11-12.5 Initial Log-Periodic Dipole Design

The program **LPDPAW** computes log periodic dipole designs using concepts from the previous sections. It runs in a DOS window from a folder and will generate an output file LPDPAW.OUT. Reference 22, by Smith, is used for these calculations.

Below is an example.

```
C:\WINDOWS\system32\cmd.exe - lpdpaw
C:\Log Periodic Dipole>lpdpaw
File input? n

Log Periodic Dipole Antenna
Enter Lower, Upper Frequency (MHz) 100,1000
Enter units: 1 inches, 2 ft, 3 cm, 4 m 3
Enter Scaling Factor (.LT. 1) .85
Enter K (1) Give Spacing Constant, (2) Half Apex Angle 1
Enter Spacing Constant .1
Enter Lower and Upper Truncation Constants? n
Scaling Factor =  0.850
Spacing Constant = 0.1000
Half Apex Angle =   20.56
Bandwidth =   10.00
Number of Elements Required =  19.2

Enter Number of Elements 19
Upper Frequency (MHz) =   966.0
Lower Truncation Constant K1 =  0.569
Upper Truncation Constant K2 =  0.295
Number of Elements in Active Region =    5.0

     Element                Apex
NO   Length    Spacing   Distance

 1   170.537    34.107   227.383
 2   144.956    28.991   193.275
 3   123.213    24.643   164.284
 4   104.731    20.946   139.641
 5    89.021    17.804   118.695
 6    75.668    15.134   100.891
 7    64.318    12.864    85.757
 8    54.670    10.934    72.894
 9    46.470     9.294    61.960
10    39.499     7.900    52.666
11    33.574     6.715    44.766
12    28.538     5.708    38.051
13    24.257     4.851    32.343
14    20.619     4.124    27.492
15    17.526     3.505    23.368
16    14.897     2.979    19.863
17    12.663     2.533    16.883
18    10.763     2.153    14.351
19     9.149               12.198

Total Length =   215.184
```

The program generates a table of dimensions from an input of lower and upper frequencies, log periodic scaling factor τ, and selected input of spacing constant σ. We have the option of specifying truncation constant, the ones computed from Eq. (11-28) and Eq. (11-29), the Smith approximations, have been selected. Equation (11-30) determined that 19.2 elements are required, but reducing this to 19 will have little effect. We obtain the table shown with length in cm. as initially specified.

It is desirable to limit the axial length to 2 m. (200 cm) which can be obtained if the scaling constant and spacing constant are adjusted for a given number of elements. We select Task 6.

```
Total Length =   215.184

Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length 6

Enter Length 200
Enter Number of Elements, Start,Stop,Step 16,20,1

      Scaling   Spacing     Apex
NO.   Factor    Constant    Angle     K1       K2

 16    0.8056    0.11402    23.09    0.592    0.231
 17    0.8231    0.10596    22.66    0.583    0.259
 18    0.8371    0.09925    22.31    0.576    0.280
 19    0.8487    0.09348    22.03    0.570    0.297
 20    0.8587    0.08843    21.78    0.564    0.312

Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length _
```

We run task 2, New Scaling Constant, to enter a design from the table above to generate a design with 18 elements with total axial length 200 cm.

```
C:\WINDOWS\system32\cmd.exe - lpdpaw
Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length 2
Enter Scaling Factor (.LT. 1) .8371
Enter K (1) Give Spacing Constant, (2) Half Apex Angle 1
Enter Spacing Constant .09925
Enter Lower and Upper Truncation Constants? n
Scaling Factor =  0.837
Spacing Constant = 0.0993
Half Apex Angle =   22.31
Bandwidth =   10.00
Number of Elements Required =  18.0

Enter Number of Elements 18
Upper Frequency (MHz) =   999.6
Lower Truncation Constant K1 =  0.576
Upper Truncation Constant K2 =  0.280
Number of Elements in Active Region =    5.1

     Element                   Apex
NO   Length    Spacing   Distance

 1   172.544    34.250   210.252
 2   144.437    28.671   176.002
 3   120.908    24.000   147.331
 4   101.212    20.091   123.331
 5    84.725    16.818   103.240
 6    70.923    14.078    86.422
 7    59.370    11.785    72.344
 8    49.698     9.865    60.559
 9    41.602     8.258    50.694
10    34.825     6.913    42.436
11    29.152     5.787    35.523
12    24.403     4.844    29.737
13    20.428     4.055    24.892
14    17.100     3.394    20.837
15    14.315     2.841    17.443
16    11.983     2.379    14.602
17    10.031     1.991    12.223
18     8.397              10.232

Total Length =   200.020
```

We use this design to compute the phase centers in the *E*- and *H*-planes using the results of Table 11-18.

```
C:\WINDOWS\system32\cmd.exe - lpdpaw
Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length 5

Phase Center Distance from Shortest Element
Enter Frequency (MHz)  Start,Stop,Step 100,1000,25

Frequency   E Plane   H Plane

   100.00   158.135   162.474
   125.00   124.462   127.933
   150.00   102.013   104.905
   175.00    85.978    88.457
   200.00    73.952    76.121
   225.00    64.598    66.526
   250.00    57.115    58.850
   275.00    50.992    52.570
   300.00    45.890    47.337
   325.00    41.573    42.908
   350.00    37.873    39.113
   375.00    34.666    35.823
   400.00    31.860    32.945
   425.00    29.384    30.405
   450.00    27.183    28.147
   475.00    25.214    26.127
   500.00    23.441    24.309
   525.00    21.838    22.664
   550.00    20.380    21.169
   575.00    19.049    19.804
   600.00    17.829    18.552
   625.00    16.707    17.401
   650.00    15.671    16.338
   675.00    14.711    15.354
   700.00    13.821    14.440
   725.00    12.991    13.590
   750.00    12.217    12.796
   775.00    11.493    12.053
   800.00    10.814    11.356
   825.00    10.176    10.702
   850.00     9.576    10.086
   875.00     9.010     9.506
   900.00     8.476     8.958
   925.00     7.970     8.439
   950.00     7.491     7.948
   975.00     7.037     7.482
  1000.00     6.605     7.039
```

The phase center is located inside the active region of the antenna which we want to know when using this as a feed for a reflector.

```
Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length 3

Enter Element Radius, Feed Impedance .25,200

      Antenna
NO   Impedance

 1    139.05
 2    137.22
 3    135.27
 4    133.18
 5    130.95
 6    128.56
 7    125.99
 8    123.21
 9    120.19
10    116.91
11    113.31
12    109.35
13    104.96
14    100.06
15     94.51
16     88.17
17     80.78
18     71.95
```

Task 3 computes the effective feeder impedance at each dipole element due to the combination of the two-wire line characteristic impedance and the capacitive loading of the dipoles Eq. (11-36) assuming equal diameter elements. The feeder impedance at the input element (18) is approximately 72 Ω.

We use task 4 to calculate the two-wire transmission line characteristic impedance along the antenna to produce constant impedance at all dipoles.

```
Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length 4

Enter Element Radius, Antenna Impedance .25,72

      Feed
NO   Impedance

 1     87.17
 2     88.03
 3     89.00
 4     90.08
 5     91.31
 6     92.72
 7     94.35
 8     96.24
 9     98.49
10    101.18
11    104.46
12    108.54
13    113.76
14    120.62
15    130.02
16    143.55
17    164.47
18    200.25

Tasks
0 End
1 New Frequencies
2 New Scaling Factor
3 Antenna Impedance
4 Feed Impedance
5 Phase Center
6 Design to Given Length 0

C:\Log Periodic Dipole>_
```

It is questionable whether adjusting the two-wire line characteristic impedance along the feeder line would lead to a better design. The design shown in Figure 11-18(a) of constant feeder line impedance is a simpler design. Unlike what is suggested above of decreasing the feeder characteristic impedance as the element become longer, the design Figure 11-18(b) with its increasing feeder line characteristic impedance may produce a suitable design. The spacing of the elements in the *H*-plane decreases its beamwidth and increases antenna gain.

The program **LPDPAW**, based on simple ideas and experiments, produces an initial design. A file of input responses **LPDPAW1.TXT** can be edited and used to quickly generate designs.