Design and Implementation of Wide Band for Biconical Antenna for X Band Applications

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Abstract. This paper reflects architecture and pattern synthesis for biconical antenna. The Biconical Antenna Radiation Pattern is identical to the half wave dipole antenna. The ramp shaped Radiation pattern is obtained by varying different antenna parameters such as amplitude distribution, phase distribution, spacing between the element and number of elements. Biconical antennas (2-14 GHz) operating range gives reflection coefficient - 0.46; return loss - 10dB, VSWR- 2.5:1, Gain (2-4) dB with 50Ω input impedance. Biconical antenna was designed using CST Microwave Studio.

Keywords: Biconical antenna, Amplitude, phase, spacing, Radiation pattern, half wave dipole, VSWR, Ramp.

1. Introduction
Antenna arrays play a vital part in the identification and transmission of signals from multiple directions [4]. In various applications, synthesis is required for improving signal efficiency for the phased array of cellular radar, mobile communications, satellite, radar and military systems [2]. In the present case, need for antenna array formation of sized beam structures is increasing every day to increase communication [7]. The biconical antenna is a universal physical model and is commonly used for its large range and high efficiency. [1] The biconical antenna research is primarily concerned with one component that cannot provide a versatile radiation pattern and high value of gain [3]. The problem described above is overcome by increasing the number of components with a given lambda distance.

One of the most well recognised radiators is biconic and conical antennas. When omni directional radiation pattern and broadband efficiency are needed, they are natural choices for RF contact, broadcasting or EMI tests. Usually, the simple conical geometry (or biconic geometry in its dipole equal) is constructed by either a cord or an ongoing metal surface. Indeed, the perfect biconic geometry, while not possible since it stretches to infinity in the axial direction, is a frequency-in depending on antenna the frequency of its input impedance does not change [8]. It is necessary to cut practical biconic antennas, leading to broadband, not frequency-independent reaction.

This paper is organised as follows. Chapter II deals with the Biconical dipole. Analysis of biconical array antenna was given in the chapter III. Simulated results antenna provided in the chapter IV. Finally, results were concluded in the chapter V.
2. Dipoles Biconical

Two conical conductors symmetrical around an axis and vertex are known as bi-conical dipoles [12]. Figure 1 provides an example of a biconic dipole. Figure 1. Biconic dipole the biconic dipole can act on a wide range of frequencies and can be viewed as part of a broadband dipole. In the middle of both cones is the dipole feed. [13] The radiation pattern of the antenna is identical to the normal dipole and the only actual difference is a much larger bandwidth than the dipole and will usually reach bandwidths of four to one. [9] This cone may also be constructed from a heavy and expensive solid metal conductor.

\[ \tan \left( \frac{\alpha}{2} \right) = \frac{r}{h} \]  

Figure 1: Physical configuration

In order to operate in the 2-15 GHz frequency range with maximum VSWR 2.5:1, and Omni-drive pattern in the Azimuth plane, a Biconical Antenna has been developed and simulated [10]. Relevant parameters are a cone angle (\(\alpha\)), cone radius (\(r\)), cone gap (\(g\)) and conical length (\(l\)) of a bi-conical antenna. These parameters have been treated as variables and tuned for the optimal effects [14].

3. Analysis of Biconical Antenna

A basic configuration that can be used for the achievement of width broadband characteristics is the biconic antenna that is created by putting two cones [4]. The generator attached to the terminals of the biconic antenna causes a radiation from the terminals on waves with the spherical phase fronts [5]. The waves build tides and a friction between the cones [6]. The parameters such as the conical length or angle of the cone can be calculated if the other parameters like the height of the cone and the radius of the cone are specified [15].

\[ \tan \left( \frac{\alpha}{2} \right) = \frac{r}{h} \]  

The biconic antenna is designed using CST M W Studio and it is excited to use a 50ohm connector based on the optimised configuration parameter [11]. It indicates that with the aid of a dielectric connector the two metallic cones are isolated from each other and that the cone had a dial of around 1 mm. Figure 2 represents biconic antenna.
4. Simulation Results
Biconical antenna was designed using CST STUDIO With 50-ohm coaxial connector. It contains two copper cones with 1mm thickness without balun. Front view of the designed antenna is shown in the Figure 3.

It gives the wider bandwidth about 12 Ghz compare to biconical with balun. Our proposed antenna produces 2-4Db of gain, return loss below -10dB, VSWR – 1-2, radiation pattern line unit ramp as shown in Figures 4 to 9.
Figure 4: S11 (Return Loss)

Figure 5: VSWR

Figure 6: Radiation pattern (Polar plot)
5. Conclusion
In this paper, Biconical Antenna designed without balun to reduce distortion. The antenna consists of two conical conductive objects, nearly touching at their vertices. The proposed antenna is designed in
Electromagnetic Simulation software CST Studio suite. A minor rendement loss of less than 13 Db and a broad bandwidth of 2-14GHz are obtained after a simulation simultaneous antenna gain of 4dB at 3.5 GHz and 1.5dB at 2.4GHz is observed.

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