

Lecture-3

4.3. Log-periodic antennas:

A log-periodic antenna is an antenna having a structural geometry such that its impedance and radiation characteristics repeat periodically as the logarithm of frequency. In actual practice, the variation over the frequency band of operation is minor, and the log-periodic antennas are usually considered to be frequency independent antennas.

Although number of log-periodic structures has been reported in the literature, in the section some typical structures are explained without detailed analysis.

Example 1:

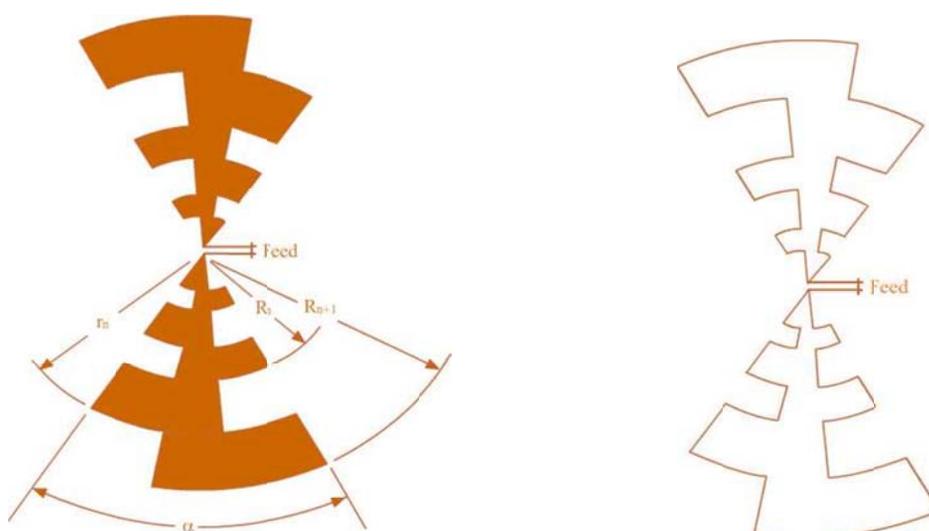


Fig. 4.5 Planer and wire logarithmically periodic antennas.

This structure is characterized by the geometric ratio

$$\tau = \frac{R_n}{R_{n+1}}$$

And the width of the antenna slot

$$\omega = \frac{r_n}{R_{n+1}}$$

If two frequencies f_1 and f_2 are one period apart, then

$$\tau = \frac{f_1}{f_2}, \quad f_2 > f_1$$

Example 2:

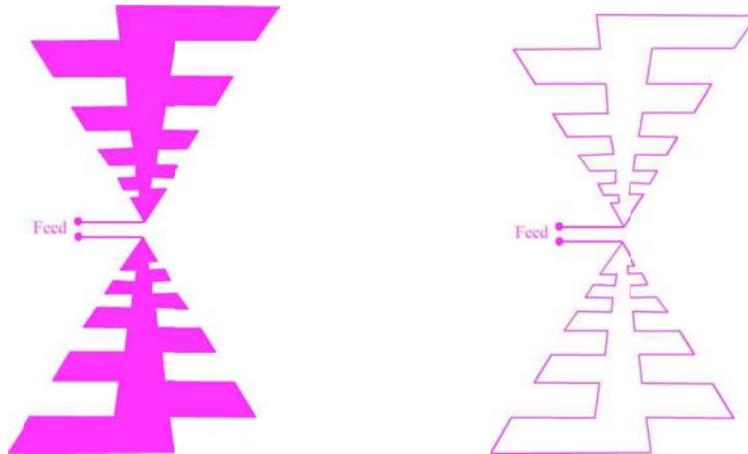
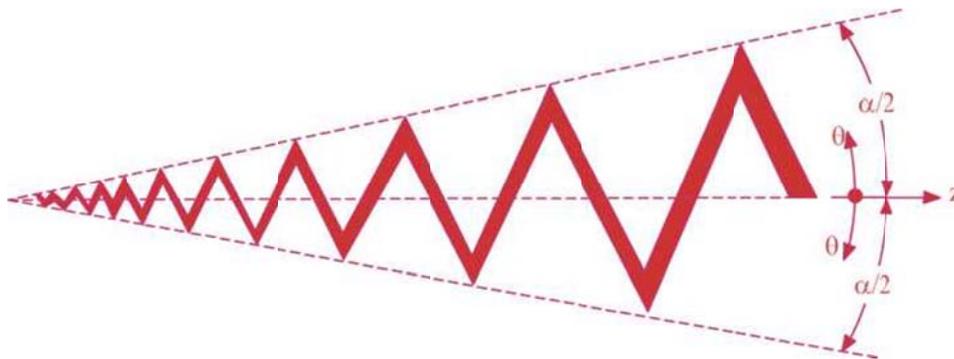


Fig.4.6 Planer and wire trapezoidal toothed log-periodic antennas.

The operational performance of these antennas is the same as that of the structure show in Example-1

Example 3:



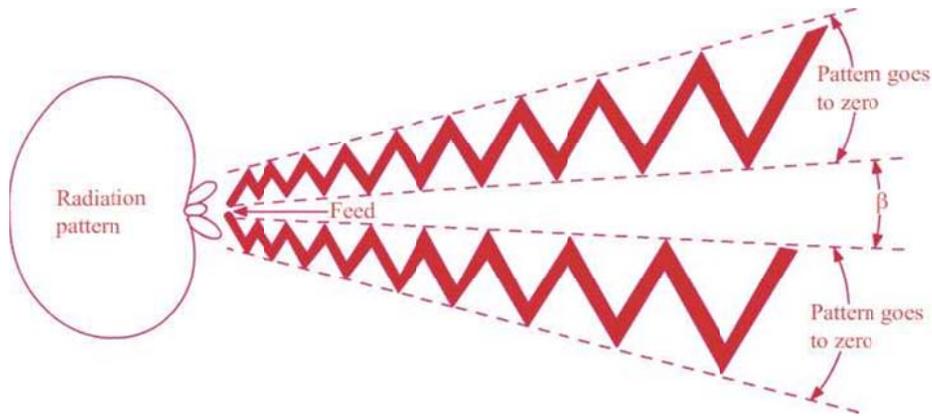


Fig.4.7 Metal strip log-periodic configuration and antenna structure

In (r, θ, ϕ) co-ordinate system, the shape of this antenna structure is given by

$$\theta = \text{Periodic function of } [b \ln(r)]$$

where b is a constant and r specifies the length from the origin.

Example 4: (Dipole array)

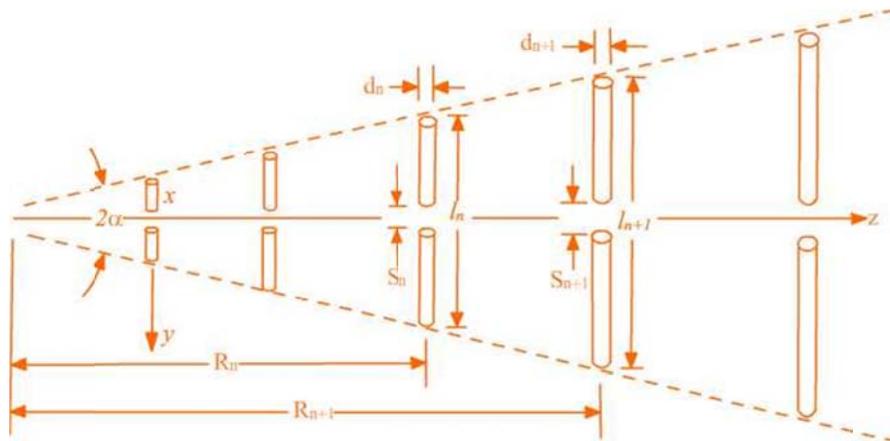


Fig.4.8 Dipole array

It consists of a sequence of side-by-side parallel linear dipoles forming a coplanar array. These arrays show high directivities (7-12dB) over a wide bandwidth.

These arrays are characterized by

$$\frac{1}{\tau} = \frac{l_{n+1}}{l_n} = \frac{R_{n+1}}{R_n} = \frac{d_{n+1}}{d_n} = \frac{s_{n+1}}{s_n}$$

The parameters are shown in Fig. (4.8)

Another parameter that is usually associated with a dipole array is the spacing factor σ defined by

$$\sigma = \frac{R_{n+1} - R_n}{2l_{n+1}}$$

To aid the design of log-periodic array, Carrel proposed a set of curves, as shown in 4.9. For example, we can choose parameters $\tau = 0.8$ and $\sigma = .12$ for a predicted gain of 6.5 dBi.

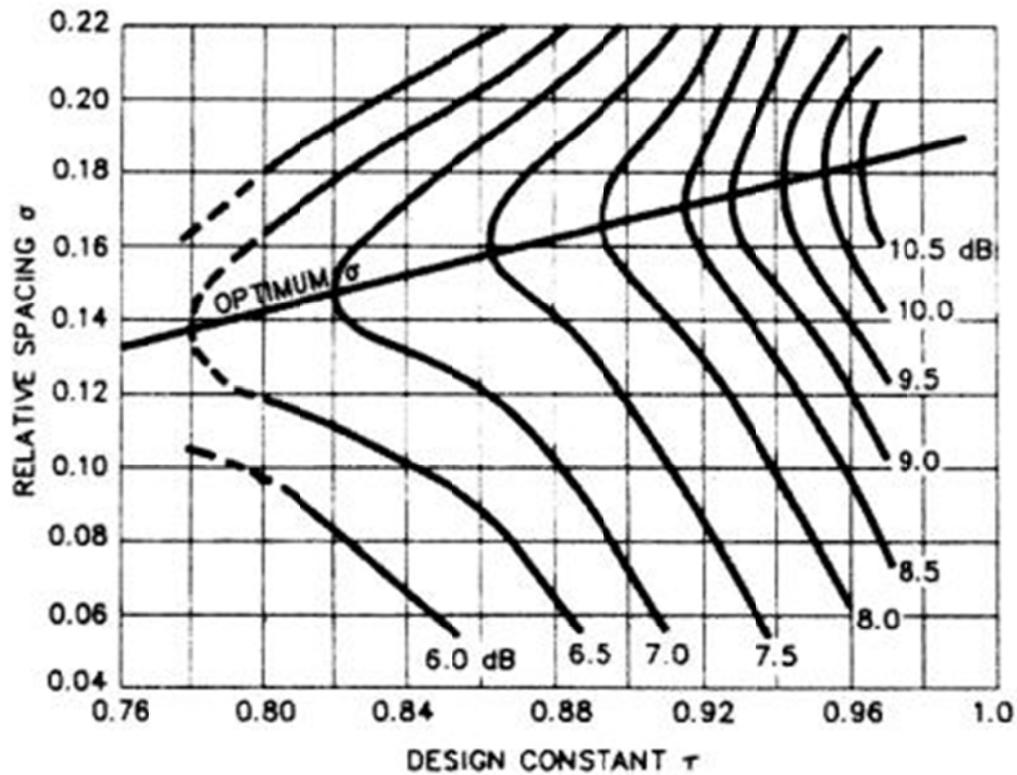


Fig.4.9 The parameters τ and σ can be chosen from this graph. [Source: R. L. Carrel, Analysis and design of log-periodic antenna, Ph.D. Dissertation, Elect. Engg. Dept., University of Illinois, University of Illinois, Ann Arbor, Michigan]

Two different connections of the dipole array are shown in Fig. (4.9), with their radiation patterns.

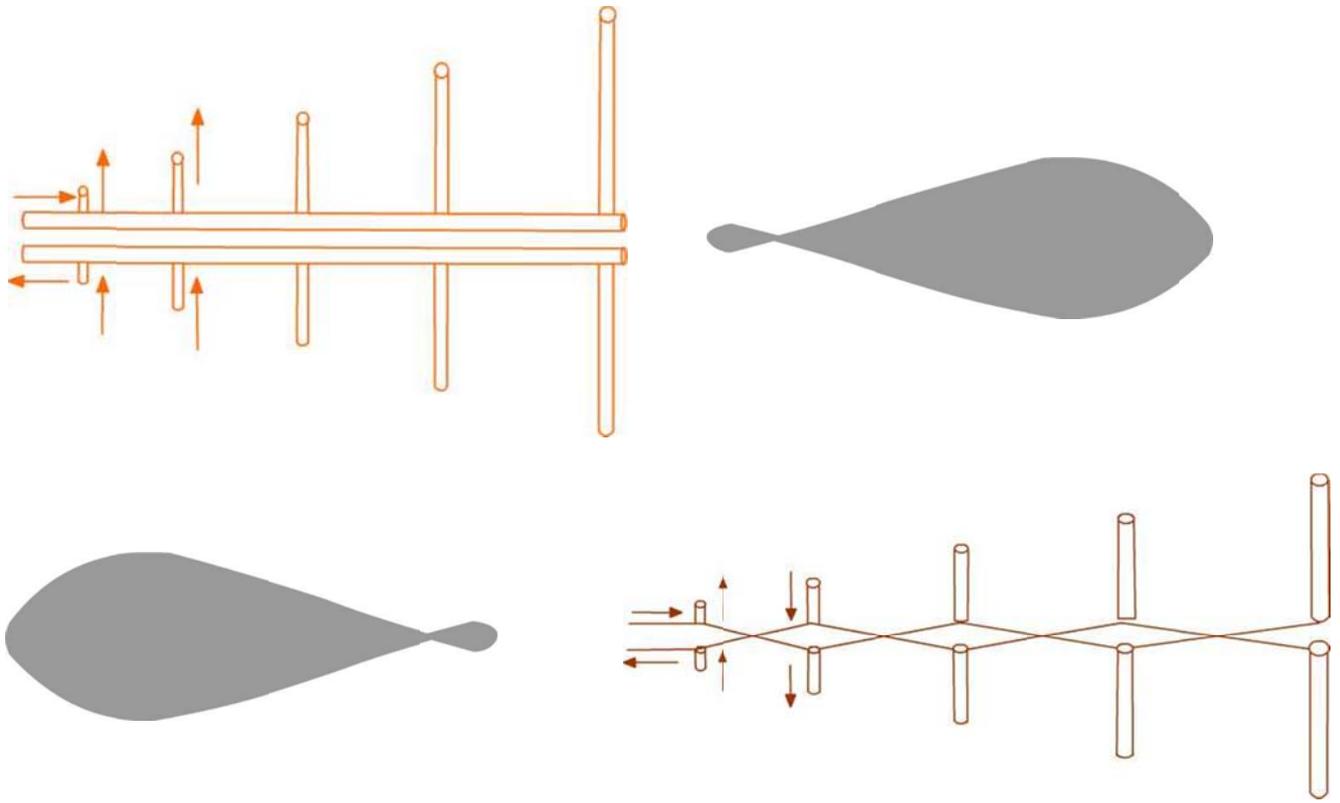


Fig.4.10 Log-periodic dipole array connections.