ENDSEM

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1 AIM

We have to find the antenna currents in a half-wave dipole antenna. For that a long wire carries a current $I(z)$ in a dipole antenna with half length - 0.5m, wavelength - 2m. The standard analysis assumes that the antenna current is given by the equation :

$$I = \begin{cases} I_m sin(k(l-z)) & 0 \leq z \leq l \\ I_m sin(k(l+z)) & -l \leq z \leq 0 \end{cases}$$

We have to obtain the expressin for the current vector and see if our answer is matching with the above equation.

2 Calculation of Current and location vector

The position vectors are z and u whereas current vectors are I and J. For calculating the z array and, its given as :

$$z[i+N] = \frac{il}{N}, -N \leq i \leq N$$

For the u array, its divided into two parts : v and w and they are given as

$$v[k] = -l + \frac{l}{N} + \frac{kl}{N},\ 0 \leq k \leq N-2$$

$$w[k] = \frac{l}{N} - \frac{kl}{N},\ 0 \leq k \leq N-2$$

This is so to obtain the u array that does not include the end points and the middle point. The array, u is then obtained as shown below:

$$u[a] = v[k],\ 0 \leq a \leq N-2, 0 \leq k \leq N-2$$

$$u[a+N-1] = w[k],\ 0 \leq a \leq N-2, 0 \leq k \leq N-2$$

The current array I is given $Im = 0.05$ at the middle point ($z = 0$) with rest all the points as 'Zero'. The curent array J is given 'Zero' to all the points.

3 Calculation of M matrix

We can compute the M matrix by using Ampere's Law :

$$H = M * J$$

4 Calculation of R_z, R_u, P and P_B

For the calculation of vector potential $A(r, z)$, it can further be simplified into a equation consisting of P which is a square matrix of order $2N - 2$ and P_B is a column vector. P_B is the contribution to the vector potential due to currrent I_N. P_B is given by :

$$P_B = \frac{\mu_0}{4\pi} \frac{exp(-jkR_{iN})}{R_{iN}} dz$$

Also the vectors R_z and R_u are obtained from the general equation :

$$\vec{R} = \vec{r}\hat{r} + (z_i - z_j)\hat{z}$$

The difference between Rz and Ru is that the former computes distances including distances to known currents, while Ru is a vector of distances to unknown currents. Also the matrices Q and Q_B are also calculated.

5 Final equation and Plot

The final equation is given by :

$$MJ = QJ + Q_B I_M$$

ie,

$$(M - Q)J = Q_B I_M$$

The value of J can thus be obtained as all other quantities have been obtained in the earlier section. J is the current vector corresponding to unknown currents. From this , I is obtained by adding the boundary conditions ie zero at i=0, i=2N, and Im at i=N). The following plot gives the variation of I with z and comparison with the assumed equation of I

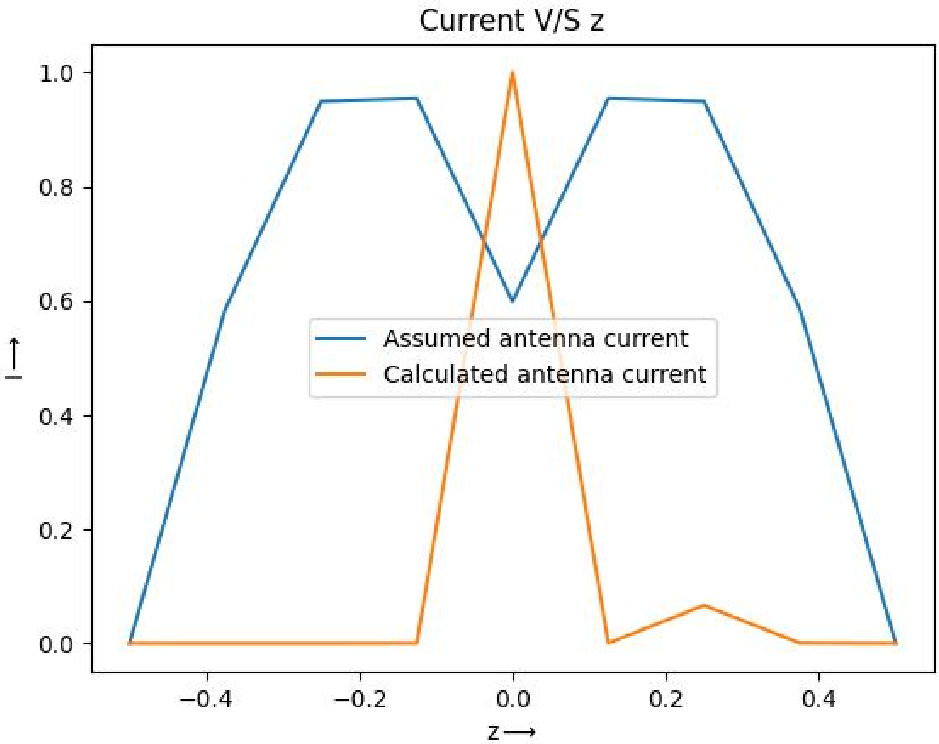

Figure 1: Currents V/S z

6 Conclusion

We have understood how current flows in a half-wave dipole antenna and compared it with the assumed current flow in it. There's still difference between the two of them but still its an appreciable estimation.