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Accurate Current Distribution of Dipole Antenna using Pocklington's Integral Equation

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Abstract: In a dipole antenna, the current distribution is usually assumed to be of sinusoidal form. For finite diameter wires the sinusoidal current distribution is representative but not accurate. To find a more accurate current distribution on a dipole, pocklington's integral equation is usually derived and solved. For the wire antenna by previously, solutions to the integral equation were obtained using iterative methods. Presently, it is most convenient to use Pocklington's integral equation techniques. Some mathematical formulation is being done and shown with help of MATLAB. If we know the voltage at the feed terminals of a dipole antenna and find the current distribution, the input impedance and radiation pattern can then be obtained.

Keywords: Dipole Antenna, Pocklington's Integral Equation, MATLAB, Linear Antenna.

I. INTRODUCTION

This the Pocklington's integral equation technique, with a Moment Method numerical solution, will be acquainted and utilized first with locate the self-and driving-point impedances, and mutual impedance of wire sort of antennas. This strategy casts the solution for the instigated current in the form of an integral (henceforth its name) where the obscure induced current density is a piece of the integrand. Numerical strategies, for example, the Moment Method can then be utilized to explain the current density.

In particular two classical integral equations for linear elements, This approach is very general, and it can be utilized with today's modern computational techniques and equipment to compute the characteristics of complex configurations of antenna components, including skewed courses of action. For uncommon cases, closed-form expressions for the self, driving-point, and mutual impedances will be exhibited utilizing the induced emf technique. This strategy is limited to classical geometries, for example, straight wires and arrays of collinear and parallel straight wires.

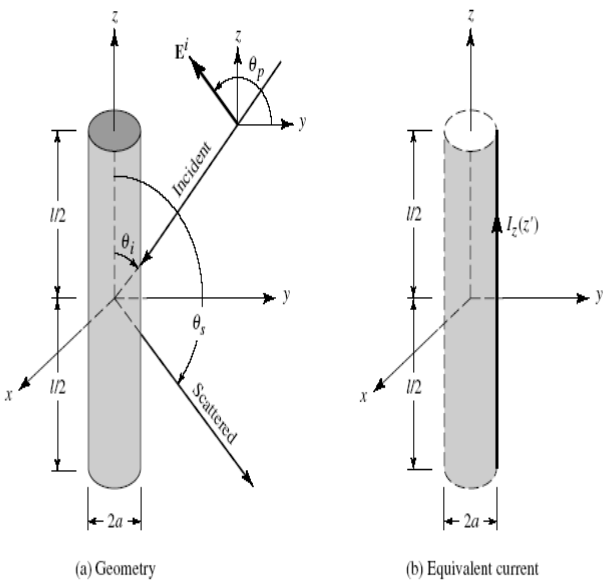


Fig 1

II. GENERAL FORMULATION FOR THE WIRE ANTENNA ANALYSIS:

Current Distribution of Linear Antenna

To infer Pocklington's integral equation, allude to above figure In spite of the fact that this general is general, it can be utilized either when the wire is a scatterer or a antenna. Let us assume that an incident wave encroaches on the surface of a conducting wire, as

Appeared in Figure 1, and it is alluded to as the incident electric field Ei (r). At the point when the wire is a antenna, the incident field is created by the feed source at the gap, as appeared in Figure 1. Part of the incident field impinges on the wire and actuates on its surface a linear current density Js (amperes per meter).

The induced current density Js reradiates and creates an electric field that is alluded to as the scattered electric field Es(r). In this manner, anytime in space the total electric field Et(r) is the sum of the incident and scattered fields, or

$$\mathbf{E}^{t}(\mathbf{r}) = \mathbf{E}^{i}(\mathbf{r}) + \mathbf{E}^{s}(\mathbf{r}) \quad (1)$$

where

$\mathbf{E}^{t}(\mathbf{r})$ = total electric field
$\mathbf{E}^{i}(\mathbf{r})$ = incident electric field
$\mathbf{E}^{s}(\mathbf{r})$ = scattered electric field

Pocklington's **integral equation** to determine the proportional filamentary line-source current of the wire, and therefore current density on the wire, by knowing the incident field on the surface of the wire.

In the event that we expect that the wire is thin (a<< λ) such that equation reduces to

$$G(z, z') = G(R) = \frac{e^{-jkR}}{4\pi R} \quad (2)$$

Equation can also be expressed in a more convenient form as

$$\int_{-l/2}^{+l/2} I_z(z') \frac{e^{-jkR}}{4\pi R^5}[(1+jkR)(2R^2-3a^2)+(kaR)^2]dz' = -j\omega\epsilon E_z^i(\rho = a) \quad (3)$$

Where for observations along the center of the wire (ρ = 0)

$$R = \sqrt{a^2 + (z - z')^2} \quad (4)$$

III. MOMENT METHOD SOLUTION

Pocklington's Integral Equations (3) , has the form of where F is a known linear operator, h is a known excitation function, and g is the response function. F is an integrodifferential operator while for and it is a integral operator. The target here is to decide g once F and h are specified. While the opposite issue is often intractable in closed form, the linearity of the operator F makes a numerical solution possible. One technique, known as the Moment Method requires that the obscure response function be extended as a linear combination of N terms and composed as

$$g(z') \simeq a_1 g_1(z') + a_2 g_2(z') + \cdots + a_N g_N(z') = \sum_{n=1}^{N} a_n g_n(z') \quad (6)$$

Each a will be an obscure consistent and each gn(z' is a referred function usually referred to as a premise or extension function. The area of the gn(z') functions is the same as that of g(z'). Substituting (6) into (5) and utilizing the linearity of the F operator diminishes (5) to

$$\sum_{n=1}^{N} a_n F(g_n) = h \quad (7)$$

The fundamental functions gn are picked so that each F(gn) in above can be assessed conveniently, ideally in closed form or at the very least numerically. The main assignment staying then is to discover the an obscure constants. Expansion of above equations. prompts one condition with N unknowns. Only it is not adequate to decide the N unknowns a (n = 1, 2, . . . , N) constants. To determine the N constants, it is important to have N linearly independent equations. This can be accomplished by assessing (7) (e.g., applying boundary conditions) at N distinctive points. This is alluded to as point- matching (or collocation). Doing this, and

$$\sum_{n=1}^{N} I_n F(g_n) = h_m, \quad m = 1, 2, \ldots, N \quad (8)$$

In matrix form,

$$[Z_{mn}][I_n] = [V_m]$$

where

$$Z_{mn} = F(g_n)$$

$$I_n = a_n$$

$$V_m = h_m$$

The unknown coefficients an can be found by solving using matrix inversion techniques, or

$$[I_n] = [Z_{mn}]^{-1}[V_m]$$

IV. MATLAB RESULT

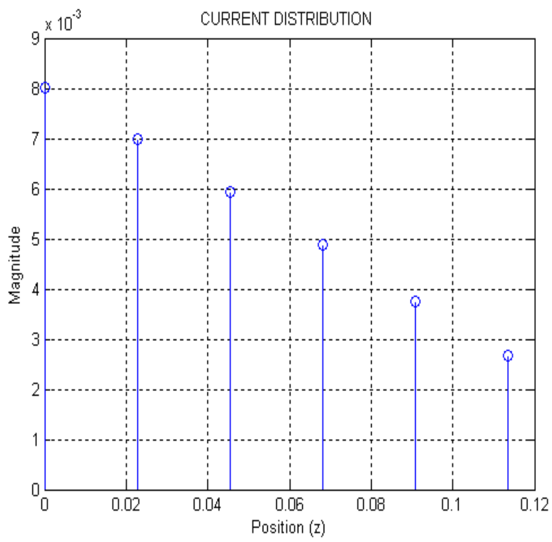
According to the expression given for current distribution, radiation pattern input impedance utilizing Pocklington integral Equation – Moment Method, distinctive plot will satisfy the equation with MATALB program.

A program in MATLAB has been composed for magnetic-frill and delta gap.

There are couple of presumptions which has been considered as :-
Number of Sub Division =11
Radius of Dipole<Wave lengths> =0.02
Total Dipole Lengths<wave lengths>= 0.25, 0.50, 1.25.

CASE :1
LENGTH = 0.2500 (WLS)
RADIUS OF THE WIRE = 0.0200 (WLS)
NUMBER OF SUBSECTIONS = 11.00

CURRENT DISTRIBUTION:-



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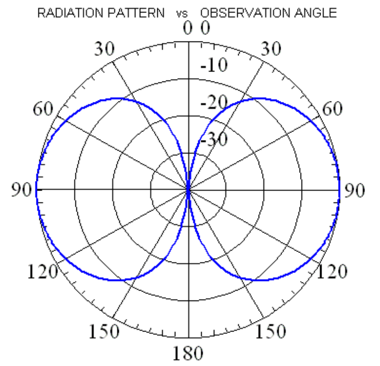
RADIATION PATTERN:-



INPUT IMPEDANCE:- Z= 21.2 -j 123.1 (OHMS)

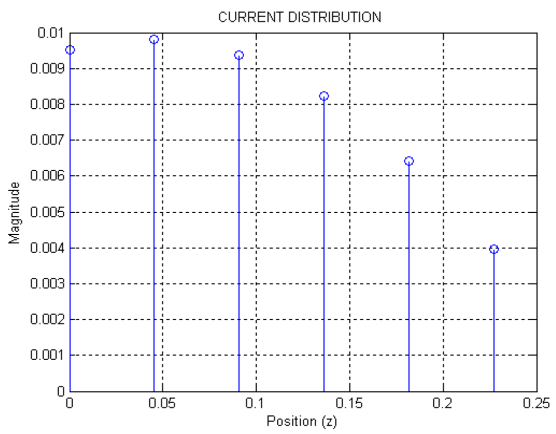
CASE:2

LENGTH = 0.5000 (WLS)

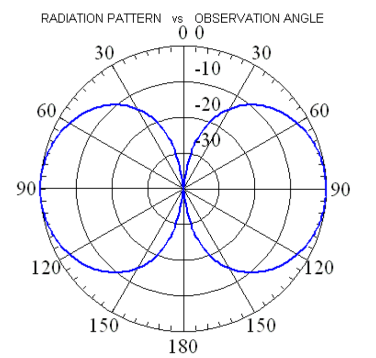
RADIUS OF THE WIRE = 0.0200 (WLS)

NUMBER OF SUBSECTIONS = 11.00=>

CURRENT DISTRIBUTION:-



RADIATION PATTERN:-



INPUT IMPEDANCE:- Z= 403.0 -j 61.7 (OHMS)

CASE: 3

LENGTH = 1.2500 (WLS)

RADIUS OF THE WIRE = 0.0200 (WLS)

NUMBER OF SUBSECTIONS = 11.00

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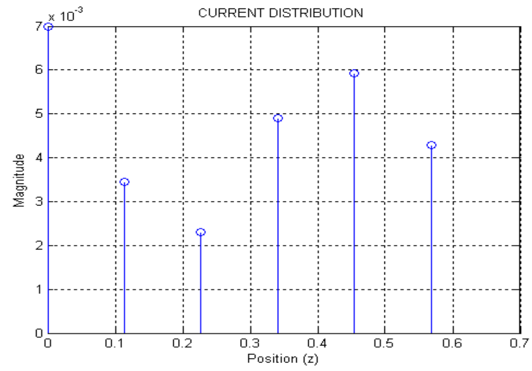
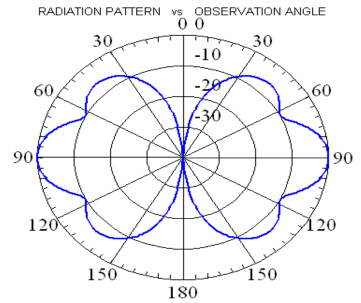


RADIATION PATTERN:-



INPUT IMPEDANCE: Z= 72.7 -j 123.5 (OHMS)

CONCLUSION

Current distribution is typically assumed to be of sinusoidal structure limited measurement wires the sinusoidal current distribution is representative accurate. To locate a more accurate current conveyance on a barrel shaped wire, pocklington's integral equation is generally derived and illuminated. For the wire antenna by already, answers for the integral equation were acquired utilizing iterative strategies presently; it is most advantageous to utilize moment strategy techniques. Some numerical definition is being done and appeared with help of MATLAB. In the event that we know the voltage at the feed terminals of a wire antenna and locate the current distribution, the input impedance and radiation pattern can then be acquired

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REFERENCES

[1] Constantine A. Balanis, “Antenna Theory”: Analysis and design, John wiley & sons New Delhi, 2008
[2] Electromagnetism and relativity theory, “Application of advance signal an analysis”, Harish Parthasarthy, (I K International publication)
[3] Advanced signal analysis and its applications to mathematical physics”, Harish Parthasarthy, (I K International publication) 2008
[4] R. F. Harrington, Field Computation by Moment Methods, Macmillan, New York, 1968