A Wideband Sleeve Monopole Antenna

Chao-Qiang Feng
National Laboratory of Science and Technology on Antennas and Microwave, Xidian University, Xi'an, Shaanxi, 710071, P. R. China
chaoqiang_feng@163.com

Fu-Shun Zhang
National Laboratory of Science and Technology on Antennas and Microwave, Xidian University, Xi'an, Shaanxi, 710071, P. R. China
fshzhang@mail.xidian.edu.cn

***Abstract*—A wideband sleeve monopole antenna is presented. In this design, a cylindrical sleeve is introduced to enhance the impedance bandwidth. For reducing the weight of the antenna, a hollow metal tube is employed as the main radiator. Moreover, another four rectangular stubs are introduced for impedance matching. It is shown that the proposed sleeve monopole antenna achieves an impedance bandwidth of 141.2% (1.16-6.74GHz) for voltage standing wave ratio (VSWR) ≤ 2, and the antenna has symmetrical radiation patterns over the operating frequency band. Therefore, it is suitable for the applications of wide wireless communication.**

Keywords—wideband; sleeve monopole; hollow metal tube; wide wireless communication

I. INTRODUCTION

As a modification of the conventional monopole antenna, sleeve monopole antennas have an interesting property of broadband characteristic. By now, a large number of researches on sleeve monopole antenna have been down. In [1, 2], some theoretical analysis methods of sleeve monopole antennas are proposed, which are useful references in designing sleeve antennas. And in [3], a miniaturized loaded open sleeve antenna is reported. By loading inductor/resistor circuit, the antenna achieves an impedance bandwidth of 6:1. Moreover, a wideband dual sleeve antenna is proposed in [4]. Owing to top loaded, the antenna realizes an impedance bandwidth of 123% for VSWR ≤ 2 and has excellent radiation characteristics. In [5], a monopole antenna with dual sleeve structure is presented, which has an impedance bandwidth of about 137% for VSWR ≤ 2. By a top-loading circular patch shorted to the ground plane, this antenna achieves size reduction simultaneously. In [6], through changing the structure of the antenna above the sleeve, a dual sleeve antenna achieves a bandwidth of 125% for VSWR ≤ 3. Besides, planar sleeve monopole antennas have been studied. A CPW fed sleeve monopole antenna is proposed in [7], which has an operating band covering 3.15GHz to 4.3GHz.

In this paper, a wideband sleeve monopole antenna is designed. The structure of the antenna is simple. A metal sleeve is introduced to improve the impedance bandwidth. And a hollow metal tube is employed as the main radiator for reducing the weight of the antenna. For enhancing the impedance matching, another four rectangular stubs are added at the lower part of the metal tube. The proposed antenna achieves an impedance bandwidth of 141.2% from 1.16GHz to 6.74GHz for VSWR ≤ 2. In addition, the radiation patterns of the sleeve monopole antenna are symmetrical in E-plane and omnidirectional in H-plane. As a result, the antenna is suitable for the applications of wide wireless communication.

II. ANTENNA CONFIGURATION

The configuration of the proposed sleeve monopole antenna is shown in Fig. 1, which is composed of a hollow metal tube, a cylindrical sleeve and a ground plane with a diameter of d_4. For a lighter, a hollow metal tube is employed as the main radiator instead of a solid metal bar. The upper part of the hollow metal tube is thickened for enhancing the impedance bandwidth and reducing the height of the antenna. The hollow metal tube produces the resonance at the lowest frequency of the operating bandwidth. The sleeve with an outer diameter of d_1 and a height of h_1 acts as a radiating element at low frequency band and plays a role in impedance matching simultaneously.

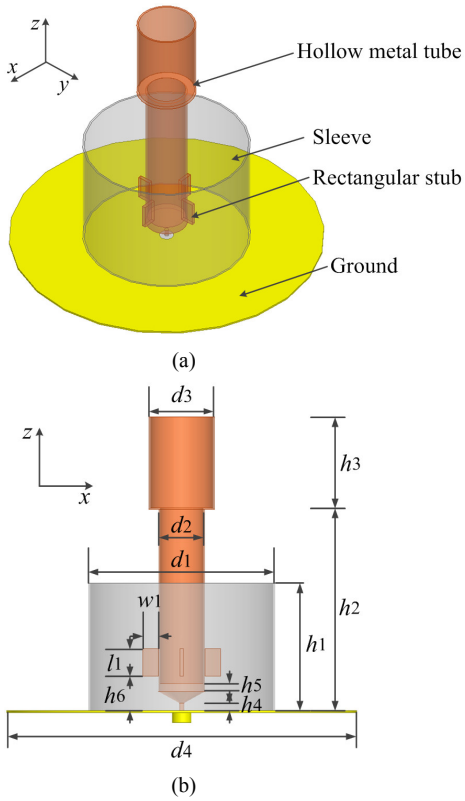

Fig. 1 Configuration of the sleeve monopole antenna. (a) 3D view. (b) Side view.

TABLE I. THE DETAILED PARAMETERS OF THE PROPOSED ANTENNA

Parameters	d_1	d_2	d_3	d_4	l_1	w_2
Values/(mm)	48	12	17	90	7	4
Parameters	h_1	h_2	h_3	h_4	h_5	h_6
Values/(mm)	33	52	24	2	2	9

In addition, another four rectangular stubs are added at the lower part of the hollow metal tube. By adjusting the position and size of the rectangular stubs, the matching impedance can be observably improved. The thickness of the hollow metal tube and the sleeve both are 0.5mm. And the thickness of the rectangular stub is 1mm. The antenna is fed from a 50Ω coaxial transmission line. In this design, the prototype is modeled and simulated by ANSYS HFSS. The detailed parameters of the proposed antenna are listed in Table I.

III. RESULTS

Fig. 2 shows the VSWR of the proposed sleeve monopole antenna. It can be observed that the impedance bandwidth is 141.2% ranging from 1.16 GHz to 6.74 GHz for VSWR ≤ 2. Meanwhile, the radiation patterns of the proposed antenna at 1.5, 3, 4.5 and 6 GHz are depicted, as shown in Fig. 3. The antenna has stable monopole-like radiation patterns. With reference to Fig. 3(a), (b), (c) and (d), the radiation patterns of the antenna are symmetrical in the elevation plane (E-plane). Moreover, as shown in Fig. 3(e), the radiation patterns of the antenna have good omnidirectional characteristic in azimuth plane (H-plane).

IV. CONCLUSION

In this paper, a wideband sleeve monopole antenna is designed. By introducing a cylindrical sleeve, the impedance bandwidth is broadened greatly. Moreover, a hollow metal tube is employed as the main radiator, reducing the weight of the antenna. Another four rectangular stubs are added at the lower part of the metal tube for impedance matching. The simulations show that the antenna exhibits an impedance bandwidth of 141.2% for VSWR ≤ 2 and has symmetrical radiation patterns over the operating frequency band. With the merits of small in size, light in weight and wide in bandwidth, the antenna is suitable for the applications of wide wireless communication.

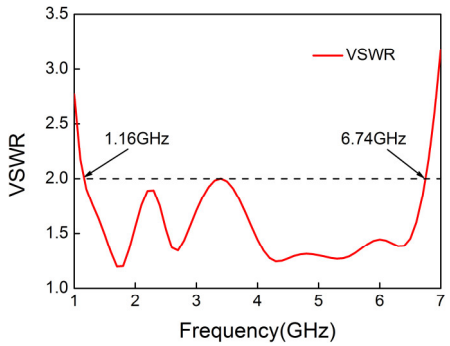

Fig. 2. VSWR of the sleeve monopole antenna.

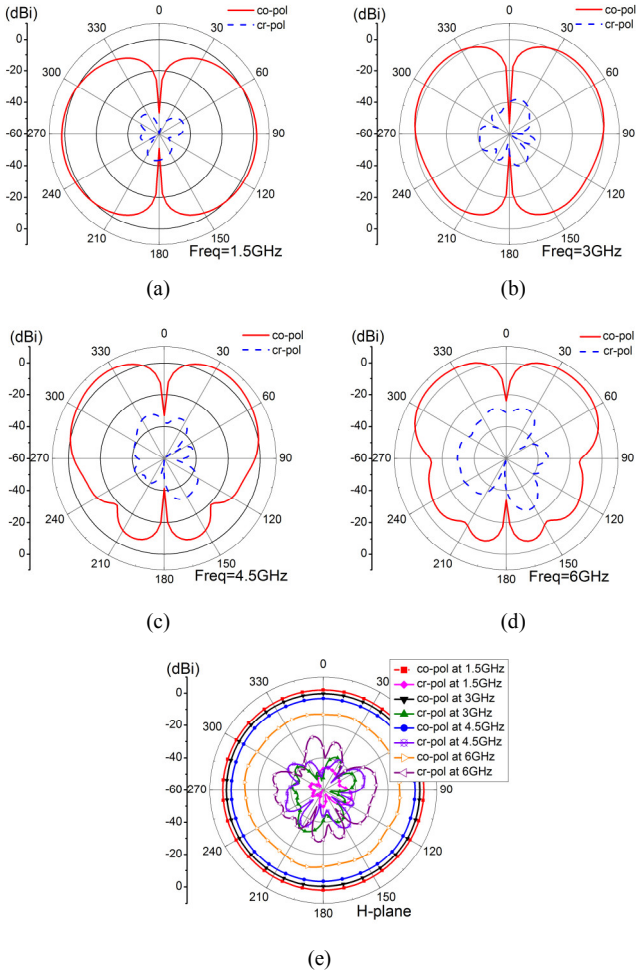

Fig. 3. Radiation patterns of the proposed antenna. (a)1.5GHz in E-plane. (b) 3GHz in E-plane. (c) 4.5GHz in E-plane. (d) 6GHz in E-plane. (e) H-plane.

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