4.3 Yagi antenna

Developing Matlab

In this paragraph, the moment analysis of Yagi antenna is described from the programmer's point of view. The description assumes the knowledge of the description presented in the paragraph 4.1 and in the layer A of this chapter.

The program consists of files `Yagi_Gui_Master.mat` and `Yagi_Gui_Master.m` , which create the form of the user's interface, of `Yagi_Antena_OK_Master.m`, which is an reaction to pressing the button OK in the main form, of `Yagi_Antena_Apply_Master.m`, which is an reaction to pressing Apply and of `Yagi_Antenna_Slave.m`, which is responsible for all the computations.

First, we explain the meaning of symbols appearing in the source code:

`delta` is the segment length,
`alfa` is one half of the segment length,
`k` denotes wave-number,
`M` is the number of antenna elements,
`N` is the number of segments to which the reflector is divided,
`epsilon` denotes permittivity of vacuum,
`omega` denotes angular frequency,
`j` is imaginary unit,
`Z` denotes impedance matrix,
`Y` is admittance matrix,
`I` is the vector of currents,
`feed` is the index of the excitation segment,
`diff(1)` is the number of segments, for which the active dipole is shorter than the reflector,
`diff(2)` is the number of segments, for which the directors are shorter than the reflector,
`beta` is an angle given by $\beta = 360° - \theta$ (see the layer A – fig. **4.3A.2**) and
`F` denotes directivity pattern of the antenna.

Now, we turn our attention to the basic blocks of the program.

First, [$\exp(-jkr)/(4\pi r)$] is numerically integrated to all the possible distances among segments of both a single antenna element and different antenna elements of Yagi antenna (see paragraph 4.1, the layer D).

Second, results of numerical (vector `psi`) are composed into the impedance matrix. Individual sub-matrices [Z_{rr}], [Z_{dd}], [Z_{11}], [Z_{22}], ..., [Z_{nn}] are composed the similar way as described in the paragraph 4.1, the layer D.

On the basis of a known impedance matrix, the admittance matrix can be computed

```
Y = inv(Z);
```

current distribution on antenna elements can be obtained

```
for m=1:(N-2*diff(1))  % current distribution of the dipole
     I(m)=Y(m+N,feed);
     n(m)=m;
end

for m=1:N % current distribution of the reflector
     I(m)=Y(m,feed);
     n(m)=m;
end

for o=3:M
     for m=1:(N-2*diff(2))  % current distribution of directors
          Id(m)=Y(2*N-2*diff(1)+m+(o-3)*(N-2*diff(2)),feed);
          u(m)=m;
     end
end
```

input impedance can be evaluated

```
1/Y(feed,feed)
```

and directivity pattern can be computed.

All the above-given parameters of the antenna can be computed for an arbitrary wavelength of the excitation voltage, for an arbitrary length of the reflector, for arbitrary distances reflector - active dipole, active dipole - director and director - director (the way of individual setting of the distance among directors is described in the layer C), for an arbitrary radius of antenna wire, for an arbitrary number of antenna elements and for an arbitrary number of segments to which antenna elements are divided. The length of the active dipole is for `diff(1)` segments shorter than the length of the reflector, the length of each director is for `diff(2)` segments shorter than the length of the reflector. Magnitude of the feeding voltage is normalized. The radius of antenna elements has to be properly chosen in order to meet conditions ensuring functionality of the method (see the layer A). More details are given in the source code of the program in the form of comments.