

Scilab Manual for
Antenna Wave Propagation
by Mrs Nandini Ammanagi
Electronics Engineering
VESIT¹

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

August 14, 2024

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	3
1 SCILAB CODE FOR PATTERN MULTIPLICATION OF TWO INFINITESIMAL DIPOLES (given $d=\lambda/2, \lambda=\lambda/2$)	5
2 SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT UNIFORM AMPLITUDE ENDFIRE 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 TSCHEBYSCHIEFF ARRAY	16
5 SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT BINOMIAL 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 $d = \lambda/2, = -\lambda/2$)

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= lambda/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');

```

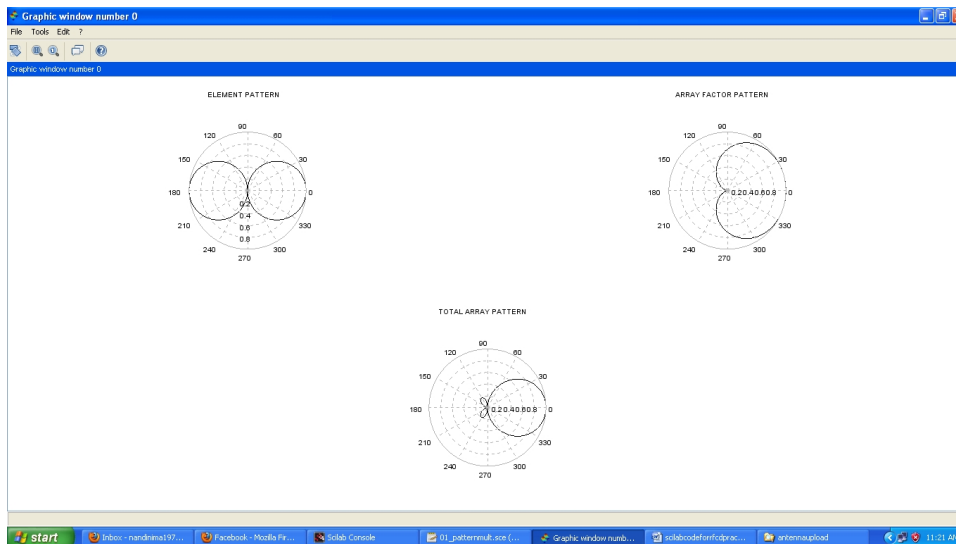


Figure 1.1: patternmult

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');

```

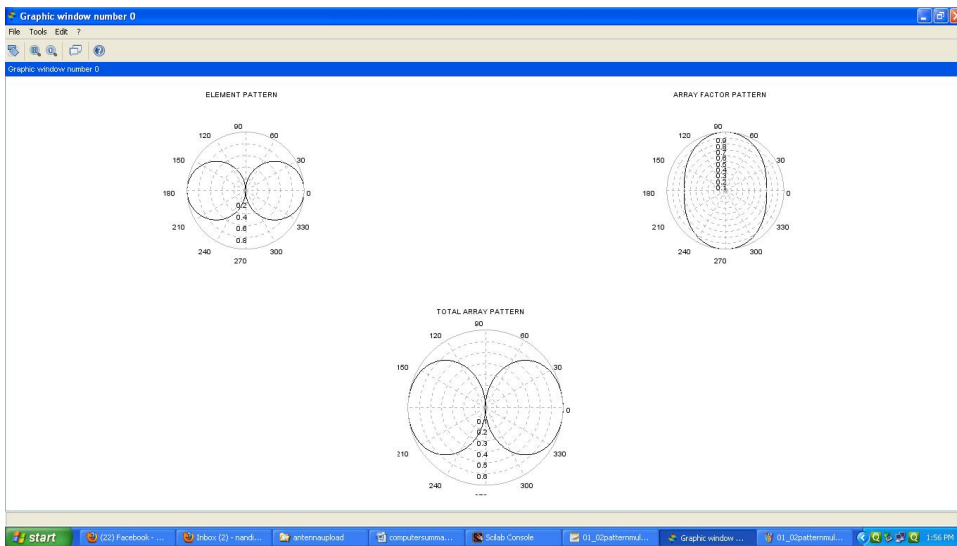


Figure 1.2: patternmult

Experiment: 2

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

```

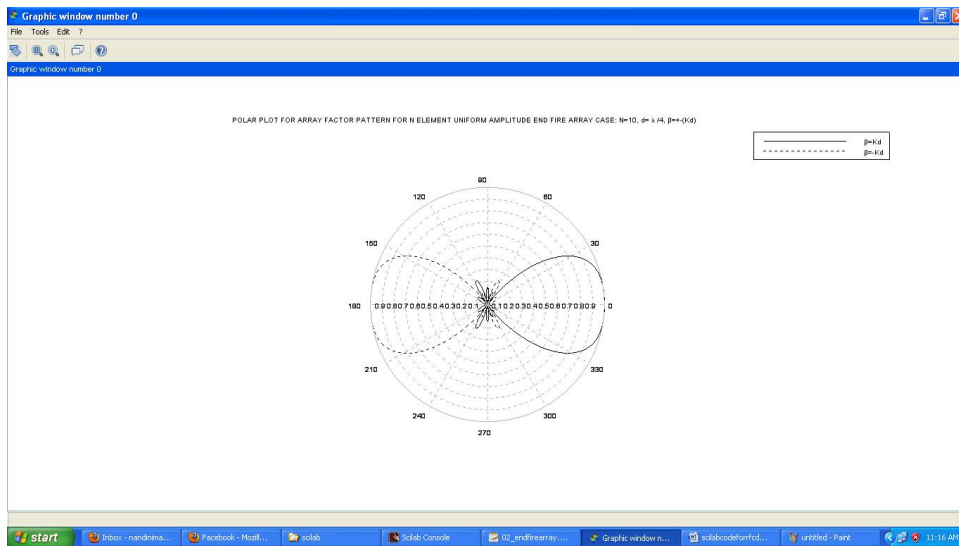


Figure 2.1: endfirearray

```
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= ')

```

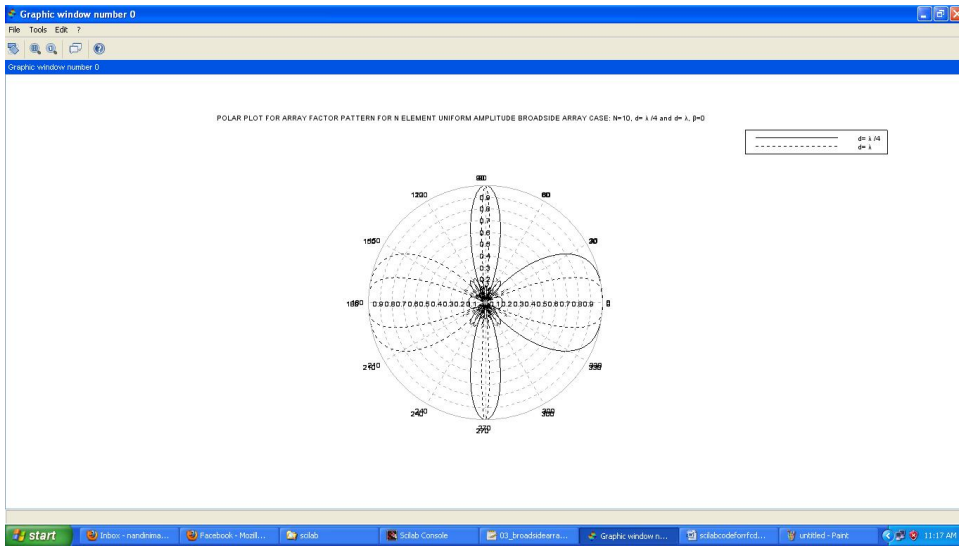


Figure 3.1: broadsidearray

Experiment: 4

SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT DOLPH TSCHEBYSCHIEFF 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 TSCHEBYSCHIEFF 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');

```

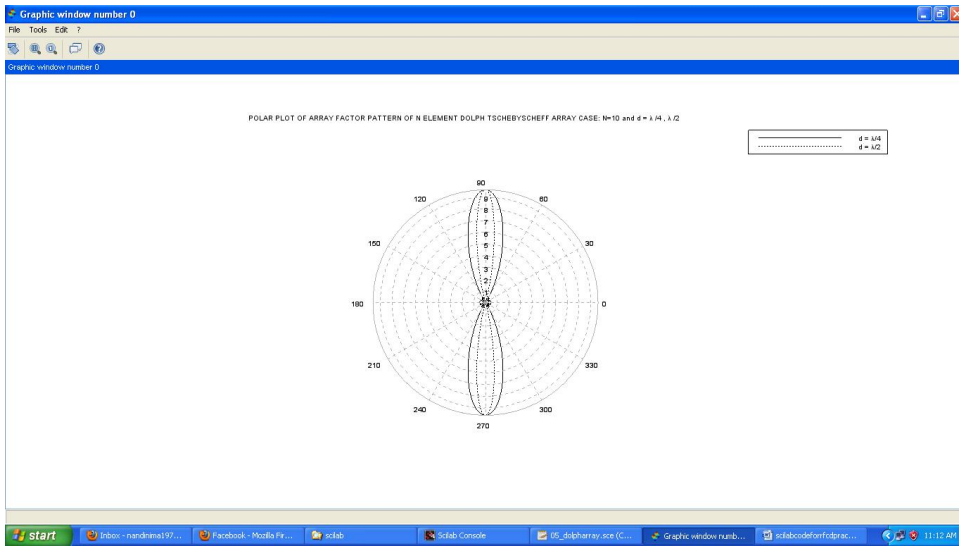


Figure 4.1: dolpharray

Experiment: 5

SCILAB CODE FOR ARRAY FACTOR PATTERN OF N ELEMENT BINOMIAL 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
```

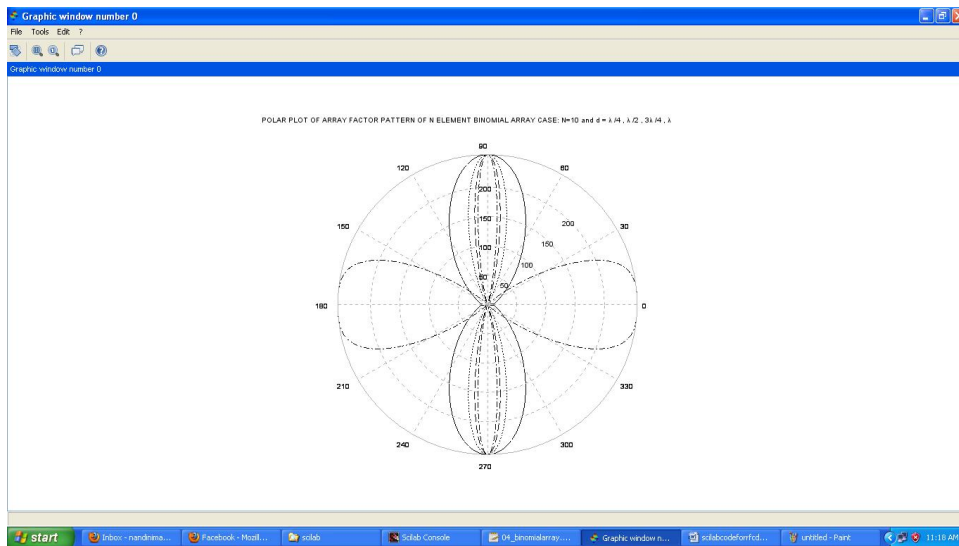


Figure 5.1: binomialarray

```

12     between the dipoles d1= lambda/4
13     u1=(%pi*d1/lambda).*cos(theta);           //u1 =
        d1 / lambda * 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= lambda/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 =
    ');

```
