Scilab Manual for Antenna Wave Propagation by Mrs Nandini Ammanagi Electronics Engineering VESIT[1]

Solutions provided by
Mrs. Nandini Ammanagi
Electronics Engineering
V.E.S.I.T.

April 19, 2024

[1]Funded 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 3

1 SCILAB CODE FOR PATTERN MULTIPLICATION OF TWO INFINITESIMAL DIPOLES (given d=/2,=- /2) 5

2 SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT UNIFORM AMPLITUD EENDFIRE ARRAY 10

3 SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT UNIFORM AMPLITUDE BROADSIDE ARRAY 13

4 SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT DOLPH TSCHEBYSCHEFF ARRAY 16

5 SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT BIONOMIAL ARRAY 19

List of Experiments

Solution 1.01 patternmult 5
Solution 1.02 patternmult 7
Solution 2.01 endfirearray 10
Solution 3.01 broadsidearray 13
Solution 4.01 dolpharray 16
Solution 5.01 binomialarray 19

List of Figures

1.1 patternmult 7
1.2 patternmult 9

2.1 endfirearray 12

3.1 broadsidearray 15

4.1 dolpharray 18

5.1 binomialarray 20

Experiment: 1

SCILAB CODE FOR PATTERN MULTIPLICATION OF TWO INFINITESIMAL DIPOLES (given d=/2,=- /2)

Scilab code Solution 1.01 patternmult

```
1 //OS version = ubuntu 16.04 LTS
2 //Scilab version 5.5.2
3
4 clear;
5 clc;
6
7 lambda=1;                                    // defining
8
9 d=lambda/4;                                  //distance
     between the dipoles=   /4
10
```

```
11 k=(2*%pi)/lambda;                    //defining constant
       k=2   /
12
13 beta= - (%pi/2);                                  //
       defining beta as phase difference between the
       dipoles
14
15 theta=0:0.01:2*%pi;                          //theta
       varies from 0    to 360
16
17 subplot(2,2,1);
18
19 polarplot(theta,abs(cos(theta)));                  //
       to plot single element pattern
20
21 title('ELEMENT PATTERN');
22
23 AF=cos(0.5*(d*k*cos(theta)+beta))                  //
       Expression for Array factor
24
25 subplot(2,2,2);
26
27 polarplot(theta,abs(AF));
       //to plot array factor pattern
28
29 title('ARRAY FACTOR PATTERN');
30
31 subplot(2,2,3.5);
32
33 polarplot(theta,abs(cos(theta)).*abs(AF));       //to
       plot total field of the array
34
35 title('TOTAL ARRAY PATTERN');
```

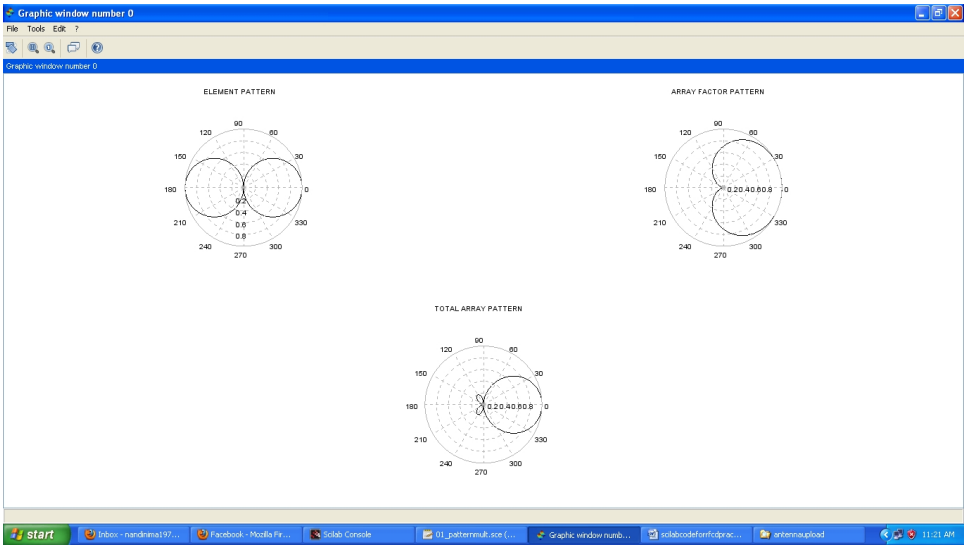

Figure 1.1: patternmult

Scilab code Solution 1.02 patternmult

```
1 //OS version = ubuntu 16.04 LTS
2 //Scilab version 5.5.2
3
4 clear;
5 clc;
6
7 lambda=1;                                  // defining

8
9 d=lambda/4;                                //distance
     between the dipoles=   /4
10
11 k=(2*%pi)/lambda;                        //defining constant
      k=2   /
12
13 beta= 0;                                  //defining beta
     as phase difference between the dipoles
14
```

```
15 theta=0:0.01:2*%pi;                          //theta
      varies from 0    to 360
16
17 subplot(2,2,1);
18
19 polarplot(theta,abs(cos(theta)));                //
      to plot single element pattern
20
21 title('ELEMENT PATTERN');
22
23 AF=cos(0.5*(d*k*cos(theta)+beta))              //
      Expression for Array factor
24
25 subplot(2,2,2);
26
27 polarplot(theta,abs(AF));
      //to plot array factor pattern
28
29 title('ARRAY FACTOR PATTERN');
30
31 subplot(2,2,3.5);
32
33 polarplot(theta,abs(cos(theta)).*abs(AF));      //to
       plot total field of the array
34
35 title('TOTAL ARRAY PATTERN');
```

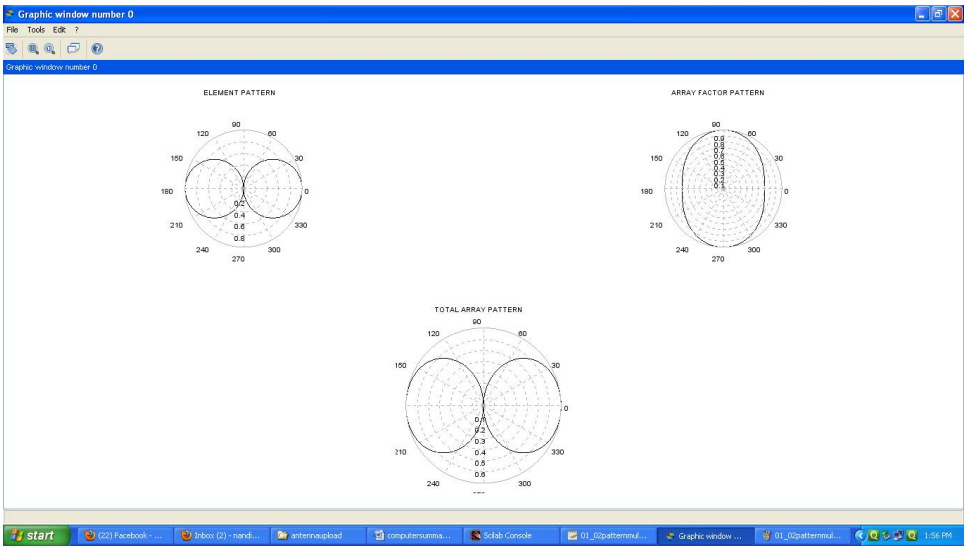

Figure 1.2: patternmult

Experiment: 2

SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT UNIFORM AMPLITUD EENDFIRE ARRAY

Scilab code Solution 2.01 endfirearray

```
1  //OS version = ubuntu 16.04 LTS
2  //Scilab version 5.5.2
3
4  clear;
5  clc;
6
7  n=10;                                    //Number of
       Elements
8
9  lambda=1;                                // defining

10
11 d=lambda/4;                              //distance
```

```
    between the dipoles=   /4
12
13 k=(2*%pi)/lambda;                    //defining constant
    k=2   /
14
15 theta=0.0001:0.01:2*%pi;                              //
    theta varies from 0   to 360
16
17 beta1=-(k*d);                                  // 1 =-
    kd
18
19 psi=k*d.*cos(theta)+beta1;                            //
    Progressive Phase
20
21 AF=sin(n.*psi/2)./(n*sin(psi/2));                     //
    Expression for Array Factor
22
23 polarplot(theta,AF);                          //plot for
     =-kd
24
25 beta2=k*d;                                     //  2 =
    kd
26
27 psi=k*d.*cos(theta)+beta2;                            //
    Progressive Phase
28
29 AF=sin(n.*psi/2)./(n*sin(psi/2));                     //
    Expression for Array Factor
30
31 xset('line style',3)
32
33 polarplot(theta,AF);                                 //plot
    for   =kd
34
35 title("POLAR PLOT FOR ARRAY FACTOR PATTERN FOR N
    ELEMENT UNIFORM AMPLITUDE END FIRE ARRAY CASE: N
    =10, d=     /4,   =+-(Kd)")
36
```

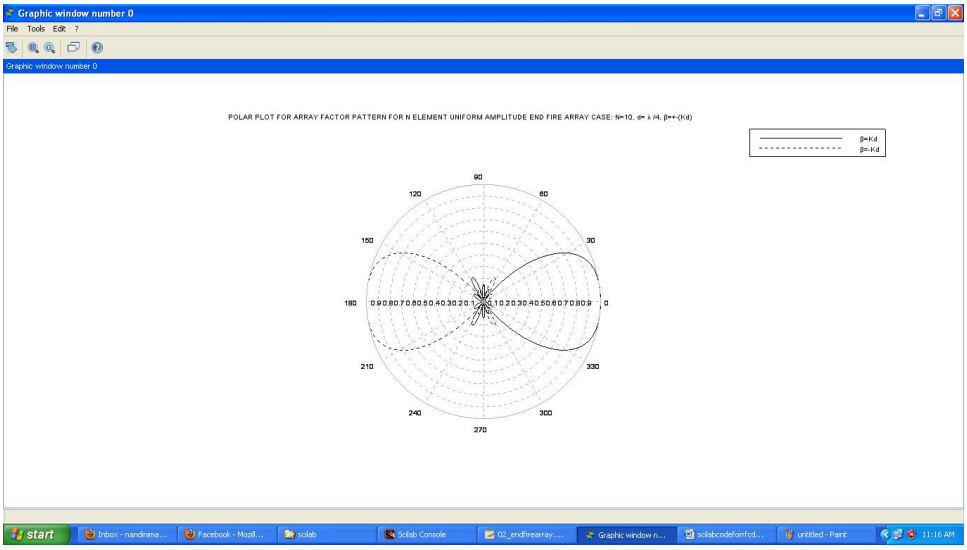

Figure 2.1: endfirearray

```
37 h1=legend('  =Kd','  =-Kd')
```

Experiment: 3

SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT UNIFORM AMPLITUDE BROADSIDE ARRAY

Scilab code Solution 3.01 broadsidearray

```
1 //OS version = ubuntu 16.04 LTS
2 //Scilab version 5.5.2
3
4 clear;
5 clc;
6
7 n=10;                                    //Number of
      Elements
8
9 lambda=1;                                // defining

10
11 d1=lambda/4;                            //distance
```

```
    between the dipoles d1=   /4
12
13 k=(2*%pi)/lambda;                  //defining constant
    k=2   /
14
15 theta=0.0001:0.01:2*%pi;                              //
    theta varies from 0   to 360
16
17 beta=0;                                        //  =0
18
19 psi=k*d1*cos(theta)+beta;                              //
    Progressive Phase
20
21 AF=sin(n.*psi/2)./(n*sin(psi/2));                      //
    Expression for Array Factor
22
23 polarplot(theta,AF);                          //plot for
    d1=   /4
24
25 d2=lambda;                                     //distance
    between the dipoles d2=
26
27 psi=k*d2*cos(theta)+beta;                              //
    Progressive Phase
28
29 AF=sin(n.*psi/2)./(n*sin(psi/2));                      //
    Expression for Array Factor
30
31 xset('line style',3)
32
33 polarplot(theta,AF);                                //plot
    for d2=
34
35 title("POLAR PLOT FOR ARRAY FACTOR PATTERN FOR N
    ELEMENT UNIFORM AMPLITUDE BROADSIDE ARRAY CASE: N
    =10, d=     /4 and d=    ,    =0")
36
37 h1=legend(' d=     /4',' d=     ')
```

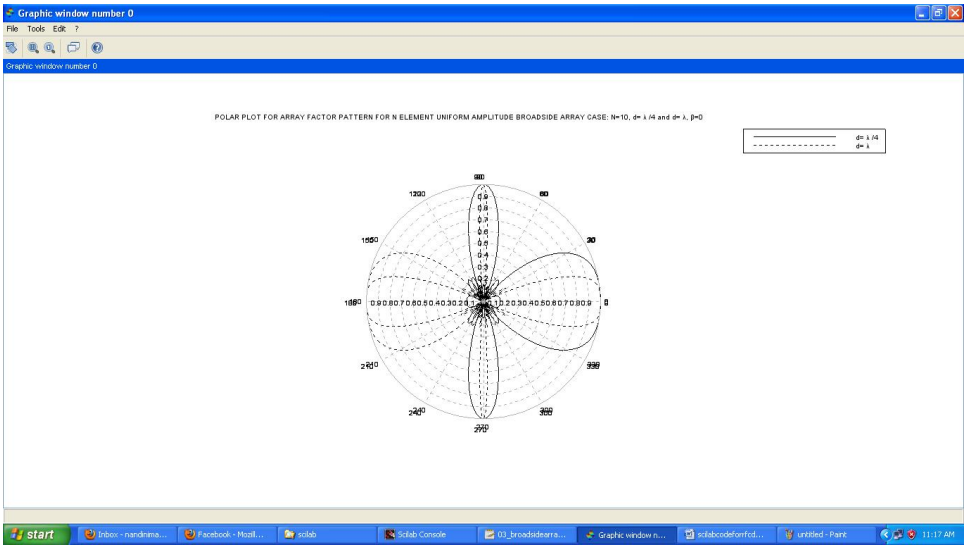

Figure 3.1: broadsidearray

Experiment: 4

SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT DOLPH TSCHEBYSCHEFF ARRAY

Scilab code Solution 4.01 dolpharray

```
1 //OS version = ubuntu 16.04 LTS
2 //Scilab version 5.5.2
3
4 clear;
5 clc;
6
7 lambda=1;                                  // defining

8
9 d1=lambda/4;                               //distance
     between the dipoles d1=   /4
10
11 theta=0:0.01:2*%pi;                      // Theta varies from 0
     to 360
12
```

```
13 u1=(%pi*d1/lambda).*cos(theta);                    //u1 =
       d1 /  *cos
14
15 AF1=2.798.*cos(u1)+2.496.*cos(3.*u1)+1.974.*cos(5.*
       u1)+1.357.*cos(7.*u1)+cos(9.*u1);
16                  //expression for array factor
                      pattern for N=10, 2M=10
17
18 p=get("hdl");                                     //get handle
       on current entity (here the polyline entity)
19
20 p.line_style=1;
21
22 polarplot(theta,AF1)          //plot polar plot
23
24 d2=lambda/2;                                      //distance
       between the dipoles d2=   /2
25
26 u2=(%pi*d2/lambda).*cos(theta);                    //u2 =
       d2 /  *cos
27
28 AF2=2.798.*cos(u2)+2.496.*cos(3.*u2)+1.974.*cos(5.*
       u2)+1.357.*cos(7.*u2)+cos(9.*u2);
29                  //expression for array factor
                      pattern for N=10, 2M=10
30
31 p.line_style=8;
32
33 title('POLAR PLOT OF ARRAY FACTOR PATTERN OF N
       ELEMENT DOLPH TSCHEBYSCHEFF ARRAY CASE: N=10 and
       d =    /4  ,    /2');
34
35
36 polarplot(theta,AF2)          //plot polar plot
37
38 hl=legend('d =   /4','d =   /2');
```

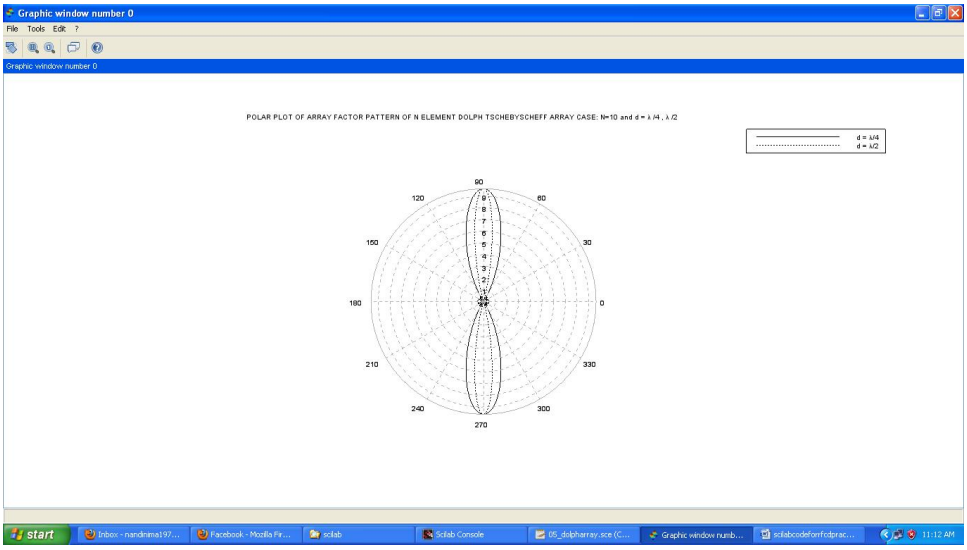

Figure 4.1: dolpharray

Experiment: 5

SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT BIONOMIAL ARRAY

Scilab code Solution 5.01 binomialarray

```
1 //OS version = ubuntu 16.04 LTS
2 //Scilab version 5.5.2
3
4 clear;
5 clc;
6
7 theta=0:0.001:2*%pi;                          //theta
      varies from 0    to 360
8
9 lambda=1;                                  // defining

10
11 d1=lambda/4;                              //distance
```

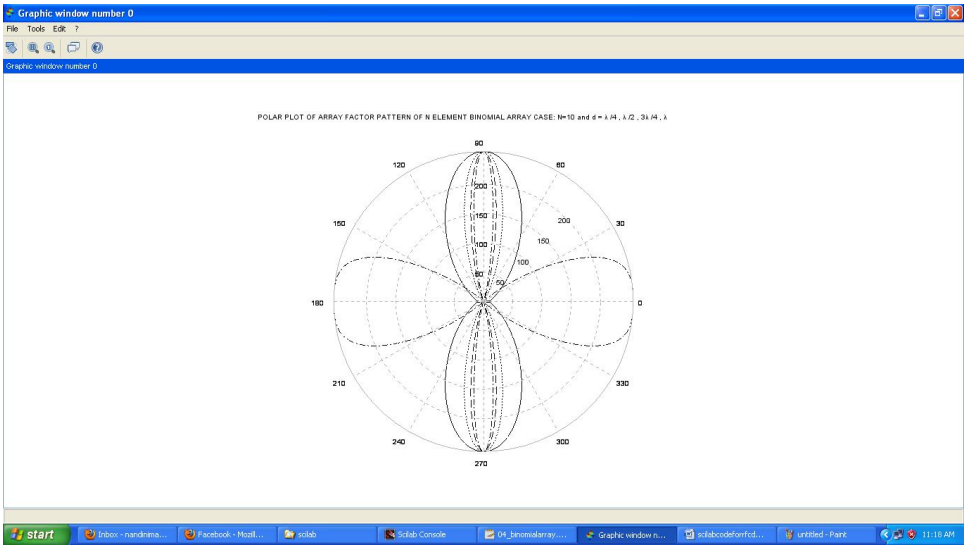

Figure 5.1: binomialarray

```
    between the dipoles d1=   /4
12
13  u1=(%pi*d1/lambda).*cos(theta);                //u1 =
     d1 /  *cos
14
15  AF1=126.*cos(u1)+84.*cos(3*u1)+36.*cos(5*u1)+9.*cos
    (7*u1)+cos(9*u1); //expression for

    //array factor N=10, N=2M, AF= an  cos(2n-1)u
         for n=1 to M
16  p=get("hdl");                        //get handle on
    current entity (here the polyline entity)
17
18  p.line_style=1;
19
20  polarplot(theta,AF1)          //polar plot of AF
21
22  d2=lambda/2                  //distance between the
    dipoles d2=   /2
23
```

```
24 u2=(%pi*d2/lambda).*cos(theta);                    //u2 =
       d2 /  *cos
25
26 AF2=126.*cos(u2)+84.*cos(3*u2)+36.*cos(5*u2)+9.*cos
       (7*u2)+cos(9*u2);       //expression for
27                                                    //
                                                        array

                                                        factor


28
29 p.line_style=8;
30
31 polarplot(theta,AF2)                 //polar plot of AF
32
33
34 d3=3*lambda/4              //distance between the
       dipoles d3= 3  /4
35
36 u3=(%pi*d3/lambda).*cos(theta);                     //
       u3 =  d3 /  *cos
37
38 AF3=126.*cos(u3)+84.*cos(3*u3)+36.*cos(5*u3)+9.*cos
       (7*u3)+cos(9*u3);     //expression for
39                                                  //
                                                      array

                                                      factor


40
41 p.line_style=2;
42
43 polarplot(theta,AF3)

       //polar plot of AF
44
```

```
45 d4=lambda                                    //distance
      between the dipoles d4=
46
47 u4=(%pi*d4/lambda).*cos(theta);                    //u4
       =  d4 /  *cos
48
49 AF4=126.*cos(u4)+84.*cos(3*u4)+36.*cos(5*u4)+9.*cos
      (7*u4)+cos(9*u4);          //expression for
50                                                  //array
                                                       factor
51
52 p.line_style=6;
53
54 polarplot(theta,AF4)                        //polar plot of
      AF
55
56 title('POLAR PLOT OF ARRAY FACTOR PATTERN OF N
      ELEMENT BINOMIAL ARRAY CASE: N=10 and d =    /4 ,
          /2 , 3   /4 ,   ');
57
58 hl=legend('d =    /4';'d =    /2';'d = 3   /4'; 'd =
         ');
```