

Scilab Manual for
Digital Signal Processing
by Mr Rajesh B Raut
Electronics Engineering
Shri Ramdeobaba College of Engg & Mgmt¹

Solutions provided by
Mr. Vipul S Lande
Electronics Engineering
Shri Ramdeobaba College of Engg & Mgmt, Nagpur

July 10, 2021

¹Funded by a grant from the National Mission on Education through ICT, <http://spoken-tutorial.org/NMEICT-Intro>. This Scilab Manual and Scilab codes written in it can be downloaded from the "Migrated Labs" section at the website <http://scilab.in>

Contents

List of Scilab Solutions	4
1 Basic operations on sequences and plotting them in continuous/discrete form.	6
2 Analyzing the effect of Sampling of continuous time signal to avoid aliasing.	13
3 Convolving two sequences in discrete time domain in discrete frequency domain.	15
4 Evaluating circular convolution using DFT-IDFT method.	18
5 Designing of FIR filters for low pass, high pass and band reject response.	21
6 Designing of Butterworth IIR filters and its realisation to filter out noise from a given signal.	27
7 Designing of Chebychev/inverse Chebychev/elliptical filter from a given transfer function.	29
8 Application of sound effect on wave file like Flanging, Echo and Equiliser.	31
9 Polyphase decomposition by decimation method for a given decimation factor.	34
10 Spectral estimation of a sequence using Periodogram method.	36

11 Real-time data acquisition and plotting through external hardware interfaced through serial port.	38
--	----

List of Experiments

Solution 1.0	Basic operations on sequences and plotting them in continuous form	6
Solution 1.1	Basic operations on sequences and plotting them in discrete form	8
Solution 1.2	Basic operations on sequences Delaying and Advancing	10
Solution 2.0	Analyzing the effect of sampling of continuous time signal to avoid aliasing	13
Solution 3.0	Convolving two sequences in discrete time domain	15
Solution 4.0	Evaluating circular convolution using DFT IDFT method	18
Solution 5.1	Design an Low Pass FIR Filter	21
Solution 5.2	To Design an High Pass FIR Filter	22
Solution 5.3	To Design Band Pass FIR Filter	23
Solution 5.4	To Design Band Stop FIR Filter	25
Solution 6.0	Designing of butterworth IIR filters and its realization to filter our noise from a given signal	27
Solution 7.0	Designing of chebychev inverse chebyshev elliptical filter from a given transfer function	29
Solution 8.0	Application of sound effect on wave file like Flanging Echo and Equalizer	31
Solution 9.0	Polyphase decomposition by decimation method for a given decimation factor	34
Solution 10.0	Spectral estimation of a sequence using Periodogram method	36
Solution 11.0	Real time Data acquisition and plotting through external hardware interfaced through serial port .	38

List of Figures

11.1 Real time Data acquisition and plotting through external hardware interfaced through serial port	39
---	----

Experiment: 1

Basic operations on sequences and plotting them in continuous/discrete form.

Scilab code Solution 1.0 Basic operations on sequences and plotting them
in continuous form

```
1 //Experiment -1.1
2 //Basic operations on sequences and plotting them in
   continuous form.
3
4 clear;
5 clc;
6 close;
7
8 //unit step
9 N=input('enter time of unit step sequence: ');//N=20
   (only integer value)
10 n=0:0.5:N-1;
11 NL=length(n)
12 y=ones(1,NL);
13 subplot(2,2,1);
14 plot(n,y);
```

```

15 title('UNIT STEP');
16 xlabel('Time—>'); ylabel('AMPL—>');
17
18 //ramp
19 N=input('enter time of ramp sequence: ');//N=20 (
    only intiger value)
20 n=0:0.5:N-1;
21 subplot(2,2,2);
22 plot(n,n);
23 title('RAMP');
24 xlabel('Time—>'); ylabel('AMPL—>');
25
26 //exponential exp(a*t)
27 N=input('enter time of expo. sequence: ');//N=20 (
    only intiger value)
28 n=0:0.5:N-1;
29 a=input('enter value of a= ');//a=0.03
30 y=exp(a*n);
31 subplot(2,2,3);
32 plot(n,y);
33 title('EXPONENTIAL');
34 xlabel('Time—>'); ylabel('AMPL—>');
35
36 //sine wave
37 f=input('enter frequency of sine sequence: ');//f=5
    (only intiger value)
38 t=0:0.001:1;
39 y=sin(2*%pi*f*t);
40 figure(1);
41 subplot(3,2,1);
42 plot(t,y);
43 title('SINE');
44 xlabel('Time—>'); ylabel('AMPL—>');
45
46 //cosine wave
47 f2=input('enter frequency of cosine sequence: ');//f
    =5 (only intiger value)
48 t=0:0.001:1;

```



```

49 y2=cos(2*%pi*f2*t);
50 subplot(3,2,2);
51 plot(t,y2);
52 title('COSINE');
53 xlabel('Time—>'); ylabel('AMPL—>');
54
55 //sine + cosine wave
56 y3=cos(2*%pi*f2*t)+sin(2*%pi*f*t);
57 subplot(3,2,3);
58 plot(t,y3);
59 title('SINE+COSINE');
60 xlabel('Time—>'); ylabel('AMPL—>');
61
62 //sine x sine wave
63 y4=y.*y2;
64 subplot(3,2,4);
65 plot(t,y4);
66 title('SINE x COSINE');
67 xlabel('Time—>'); ylabel('AMPL—>');

```

Scilab code Solution 1.1 Basic operations on sequences and plotting them in discrete form

```

1 //Experiment -1.2
2 //Basic operations on sequences and plotting them in
   discrete form.
3
4 clear;
5 clc;
6 close;
7
8 //impulse
9 N=-3:1:3;
10 y=[zeros(1,3),ones(1,1),zeros(1,3)];
11 subplot(2,2,1);

```

```

12 plot2d3(N,y);
13 title('IMPULSE');
14 xlabel('N'); ylabel('AMPL-->');
15
16 //unit step
17 N=input('enter length of unit step sequence: '); //N
    =20 (only integer value)
18 n=0:1:N-1;
19 y=ones(1,N);
20 subplot(2,2,2);
21 plot2d3(n,y);
22 title('UNIT STEP');
23 xlabel('N'); ylabel('AMPL-->');
24
25 //ramp
26 N=input('enter length of ramp sequence: '); //N=20 (
    only integer value)
27 n=0:1:N-1;
28 subplot(2,2,3);
29 plot2d3(n,n);
30 title('RAMP');
31 xlabel('N'); ylabel('AMPL-->');
32
33 //exponential exp(a*t)
34 N=input('enter length of expo. sequence: '); //N=20 (
    only integer value)
35 n=0:1:N-1;
36 a=input('enter value of a= '); //a=0.03
37 y=exp(a*n);
38 subplot(2,2,4);
39 plot2d3(n,y);
40 title('EXPONENTIAL');
41 xlabel('N'); ylabel('AMPL-->');
42
43 //sine wave
44 N=input('enter length of sine sequence: '); //N=60 (
    only integer value)
45 n=0:1:N-1;

```

```

46 y=sin(0.3*%pi*n);
47 figure(1);
48 subplot(3,1,1);
49 plot2d3(n,y);
50 title('SINE');
51 xlabel('N'); ylabel('AMPL—>');
52
53 //cosine wave
54 N=input('enter length of cosine sequence: ');//N=60
    (only intiger value)
55 n=0:1:N-1;
56 y=cos(0.2*%pi*n);
57 subplot(3,1,2);
58 plot2d3(n,y);
59 title('COSINE');
60 xlabel('N'); ylabel('AMPL—>');
61
62 //sine + cosine wave
63 N=input('enter length of cosine/sine sequence: ');//
    N=80 (only intiger value)
64 n=0:1:N-1;
65 y=cos(0.2*%pi*n)+sin(0.3*%pi*n);
66 subplot(3,1,3);
67 plot2d3(n,y);
68 title('SINE+COSINE');
69 xlabel('N'); ylabel('AMPL—>');

```

Scilab code Solution 1.2 Basic operations on sequences Delaying and Advancing

```

1 //Experiment -1.3
2 //Basic operations on sequences and plotting them in
    continuous form.
3 clc;
4 clear;

```

```

5 close;
6 x = input('Enter the input sequence:=')//x =[1 2 3
    -2 3]
7 m = length(x);
8 lx = input('Enter the starting index of original
    signal:=')//lx = -2
9 hx = lx+m-1;
10 n = lx:1:hx;
11 subplot(3,1,1)
12 a = gca();
13 a.x_location = "origin";
14 a.y_location = "origin";
15 a.data_bounds = [-10,0;10,10];
16 plot2d3('gnn',n,x);
17 xlabel('n====>')
18 ylabel('Amplitdue——>')
19 title('Original Sequence')
20 //
21 d = input('Enter the delay:=')// d = 1
22 n = lx+d:1:hx+d;
23 subplot(3,1,2)
24 a = gca();
25 a.x_location = "origin";
26 a.y_location = "origin";
27 a.data_bounds = [-10,0;10,10];
28 plot2d3('gnn',n,x)
29 xlabel('n====>')
30 ylabel('Amplitude——>')
31 title('Delayed Sequence')
32 //
33 a = input('Enter the advance:=')// a = 2
34 n = lx-a:1:hx-a;
35 subplot(3,1,3)
36 a = gca();
37 a.x_location = "origin";
38 a.y_location = "origin";
39 a.data_bounds = [-10,0;10,10];
40 plot2d3('gnn',n,x)

```

```
41 xlabel('n $\implies$ >')
42 ylabel('Amplitude $\longrightarrow$ ')
43 title('Advanced Sequence')
```

Experiment: 2

Analyzing the effect of Sampling of continuous time signal to avoid aliasing.

Scilab code Solution 2.0 Analyzing the effect of sampling of continuous time signal to avoid aliasing

```
1 //Experiment - 2
2 //Analyzing the effect of sampling of continuous
   time signal to avoid aliasing.
3
4 clear;
5 clc;
6 close;
7
8
9 // Aliasing
10
11 f = 60; // signal freq. in Hz
12 tmin = -0.05;
13 tmax = 0.05;
14 t = linspace(tmin, tmax, 400);
15 alpha = 1;
```

```

16 x_c = cos(alpha * 2 * %pi * f * t);
17 figure;
18 plot(t, x_c)
19
20 Fs = 200 // for 400, 200, 120, 70, 40 Hz
21
22 T = 1/Fs;
23 nmin = ceil(tmin/T);
24 nmax = floor(tmax/T);
25 n = nmin:nmax;
26 x_s = cos(2*%pi*f*n*T);
27 figure;
28 plot(t, x_c)
29 mtlb_hold("on")
30 plot(n*T, x_s, '. ')
31 mtlb_hold("off")
32
33 figure;
34 plot(n*T, x_s, '-. ');
35
36 //viewing spectrum of signals
37 t=soundsec(0.5);
38 s1=sin(2*%pi*60*t); // signal frequency=60Hz
39 s2=sin(2*%pi*200*t); // sampling frequency=200Hz
40 analyze(s1,10,600,22050)
41 analyze(s2,10,600,22050)
42 title('Spectrum of signals')

```

Experiment: 3

Convolving two sequences in discrete time domain in discrete frequency domain.

Scilab code Solution 3.0 Convolving two sequences in discrete time domain

```
1 //Experiment - 3
2 //Convolving two sequences in discrete time domain.
3
4
5 clc;
6 clear ;
7 close ;
8 x=input('enter i/p x(n): ');// x=[1 2 3 4 5 6]
9 m=length(x);
10 h=input('enter i/p h(n): ');// h=[1 -1 1]
11 n=length(h);
12
13 subplot(2,2,1),
14 p=0:1:m-1;
15
16 a = gca ();
```



```

17 a.x_location = "origin";
18 a.y_location = "origin";
19 plot2d3('gnn',p,x)
20
21 title('i/p sequence x(n) is:');
22 xlabel('--->n');
23
24
25 x=[x,zeros(1,n)];
26
27 subplot(2,2,2),
28 q=0:1:n-1;
29
30 a = gca ();
31 a.x_location = "origin";
32 a.y_location = "origin";
33 plot2d3('gnn',q,h)
34 title('i/p sequence h(n) is:');
35 xlabel('--->n');
36
37
38 h=[h,zeros(1,m)];
39
40 disp('convolution of x(n) & h(n) is y(n):');
41 y=zeros(1,m+n-1);
42 for i=1:m+n-1
43     y(i)=0;
44     for j=1:m+n-1
45         if(j<i+1)
46             y(i)=y(i)+x(j)*h(i-j+1);
47         end
48     end
49 end
50 y
51 subplot(2,2,3)
52 r=0:1:m+n-2;
53
54 a = gca ();

```

```
55 a.x_location = "origin";
56 a.y_location = "origin";
57 plot2d3('gnn',r,y)
58
59
60 title('convolution of x(n) & h(n) is :');
61 xlabel('-->n');
```

Experiment: 4

Evaluating circular convolution using DFT-IDFT method.

Scilab code Solution 4.0 Evaluating circular convolution using DFT IDFT method

```
1 //Experiment - 4
2 //Evaluating circular convolution using DFT-IDFT
  method.
3
4 clear ;
5 clc;
6 close ;
7 x=input('enter 1st seq: ');// x=[1 2 3 4 5 6]
8 h=input('enter 2nd seq: ');// h=[1 -1 1]
9
10
11 dif =abs( max(size(x))- max(size(h)));
12 if(dif>0)
13     h(max(size(h))+dif) = 0;
14 else
15     x(max(size(x))+dif) = 0;
16 end
17
```

```

18
19 X=fft(x,-1);
20 H=fft(h,-1);
21 Y=X.*H;
22 y=ifft(Y);
23
24 subplot(3,2,1);
25 n=0:1:length(x)-1
26 plot2d3(n,x);
27 ylabel('amplitude——>');
28 xlabel('x(n)      n——>');
29
30 subplot(3,2,2);
31 plot2d3(n,abs(X));
32 ylabel('amplitude——>');
33 xlabel('X(k)      k——>');
34
35 subplot(3,2,3);
36 n=0:1:length(h)-1
37 plot2d3(n,h);
38 ylabel('amplitude——>');
39 xlabel('h(n)      n——>');
40
41 subplot(3,2,4);
42 plot2d3(n,abs(H));
43 ylabel('amplitude——>');
44 xlabel('H(k)      k——>');
45
46 subplot(3,2,5);
47 n=0:1:length(y)-1
48 plot2d3(n,y);
49 ylabel('amplitude——>');
50 xlabel('y(n)      n——>');
51
52 subplot(3,2,6);
53 plot2d3(n,abs(Y));
54 ylabel('amplitude——>');
55 xlabel('Y(k)      k——>');

```

56

57 `disp(y, 'the circular conv. resultant signal is ');`

Experiment: 5

Designing of FIR filters for low pass, high pass and band reject response.

Scilab code Solution 5.1 Design an Low Pass FIR Filter

```
1 //Experiment - 5
2 //Designing of FIR filters for low pass, high pass,
   band pass and band reject response.
3
4 // To Design an Low Pass FIR Filter
5 //Filter Length =5, Order = 4
6 //Window = Rectangular Window
7
8 clc;
9 clear;
10 xdel(winsid());
11 fc = input("Enter Analog cutoff freq. in Hz=")//250
12 fs = input("Enter Analog sampling freq. in Hz=")//
   2000
13 M = input("Enter order of filter =")//4
14 w = (2*%pi)*(fc/fs);
15 disp(w, 'Digital cutoff frequency in radians.cycles/
```

```

        samples');
16 wc = w/%pi;
17 disp(wc,'Normalized digital cutoff frequency in
    cycles/samples');
18 [wft,wfm,fr]=wfirm('lp',M+1,[wc/2,0],'re',[0,0]);
19 disp(wft,'Impulse Response of LPF FIR Filter:h[n]=')
    ;
20 //Plotting the Magnitude Response of LPF FIR Filter
21 subplot(2,1,1)
22 plot(2*fr,wfm)
23 xlabel('Normalized Digital Frequency w-->')
24 ylabel('Magnitude |H(w)|=')
25 title('Magnitude Response of FIR LPF')
26 xgrid(1)
27 subplot(2,1,2)
28 plot(fr*fs,wfm)
29 xlabel('Analog Frequency in Hz f -->')
30 ylabel('Magnitude |H(w)|=')
31 title('Magnitude Response of FIR LPF')
32 xgrid(1)

```

Scilab code Solution 5.2 To Design an High Pass FIR Filter

```

1 //Experiment - 5
2 //Designing of FIR filters for low pass, high pass,
    band pass and band reject response.
3
4 // To Design an High Pass FIR Filter
5 //Filter Length =5, Order = 4
6 //Window = Rectangular Window
7
8 clc;
9 clear;
10 xdel(winsid());
11 fc = input("Enter Analog cutoff freq. in Hz=")//250

```

```

12 fs = input("Enter Analog sampling freq. in Hz=")//
    2000
13 M = input("Enter order of filter =")//4
14 w = (2*%pi)*(fc/fs);
15 disp(w, 'Digital cutoff frequency in radians.cycles/
    samples');
16 wc = w/%pi;
17 disp(wc, 'Normalized digital cutoff frequency in
    cycles/samples');
18 [wft,wfm,fr]=wfir('hp',M+1,[wc/2,0], 're',[0,0]);
19 disp(wft, 'Impulse Response of HPF FIR Filter:h[n]=')
    ;
20 //Plotting the Magnitude Response of HPF FIR Filter
21 subplot(2,1,1)
22 plot(2*fr,wfm)
23 xlabel('Normalized Digital Frequency w——>')
24 ylabel('Magnitude |H(w)|=')
25 title('Magnitude Response of FIR HPF')
26 xgrid(1)
27 subplot(2,1,2)
28 plot(fr*fs,wfm)
29 xlabel('Analog Frequency in Hz f ——>')
30 ylabel('Magnitude |H(w)|=')
31 title('Magnitude Response of FIR HPF')
32 xgrid(1)

```

Scilab code Solution 5.3 To Design Band Pass FIR Filter

```

1 //Experiment – 5
2 //Designing of FIR filters for low pass, high pass,
    band pass and band reject response.
3
4 // To Design an Band Pass FIR Filter
5 //Filter Length =5, Order = 4
6 //Window = Rectangular Window

```



```

7
8 clc;
9 clear;
10 xdel(winsid());
11 fc1 = input("Enter Analog lower cutoff freq. in Hz="
    )//250
12 fc2 = input("Enter Analog higher cutoff freq. in Hz="
    )//600
13 fs = input("Enter Analog sampling freq. in Hz=")//
    2000
14 M = input("Enter order of filter =")//4
15 w1 = (2*%pi)*(fc1/fs);
16 w2 = (2*%pi)*(fc2/fs);
17 disp(w1, 'Digital lower cutoff frequency in radians.
    cycles/samples');
18 disp(w2, 'Digital higher cutoff frequency in radians.
    cycles/samples');
19 wc1 = w1/%pi;
20 wc2 = w2/%pi;
21 disp(wc1, 'Normalized digital lower cutoff frequency
    in cycles/samples');
22 disp(wc2, 'Normalized digital higher cutoff frequency
    in cycles/samples');
23 [wft,wfm,fr]=wfir('bp',M+1,[wc1/2,wc2/2], 're',[0,0])
    ;
24 disp(wft, 'Impulse Response of BPF FIR Filter:h[n]=')
    ;
25 //Plotting the Magnitude Response of HPF FIR Filter
26 subplot(2,1,1)
27 plot(2*fr,wfm)
28 xlabel('Normalized Digital Frequency  $w \longrightarrow$ ')
29 ylabel('Magnitude  $|H(w)| =$ ')
30 title('Magnitude Response of FIR BPF')
31 xgrid(1)
32 subplot(2,1,2)
33 plot(fr*fs,wfm)
34 xlabel('Analog Frequency in Hz  $f \longrightarrow$ ')
35 ylabel('Magnitude  $|H(w)| =$ ')

```

```
36 title('Magnitude Response of FIR BPF')
37 xgrid(1)
```

Scilab code Solution 5.4 To Design Band Stop FIR Filter

```
1 //Experiment - 5
2 //Designing of FIR filters for low pass, high pass,
  band pass and band reject response.
3
4 // To Design an Band Stop FIR Filter
5 //Filter Length =5, Order = 4
6 //Window = Rectangular Window
7
8 clc;
9 clear;
10 xdel(winsid());
11 fc1 = input("Enter Analog lower cutoff freq. in Hz="
  )//250
12 fc2 = input("Enter Analog higher cutoff freq. in Hz="
  )//600
13 fs = input("Enter Analog sampling freq. in Hz=")//
  2000
14 M = input("Enter order of filter =")//4
15 w1 = (2*%pi)*(fc1/fs);
16 w2 = (2*%pi)*(fc2/fs);
17 disp(w1,'Digital lower cutoff frequency in radians.
  cycles/samples');
18 disp(w2,'Digital higher cutoff frequency in radians.
  cycles/samples');
19 wc1 = w1/%pi;
20 wc2 = w2/%pi;
21 disp(wc1,'Normalized digital lower cutoff frequency
  in cycles/samples');
22 disp(wc2,'Normalized digital higher cutoff frequency
  in cycles/samples');
```

```

23 [wft,wfm,fr]=wfirm('sb',M+1,[wc1/2,wc2/2],'re',[0,0])
    ;
24 disp(wft,'Impulse Response of BSF FIR Filter:h[n]=')
    ;
25 //Plotting the Magnitude Response of HPF FIR Filter
26 subplot(2,1,1)
27 plot(2*fr,wfm)
28 xlabel('Normalized Digital Frequency  $\omega$ —>')
29 ylabel('Magnitude  $|H(\omega)|$ =')
30 title('Magnitude Response of FIR BSF')
31 xgrid(1)
32 subplot(2,1,2)
33 plot(fr*fs,wfm)
34 xlabel('Analog Frequency in Hz  $f$  —>')
35 ylabel('Magnitude  $|H(\omega)|$ =')
36 title('Magnitude Response of FIR BSF')
37 xgrid(1)

```

Experiment: 6

Designing of Butterworth IIR filters and its realisation to filter out noise from a given signal.

Scilab code Solution 6.0 Designing of butterworth IIR filters and its realization to filter our noise from a given signal

```
1 //Experiment - 6
2 //Designing of butterworth IIR filters and its
   realization to filter our noise from a given
   signal.
3
4
5
6 t = 0:0.001:4;
7 signal = sin(2*%pi*20*t);
8 noise = sin(2*%pi*50*t);
9 compound = signal + noise;
10
11 playsnd(compound);
12
```

```

13 myfilter = iir(15,'lp','butt',[0.025 0],[0 0]); //
    butt, cheb1/2, ellip
14
15 output = flts(compound,myfilter);
16
17 halt('Press Enter');
18
19 playsnd(output);
20
21 // Sound difference in filtered sound
22 xsetech([0,0,1,1/2]);
23 plot2d(t,compound);
24 xtitle('input signal');
25 xsetech([0,1/2,1,1/2]);
26 plot2d(t,output);
27 xtitle('output signal');

```

Experiment: 7

Designing of Chebychev/inverse Chebychev/elliptical filter from a given transfer function.

Scilab code Solution 7.0 Designing of chebychev inverse chebyshev elliptical filter from a given transfer function

```
1 //Experiment - 7
2 //Designing of chebychev/inverse chebyshev/
   elliptical filter from a given transfer function.
3
4 clc;
5 clear all;
6
7 cheblpf = iir(2, 'lp', 'chebl', [0.3 0], [0.1 0]);
8 [hzm, fr]=frmag(cheblpf, 256);
9 figure;
10 plot2d(fr', hzm')
11 title('Chebysheve Lowpass Filter')
12
13
```

```

14
15 [cells,fact,zzeros,zpoles]=eqiir('lp','ellip',[%pi
    *3/8,%pi*3.5/8],0.1,0.01);
16 h=fact*poly(zzeros,'z')/poly(zpoles,'z');
17 [hzm,fr]=frmag(h,256);
18 figure;
19 plot2d(fr',hzm')
20 title('Elliptical Lowpass Filter')
21
22
23
24 [valcoeff, filtamp, filtfreq] = wfir('lp', 20, [.2
    0], 'hm', [0 0]);
25 figure;
26 plot2d(filtfreq,filtamp)
27 title('FIR-Hamming window Lowpass Filter')
28
29
30 hn=eqfir(33,[0 .2;.25 .35;.4 .5],[0 1 0],[1 1 1]);
31 [hm,fr]=frmag(hn,256);
32 figure;
33 plot2d(fr,hm)
34 title('FIR-Multiband Filter response')

```

Experiment: 8

Application of sound effect on wave file like Flanging, Echo and Equaliser.

Scilab code Solution 8.0 Application of sound effect on wave file like Flanging Echo and Equalizer

```
1
2 //Experiment – 8
3 //Application of sound effect on wave file like
   Flanging, Echo and Equalizer.
4
5
6 // The "dsp01.wav" file should be placed in current
   working directory
7 // The code can also be executed with any other
   small .wav file of duration 3–5 seconds.
8 clc;
9 clear;
10 clear all;
11
12 [y,fs] = wavread('dsp01.wav');
13 playsnd(y,fs);
```



```

14
15 halt('Original');
16
17 //Flanging
18 z = 0;
19 n = 1:length(y);
20 z(n) = y(n);
21 m = 11:length(y);
22 x(m) = z(m) + 0.8*z(m-10).*cos(2*%pi*m/fs);
23 playsnd(x,fs);
24 halt('Flange');
25
26
27 //Echo
28 clc;
29 clear all;
30 a = 0.5;
31 [l,fs] = wavread('dsp01.wav');
32 len = length(l);
33 delay = 0.4;
34 D = ceil(fs*delay);
35 m = zeros(max(size(l)));
36 for i = D+1:len
37     m(i) = l(i) + a*l(i-D);
38 end
39
40 playsnd(m,fs);
41
42
43 halt('Echo');
44
45 //Equalizer
46 //For Low frequencies
47 clc;
48 clear all;
49
50 [h,fs] = wavread('dsp01.wav');
51 playsnd(h,fs);

```

```

52 halt('Original');
53
54 j = iir(3, 'bp', 'butt', [.01 .05], [0.03 0.03]);
55
56 k = flts(h(1,:), j);
57 playsnd(k, fs);
58 halt('Low');
59
60 // For Mid frequencies
61 clc;
62 clear all;
63
64 [g, fs] = wavread('dsp01.wav');
65 playsnd(g, fs);
66 halt('Original');
67
68 j = iir(3, 'bp', 'ellip', [.05 .10], [.08 .03]);
69
70 k = flts(g(2,:), j);
71 sound(k, fs);
72
73 halt('Mid');
74
75 //For High frequencies
76 clc;
77 clear all;
78
79 [h, fs] = wavread('dsp01.wav');
80 playsnd(h, fs);
81 halt('Original');
82
83 j = iir(3, 'bp', 'butt', [.15 .25], [0.03 0.03]);
84
85 k = flts(h(1,:), j);
86 playsnd(k, fs);
87
88 halt('High');

```

Experiment: 9

Polyphase decomposition by decimation method for a given decimation factor.

Scilab code Solution 9.0 Polyphase decomposition by decimation method for a given decimation factor

```
1 //Experiment - 9
2 //Polyphase decomposition by decimation method for a
   given decimation factor.
3
4 clear;
5 clc;
6 close;
7 M =input('Enter the filter length(M)= '); //Filter
   Length = 30
8 D =input('Decimation Factor(D) ='); //Decimation
   Factor = 2
9 Ws =input('Enter stopband frequency(Ws)= '); //
   Stopband Edge Frequency = 0.31
10 Wc = %pi/2; //Cutoff Frequency
11 Wp = Wc/(2*%pi); //Passband Edge Frequency
12
```

```

13 hn=eqfir(M,[0 Wp;Ws .5],[1 0],[2 1]);
14 disp(hn,'The LPF Filter Coefficients are:')
15 //Obtaining Polyphase Filter Coefficients from hn
16 p = zeros(D,M/D);
17 for k = 1:D
18     for n = 1:(length(hn)/D)
19         p(k,n) = hn(D*(n-1)+k);
20     end
21 end
22 disp(D,'For the given Decimation factor = ')
23 disp(p,'The Polyphase Decimator are:')

```

Experiment: 10

Spectral estimation of a sequence using Periodogram method.

Scilab code Solution 10.0 Spectral estimation of a sequence using Periodogram method

```
1 //Experiment - 10
2 //Spectral estimation of a sequence using
   Periodogram method.
3
4 clear;
5 clc;
6 close;
7 x=input('Input the signal x(n) = ');// x=[0.1 2.6
   -1.1 3.2 2 -8 1.2 6]
8 N=length(x);
9 X = dft(x,-1);
10 Pxx = (1/N)*(abs(X).^2); //Periodogram Estimate
11 disp(X,'DFT of x(n) is X(k)=')
12 disp(Pxx,'Periodogram of x(n) is Pxx(k/N)=')
13 figure(1)
14 a = gca();
```

```
15 a.data_bounds =[0,0;8,11];
16 plot2d3('gnn',[1:N],Pxx)
17 a.foreground = 5;
18 a.font_color = 5;
19 a.font_style = 5;
20 title('Periodogram Estimate')
21 xlabel('Discrete Frequency Variable K ----->')
22 ylabel('Periodogram Pxx (k /N) ----->')
```

Experiment: 11

Real-time data acquisition and plotting through external hardware interfaced through serial port.

Scilab code Solution 11.0 Real time Data acquisition and plotting through external hardware interfaced through serial port

```
1 //Experiment – 11
2 //Real time Data acquisition and plotting through
   external hardware interfaced through serial port.
3
4 // This code requires serial toolbox installed on
   scilab.
5 // The code will execute only when Data acquisition
   hardware is connected on serial port(COM) of
   computer.
6
7 clear;
8 clc;
```

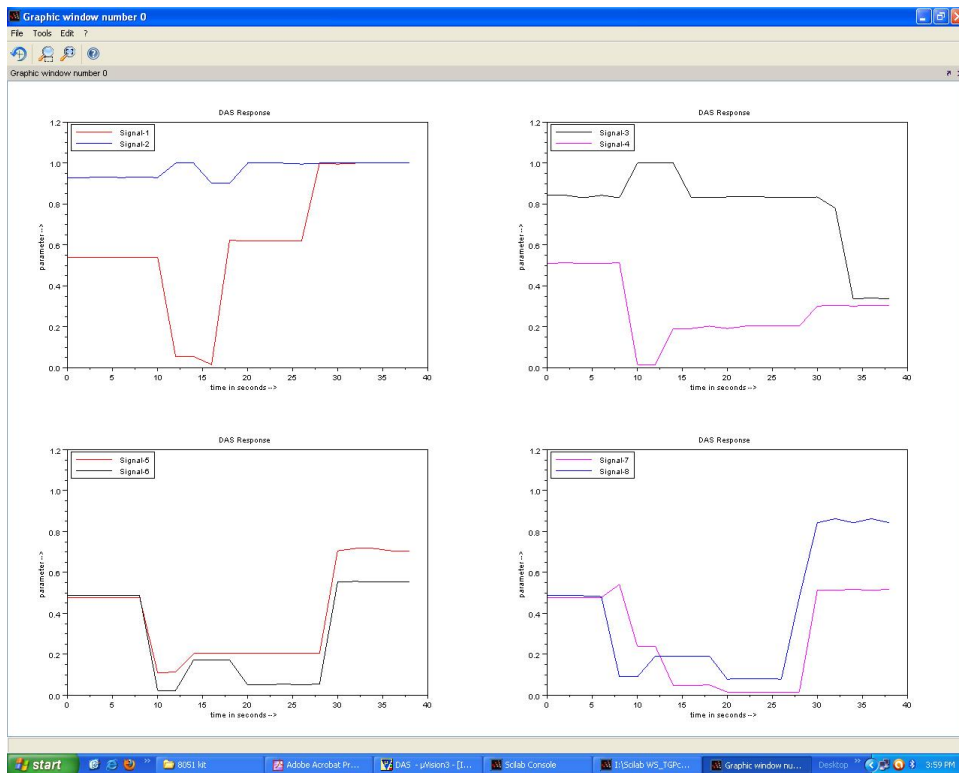


Figure 11.1: Real time Data acquisition and plotting through external hardware interfaced through serial port


```

9  close;
10
11 //s = openserial(1,"9600,n,8,1","binary","dtrdsr");
12 s = openserial(1,"9600,n,8,1","binary","none");
13 ns=input('Samples to be plotted: ');// 50
14 ts=input('Sampling time(sec): ');//2 sec
15 xpause(20000);
16
17 signal1=zeros(1,ns);
18 signal2=zeros(1,ns);
19 signal3=zeros(1,ns);
20 signal4=zeros(1,ns);
21 signal5=zeros(1,ns);
22 signal6=zeros(1,ns);
23 signal7=zeros(1,ns);
24 signal8=zeros(1,ns);
25
26 t=0:1*ts:ts*ns-1;
27 j=0;
28 clf()
29
30     result = writeserial(s,"OK");//
31     buf = readserial(s, [17]);
32     xpause(200000);
33
34 for i=1:1:ns,
35     result = writeserial(s,"OK");//
36     // xpause(6000);//66941usec after tx will begin
37     buf = readserial(s, [17]);
38     rbuf = str2code(buf);
39
40     signal1(i)=abs((1/255)*(rbuf(2)-100));
41     signal2(i)=abs((1/255)*(rbuf(4)-100));
42     subplot(2,2,1)
43     plot(t(i-j:i),signal1(i-j:i),'-r',t(i-j:i),
44          signal2(i-j:i),'-b')
45     a=gca();
46     a.data_bounds=[0 -0.1;ts*ns-1 1.2];

```

```

46     h = legend('Signal-1', 'Signal-2', 2);
47     xlabel('time in seconds -->')
48     ylabel('parameter -->')
49     title('DAS Response')
50     set(gca(), "auto_clear", "off")
51
52     signal3(i)=abs((1/255)*(rbuf(6)-100));
53     signal4(i)=abs((1/255)*(rbuf(8)-100));
54     subplot(2,2,2)
55     plot(t(i-j:i), signal3(i-j:i), '-k', t(i-j:i),
56         signal4(i-j:i), '-m')
57     a=gca();
58     a.data_bounds=[0 -0.1;ts*ns-1 1.2];
59     h = legend('Signal-3', 'Signal-4', 2);
60     xlabel('time in seconds -->')
61     ylabel('parameter -->')
62     title('DAS Response')
63     set(gca(), "auto_clear", "off")
64
65     signal5(i)=abs((1/255)*(rbuf(10)-100));
66     signal6(i)=abs((1/255)*(rbuf(12)-100));
67     subplot(2,2,3)
68     plot(t(i-j:i), signal5(i-j:i), '-r', t(i-j:i),
69         signal6(i-j:i), '-k')
70     a=gca();
71     a.data_bounds=[0 -0.1;ts*ns-1 1.2];
72     h = legend('Signal-5', 'Signal-6', 2);
73     xlabel('time in seconds -->')
74     ylabel('parameter -->')
75     title('DAS Response')
76     set(gca(), "auto_clear", "off")
77
78     signal7(i)=abs((1/255)*(rbuf(14)-100));
79     signal8(i)=abs((1/255)*(rbuf(16)-100));
80     subplot(2,2,4)
81     plot(t(i-j:i), signal7(i-j:i), '-m', t(i-j:i),
82         signal8(i-j:i), '-b')
83     a=gca();

```

```

81     a.data_bounds=[0 -0.1;ts*ns-1 1.2];
82     h = legend('Signal-7','Signal-8',2);
83     xlabel('time in seconds -->')
84     ylabel('parameter -->')
85     title('DAS Response')
86     set(gca(),"auto_clear","off")
87     sleep(ts*1000);//wait for ts sec.
88     j=j+1;
89     clear buf
90 end
91 closeserial(s);
92 clear all
93 clc
94 disp("Required Data Plotted")

```
