

4.1 Wire dipole

Developing Matlab

The Matlab program for the analysis of wire antennas by the method of moments can be written relatively simply.

In the first step, the integral

$$\psi = \int_{\Delta} \left[\frac{\exp(-jkR)}{4\pi R} \right] d\zeta \quad (4.1D.1)$$

is numerically evaluated for all the possible mutual distances between segments of the discretized antenna. In Matlab syntax:

```
alpha = 0.5*delta; % one half of the segment's length
psi = zeros(1, N+1); % numerical integration
for m=1:(N+1)
    x = (m-1)*delta;
    psi(m) = quadl('green', -alpha, alpha, 1e-5, [], x, a, k);
end
psi = psi/delta;
```

In the above-given source code, `quadl` denotes the standard Matlab function, which performs numeric integration. Next, `green` is a string corresponding to the name of the m-file, which contains the integrated function. Symbols `-alpha` and `alpha` denotes integration limits, `1e-5` is the allowed integration error, and `z`, `a`, `k` are parameters (`z` is the distance between the source segment and the observation one, `a` denotes radius of the antenna wire and `k` is wave-number).

The integrated function is programmed by the following way:

```
function out = green(ksi, z, a, k)

R = sqrt(a^2 + (z-ksi)^2); % ksi ∈ (-Δ/2; +Δ/2)
out = exp(-j*k*R)/(4*pi*R); % Green's function
```

When integrals for all the possible distances between segments are evaluated, the impedance matrix can be built:

```
for m = 1:A
    for n = m:N
        dist = abs(m-n); % distance between source and destination
        hlp = 2*psi(1+dist) - psi(1+abs(dist-1)) - psi(1+abs(dist+1));
        Z(m,n) = j*omega*mi*del*psi(1+dist) + hlp/(j*omega*epsilon*del);
        Z(n,m) = Z(m,n); % matrix is symmetrical
    end
end
```

In the above-given list, `mi` and `epsilon` are permeability and permittivity of vacuum, `omega` denotes angular frequency and `j` is imaginary unit.

In the final step, the impedance matrix is inverted. The column of the inverted matrix, which corresponds to the excitation gap, directly provides nodal values of the current distribution on the antenna.