|  |  |
| --- | --- |
|  | ***Department of Electronics and Telecommunication Engineering***  ***(NBA ACCREDIATED)***  ***Digital Communication Laboratory***  ***Academic Year 2020-2021***  ***Odd Semester*** |

|  |  |
| --- | --- |
| **Course Code** | ECC603 |
| **Subject Professor In-charge** | Prof. Santosh Jagtap |
| **Student Name** | Anuj Manoj Shah |
| **Roll Number** | 18104B0024 |
| **Class** | TE |
| **Division** | EXTC B |
| **Date of Performance** | 24-Mar-2021 |
| **Date of Submission** |  |

|  |  |
| --- | --- |
| **Total**  **(10 Marks)** | **Sign** |
|  |  |

**EXPERIMENT No.1**

**Title:** Design dipole antenna and plot its current and impedance.

**Estimated time to complete this experiment:** 02 hours

**Objective:** Understand effect of wire length on current distribution and impedance

**CO to be achieved:**

**Expected Outcome of Experiment:** Performance analysis of dipole antenna at different length by using circuit parameters.

**Pre Lab/ Prior Concepts:** Transmission Line, Electromagnetics

**Theory (2 Marks)**

A dipole antenna is a simple antenna that can be built out of electrical wire. The most common dipole antenna is a half wave dipole which is constructed from a piece of wire half wavelength long. The wire is split in the center to connect the feeding wires. The E-field of the antenna has a circular pattern along a plane which cuts the axis of the antenna perpendicularly and is similar to a figure of 8 in a plane along the axis of the antenna [[3D pattern](http://www.google.com.pk/imgres?q=dipole+antenna+radiation+pattern&hl=en&sa=X&biw=1138&bih=535&tbm=isch&prmd=imvns&tbnid=mw4D6qOsT_J1uM:&imgrefurl=http://www.antenna-theory.com/basics/radPattern.html&docid=IOkfIqbVd-bv-M&imgurl=http://www.antenna-theory.com/basics/pattern.JPG&w=673&h=614&ei=9W0iT7bCIK-TiAfqnsziBA&zoom=1&iact=hc&vpx=116&vpy=4&dur=1754&hovh=214&hovw=235&tx=136&ty=114&sig=111592406885384713336&page=6&tbnh=158&tbnw=173&start=69&ndsp=15&ved=1t:429,r:10,s:69)]. The exact E-field can be calculated as:



**Simulation Model/ Code (1 Marks)**

|  |
| --- |
| **Dipole Design** |

|  |  |
| --- | --- |
| **Design Specification:**   * **Frequency (f) :** 80 MHz, 750 MHz, 1GHz * **Length of Wire (L) :** 0.5λ, 1λ, 3λ/2, 5λ/2,   **Calculation of Dipole Length:**  Velocity factor=0.95     |  | | --- | | **λ =0.95\*c/f** |     Where,  c=Speed of light  L= Length of dipole |

|  |
| --- |
| **MATLAB CODE:**  %Define specification  f=80e6;  c=3e8;  lam=0.95\*c/f;  L=0.5\*lam;  W=L/30;  %Define Dipole  h=dipole('Length',L,'Width',W);  figure();  show(h);  %Plot current  z=0:0.001:L/3.6;  k=lam\*sin((2\*pi)\*((1/2)-abs(z)));  K=abs(k);  figure();  plot(z,K);  figure();  view(90,0);  current(h,f);  %Plot Impedance  figure();  impedance(h,50e6:1e6:100e6);  grid on; |

|  |  |
| --- | --- |
| **Results** | |
| * **Antenna Structure** | |
| **Dipole Length=0.5λ** | **Dipole Length=1λ** |
| **Dipole Length=3/2λ** | **Dipole Length=5/2λ** |
| **Results** | |
| * **Current distribution** | |
| **Dipole Length=0.5λ** | **Dipole Length=1λ** |
| **Dipole Length=3/2λ** | **Dipole Length=5/2λ** |

|  |  |
| --- | --- |
| **Results** | |
| * **Current Distribution: Bar Chart** | |
| **Dipole Length=0.5λ** | **Dipole Length=1λ** |
| **Dipole Length=3/2λ** | **Dipole Length=5/2λ** |
| **Results** | |
| * **Antenna Impedance** | |
| **Dipole Length=0.5λ** | **Dipole Length=1λ** |
| **Dipole Length=3/2λ** | **Dipole Length=5/2λ** |

**Observations:**

There is a clear relationship between the length of the antenna and the current distribution:

* dipole length = 0.5l corresponds to to a 0.5-cycle current distribution
* dipole length = 1.0l corresponds to to a 1.0-cycle current distribution
* dipole length = 1.5l corresponds to to a 1.5-cycle current distribution
* dipole length = 2.5l corresponds to to a 2.5-cycle current distribution

For our antenna to work in the real world, we require two things:

1. close to the signal frequency (f), its resitance ≈ characteristic impedance of the line.
2. close to the signal frequency (f), its reactance ≈ 0.

In the above simulation, f = 80MHz, and characteristic impedance of line = 75Ω.   
Let's see if the above two conditions are satisfied, using the "Antenna Impedance" graphs:

* dipole length = 0.5l: resistance = 73Ω. reactance = 0Ω
* dipole length = 1.0l: resistance = 260Ω. reactance = -418Ω
* dipole length = 1.5l: resistance = 78Ω. reactance = -41Ω.
* dipole length = 2.5l: resistance = 62Ω. reactance = -67Ω.

Thus, we see that the 0.5l-antenna is perfect for the real world. The 1.5l-antenna is the second best, followed by the 2.5l-antenna, and the 1.0l-antenna is very bad.

**Conclusion:**

In this experiment, we used MatLab to plot the current and impedance distributions of dipole antennas of various lengths.

We found a clear relationship between dipole length and current distribution.

And we also selected which antenna would work in the real world, based on its impedance distribution.