(2,1,2)
plot(t,ysd2,'.-r')
title('Impulse response-Angular velocity')
xgrid(1)
disp(model,'Model System Equations =')
disp(ysd1,'Impulse Resposne of Angular Position =')
disp(ysd2,'Impulse Response of Angular velocity=')

//RESULT
//Model System Equations =
//
//      0.9815 + 0.003127s          0.2756 + 1.04s
//    ------------------------    ------------------
//                          2                      2
//    0.0000634 + 3.929s + s     1.096 + 4.461s + s
```

Experiment: 13

Circular convolution of two given sequences.

Scilab code Solution 13.1 Exp13

```
1  //Note: Details of scilab software version and OS
       version used:
2  //OS: Windows 7
3  //Scilab version: 5.4.1
4  //IPD Atom version:8.3.1-2
5  //SIVP Atom version:0.5.3.1-2
6  //3.CIRCULAR CONVOLUTION OF TWO SEQUENCES
7  clc;
8  close;
9  clear all;
10 a1= input('1st Sequence x:')
11 b1= input('2nd Sequence h:')
12 ax=length(a1);
13 bx=length(b1);
14 n=max(ax,bx);
15 n3=ax-bx;
16 if(n3<=0)
```

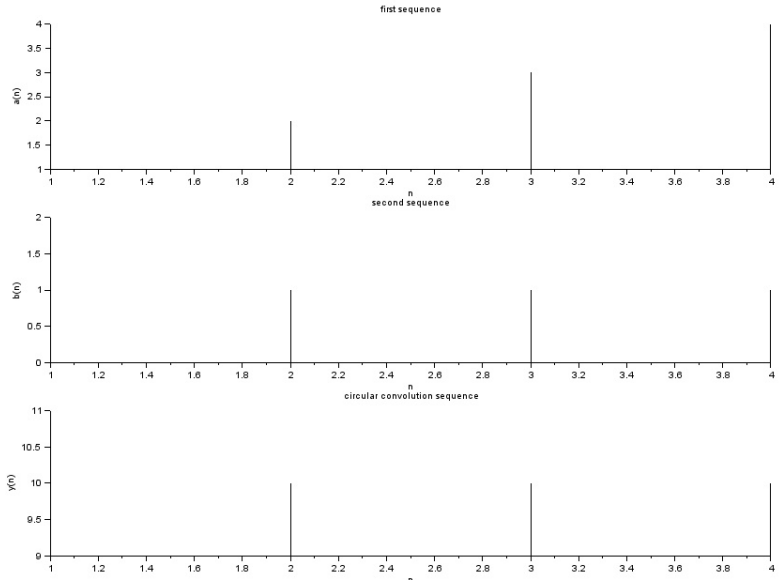


Figure 13.1: Exp13

```
17   a1=[a1,zeros(1,-n3)];
18  else
19   b1=[b1,zeros(1,n3)];
20  end
21  for r = 1:n
22      y(r)=0;
23      for i=1:n
24          j=r-i+1;
25          if (j<=0)
26              j=j+n;
27          end
28          y(r)=y(r)+b1(j)*a1(j);
29      end
30  end
31  disp(y,'circular convloution result')
32
33  subplot(3,1,1);
34  plot2d3('gnn',a1);
35  xlabel('n');
```

```
36 ylabel('a(n)');
37 title('first sequence');
38 subplot(3,1,2);
39 plot2d3('gnn',b1);
40 xlabel('n');
41 ylabel('b(n)');
42 title('second sequence');
43 subplot(3,1,3);
44 plot2d3('gnn',y);
45 xlabel('n');
46 ylabel('y(n)');
47 title('circular convolution sequence');
48
49 //RESULT
50 //Example 1
51 //1st Sequence x:[1,2,3,4]
52 //2nd Sequence h:[1,1,1,1]
53 //
54 // circular convloution result
55 //
56 //    10.    10.    10.    10.
57 //
58 //Example 2
59 //1st Sequence x:[1,2,3,4]
60 //2nd Sequence h:[1,1,1]
61 //
62 // circular convloution result
63 //
64 //    6.    6.    6.    6.
```

Experiment: 14

Linear convolution of two given sequences.

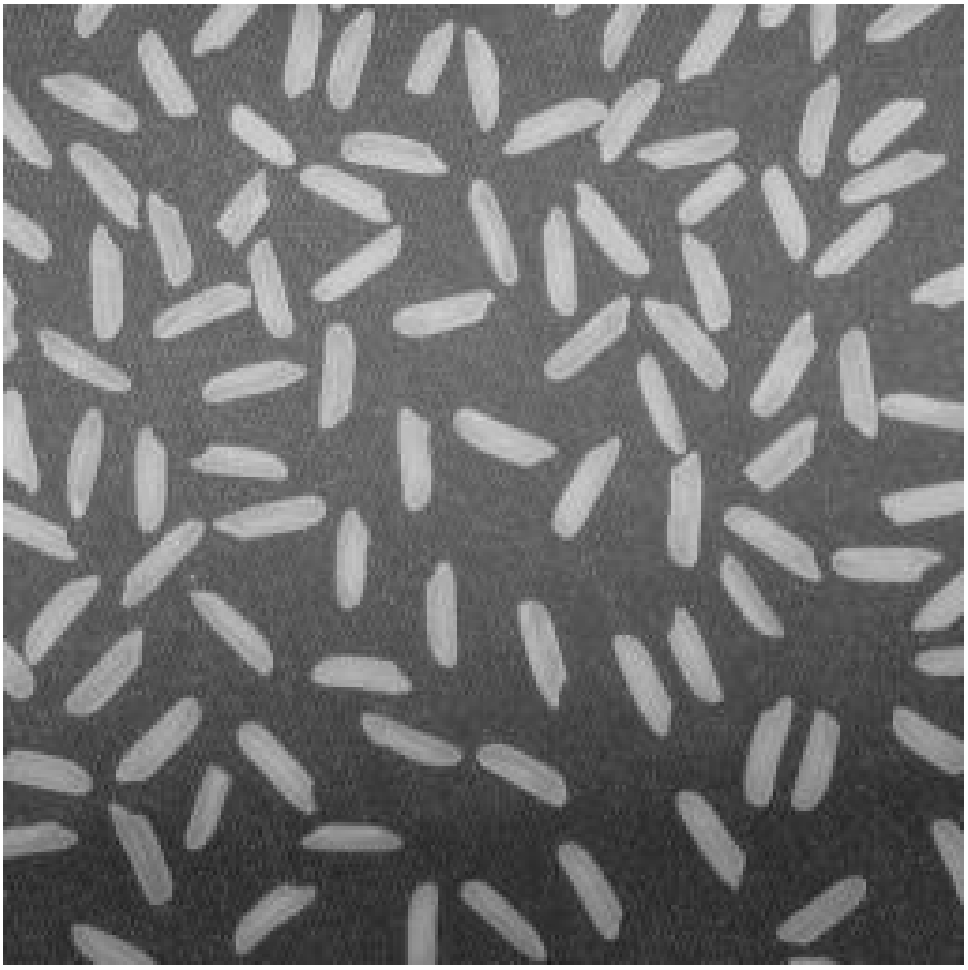
Scilab code Solution 14.1 Exp14

```
1  //Note: Details of scilab software version and OS
       version used:
2  //OS: Windows 7
3  //Scilab version: 5.4.1
4  //IPD Atom version:8.3.1-2
5  //SIVP Atom version:0.5.3.1-2
6  //4.program for linear convolution of to sequence
7  clc;
8  clear all;
9  close;
10 x = input('enter the first sequence');
11 y = input('enter the second sequence');
12 m = length(x);
13 n = length(y);
14 p = m+n-1;
15 for i=1:p
16     q=i;
17     k=0;
18     for j=1:i
```

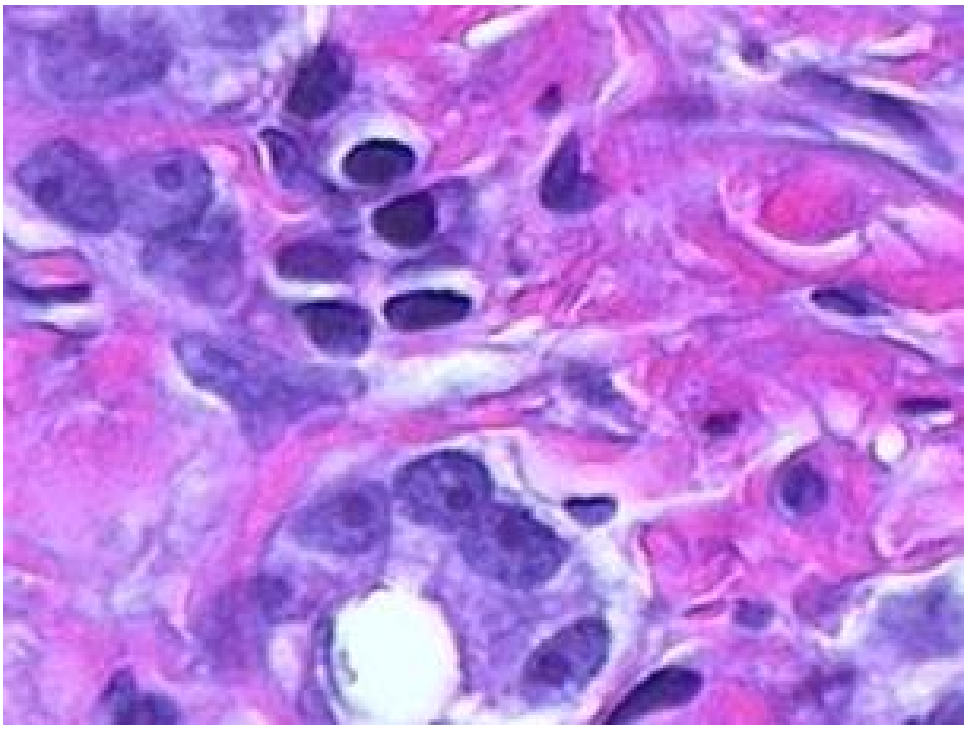
```
19          if q>m
20              q=q-1;
21          elseif j>n
22                  k=k;
23          else k=x(q)*y(j)+k;
24              q=q-1;
25          end
26      end
27      z(i)=k;
28  end
29  disp(z,'convolution of two sequence is:')
30
31  //RESULT
32  //enter the first sequence [1,2,3]
33  //enter the second sequence [1,1,1,1]
34  //
35  // convolution of two sequence is:
36  //
37  //     1.
38  //     3.
39  //     6.
40  //     6.
41  //     5.
42  //     3.
43  //
```

Appendix

Cameraman Image file



Rice Image File



Hestian Colour Image File

Lenna Image File