High Gain Dipole Antenna for Frequency Range of 6 GHz to 7 GHz

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Abstract
The dipole antenna or dipole aerial is one of the most important and commonly used types of RF antenna. It is widely used on its own, and it is also incorporated into many other RF antenna designs where it forms the driven element for the antenna. In this paper we have designed a dipole antenna for 6GHZ-7GHz band. The behavior of Dipole antenna is analyzed through simulation. The operating frequency of the antenna is given as 6.6 GHz. it produces s- parameter with -12.8 dB and gain is more then 20.

Keywords
Dipole Antenna , AC, Gain, Impedance, S - parameter

I. Introduction

The dipole antenna is one of the most simple antenna configurations. It can be designed with two thin metallic rods that have a alternating (AC) voltage difference applied across them. The length of the rods is selected such that they are one fourth wavelength elements at the resonating frequency. A dipole antenna has a well-known torus-like radiation pattern.

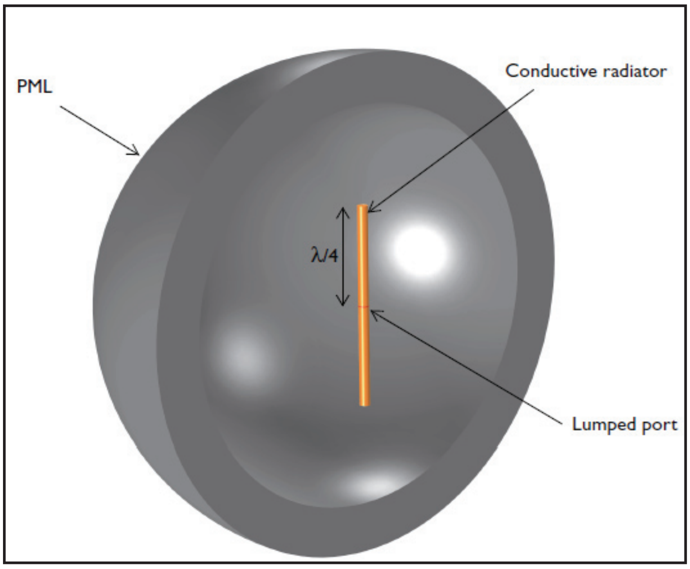

Fig. 1: A Dipole Antenna

The dipole antenna designed in this paper is made up of two cylindrical arms of conductive material (i.e. copper) and a voltage source in between. A region of free space bounded by a Perfectly Matched Layer (PML) surrounds the antenna.

II. Model Definition

The antenna designed in paper consists of two cylinders shows each of the dipole arms. The free space wavelength at the antenna's resonating frequency is 40 mm. Thus, both of the antenna arms is 10 mm long and associated with the z-axis. The arm radius is taken to be 0.5 mm. In the boundary as the radius approaches zero, this antenna will approach the logical solution.

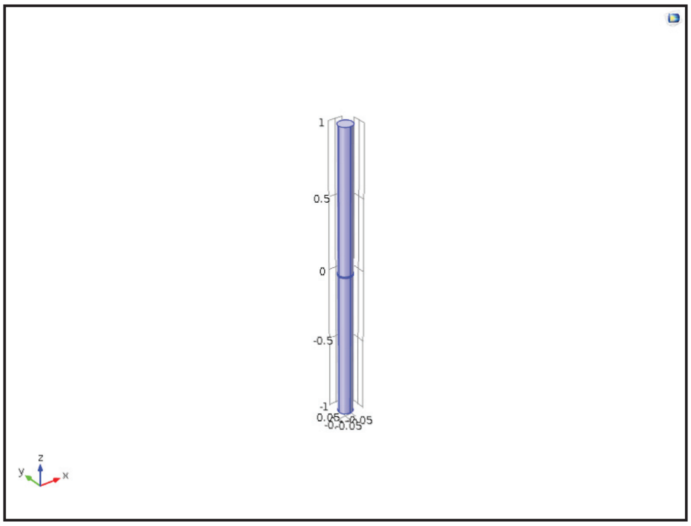

Fig. 2: Cylindrical Dipole Antenna

A tiny cylindrical gap of size 0.1 mm between the antenna arms is to input the voltage source. The power supply and feed structure are not modeled openly, and it is implicit that a uniform voltage difference is applied across these terminals. This source produces electromagnetic fields and surface currents on the both conductive faces.

The dipole arm surfaces are designed using the Impedance Boundary Condition, which is perfect conductive surfaces that have size much bigger than the skin depth. Impedance boundary condition set up a finite conductivity at the surface as well as resistive losses. The air domain around the antenna is designed as sphere of radius 20 mm, which is roughly the boundary between the near-field and the far-field. This sphere of air is shortened with a perfectly matched layer (PML) that acts as an absorber of outgoing radiation. The far-field pattern is calculated on the boundary between the air and the PML domains.

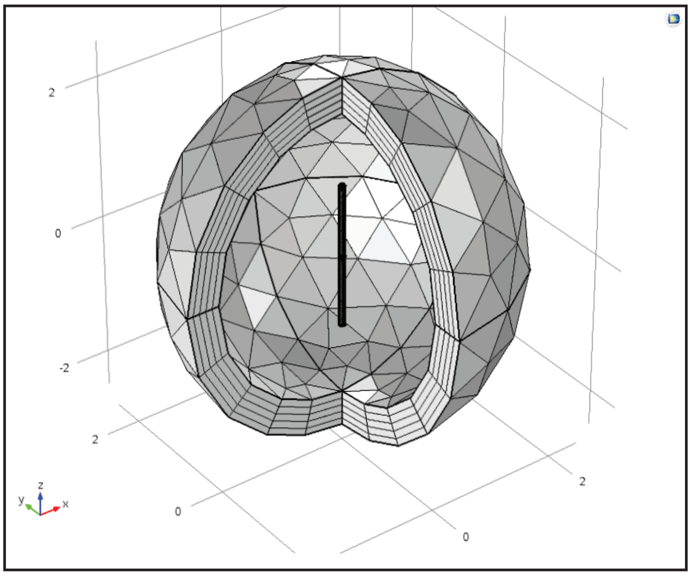

Fig. 3: Meshing

The mesh is physically attuned such that there are five elements per free space wavelength and that the boundaries of the antenna are meshed more perfectly. The PML is divided with a total of five elements all along the radial direction. Frequency domain study is used to solve the designed geometry, frequency ranging from 6.1 GHz to 7.1GHZ.

III. Results

The dipole antenna consists of two conductive elements such as metal wires or rods which are fed by a signal source or feed energy that has been picked up to are cover. The energy may be transferred to and from the dipole antenna either directly straight into from the electronic instrument or it may be transferred some distance using a feeder.

A. Electric Field

The magnitude of the electric field around the antenna is shown in fig. 4. The fields appear artificially high near the excitation, as well as at the ends of the arms. These peaks in the intensity are due to local singularities; the fields at sharp transitions in the model are locally artificially high, but they do not affect the results some distance (1~2 elements) away from these regions.

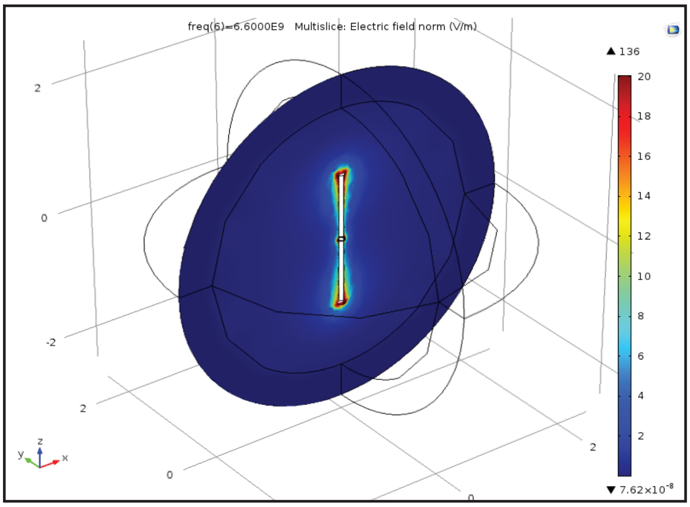

Fig. 4: Electric Field

B. Polar Plot

The polar plot in Fig. 5 of the far-field pattern in the zy-plane shows the expected radiation pattern.

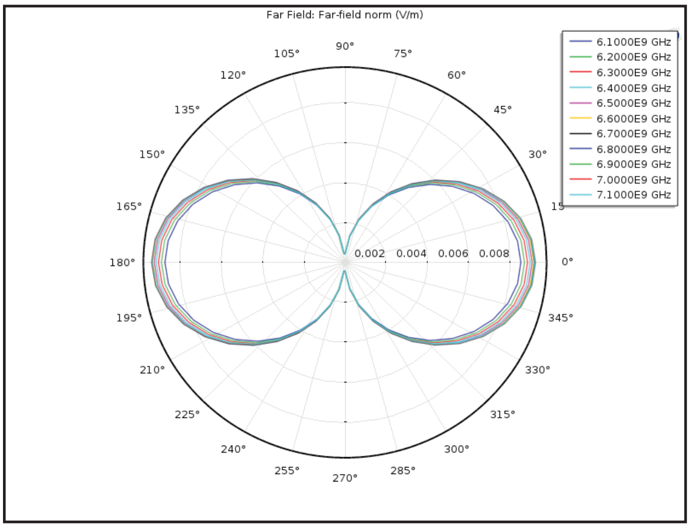

Fig. 5: The Polar Plot.

C. Radiation Pattern

The 3D visualization of the far-field intensity in Figure 6 shows the expected torus-shaped pattern.

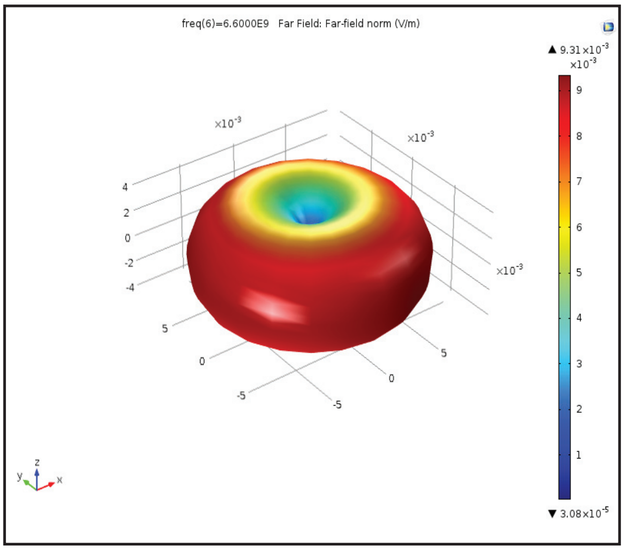

Fig. 6: Radiation Pattern.

D. S - Parameter

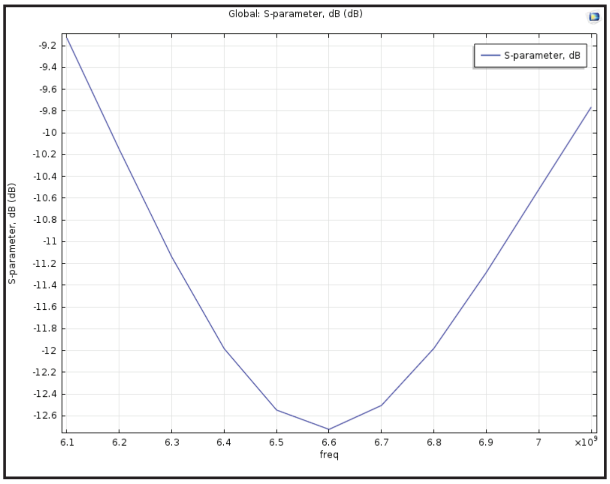

Fig. 7: S- Parameter.

Fig. 7 shows the reflection losses of the designed antenna with maximum value of -12.8 dB and bandwidth of 1GHZ.

E. Impedance

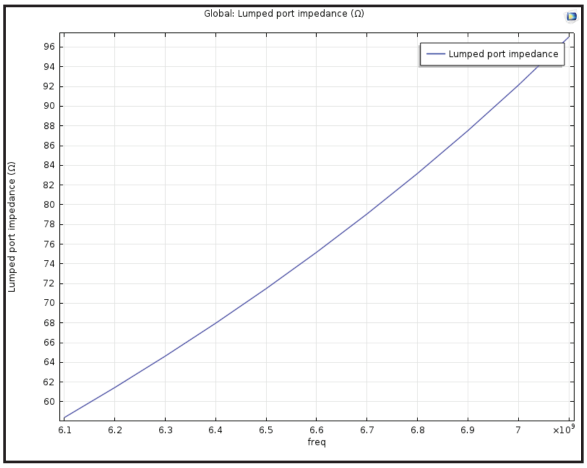

Fig. 8: Impedance

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The impedance as seen by the port is shown in figure 8 and evaluated to be 120 + 26i Ω, which agrees reasonably with expectations.

F. Gain

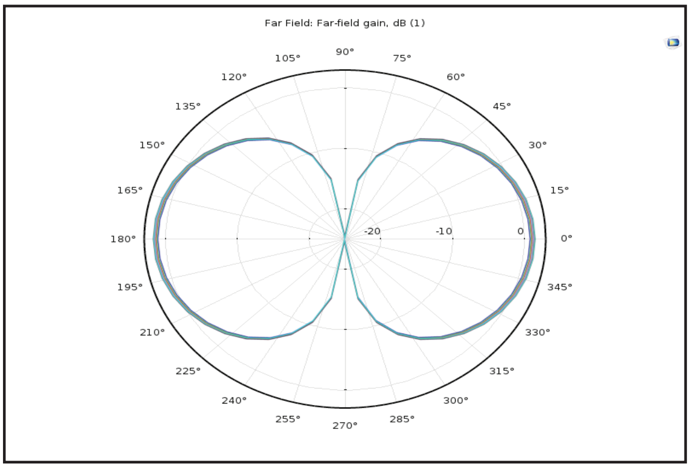

Fig. 9: Gain

The designed antenna produces the gain more then 20 as shown in fig. 9. In the limit as the antenna radius and gap height go to zero and in the limit of mesh refinement, the model approaches the analytic solution for a dipole antenna.

IV. Conclusion

we have proposed a high gain dipole antenna for frequency range of 6 GHz to 7GHZ which can be used for various application such as satellites, RFID, Bluetooth and in mobile communication. Software is used to analyze the parameters of the antenna.

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