2A1-2

A UWB Antenna with Unidirectional Radiation Characteristics

MITSUO TAGUCHI[1], and #CHUAN JING[2]
[1] Dept. of Electrical & Electronic Eng., Nagasaki University
[2] Graduate School of Science and Technology, Nagasaki University
1-14 Bunkyo-machi, Nagasaki, 852-8521 JAPAN
[1] mtaguchi@nagasaki-u.ac.jp, [2] d706021e@cc.nagasaki-u.ac.jp

1. Introduction

The authors have proposed the resistance loaded planar dipole antenna within a rectangular parallelepiped cavity for the UWB system. The balanced-fed planar dipole antenna has the unidirectional radiation characteristics without beam tilt as the frequency becomes higher. A good VSWR characteristic has obtained from 3.1 GHz to 10.6 GHz when the gap-fed is used for feeding [1].

The balanced-fed dipole is analyzed in the reference [1]. If this antenna is fed by the coaxial cable, the balun is needed for the balanced feed for the wideband operation. In this paper, two types of the planar dipole antenna fed by the coaxial cable are analyzed for the high-band UWB application. The VSWR characteristics and the radiation characteristics of these antennas are numerically analyzed at the frequencies from 7.1 GHz to 10.6 GHz. In the numerical analysis, the electromagnetic simulator "Fidelity" based on the FDTD method is used [2].

2. Analyzed Model

Figure 1 shows the structure of the resistance-loaded dipole antenna within a rectangular parallelepiped cavity (Model 1). The dipole antenna is placed 5mm behind the aperture of cavity. The conducting plate is attached at the aperture of the cavity to reduce the backward radiation. The size of conducting plate is L3 = 82 mm, W3 = 48 mm. The width of cavity is 18 mm. Two resistors of size 1 mm by 1 mm by 1 mm are loaded between the both ends of the dipole and the cavity wall. The resistance is 82 ohm. The structure of this antenna is originally proposed in the reference [1] except for the feed method. This antenna is fed by two coaxial cables with the characteristic impedance of 50 ohm. The outer conductors of two coaxial cables are connected each other. One coaxial cable is short-circuited at the cavity wall. The other coaxial cable is extended outside the cavity. The diameters of inner and outer conductors of coaxial cable are 0.32 mm and 1.6 mm, respectively. The diameter of dielectric material of coaxial cable is 1.05mm.

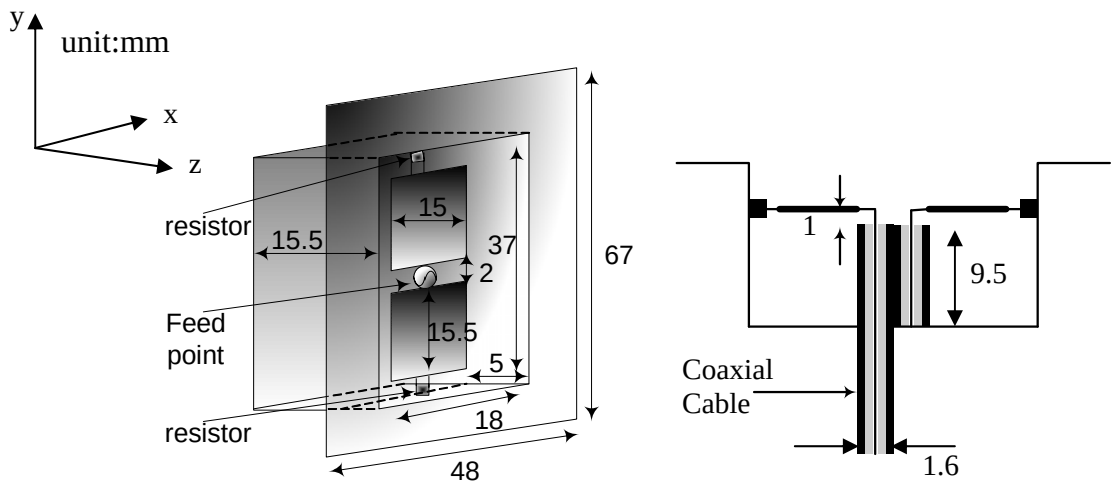
Figure 2 shows the structure of planar dipole antenna with a bended reflector plate (Model 2). This antenna is fed by a coaxial cable extended from the reflector plate. Around the coaxial cable, the rectangular cylinder sleeve with length of 11 mm is attached. The length of this sleeve is about a quarter wavelength in 7 GHz.

In the numerical analysis by the electromagnetic simulator "Fidelity" based on the FDTD method, the space steps are set to 0.1 mm to 1 mm (non-uniform mesh). The calculation region is 120 mm by 120 mm by 120 mm. As the absorbing boundary, the perfectly matched layer of six-layer and fourth-order is used. The incident voltage is the sine modulated Gaussian pulse [1].

3. Numerical Results and Discussion

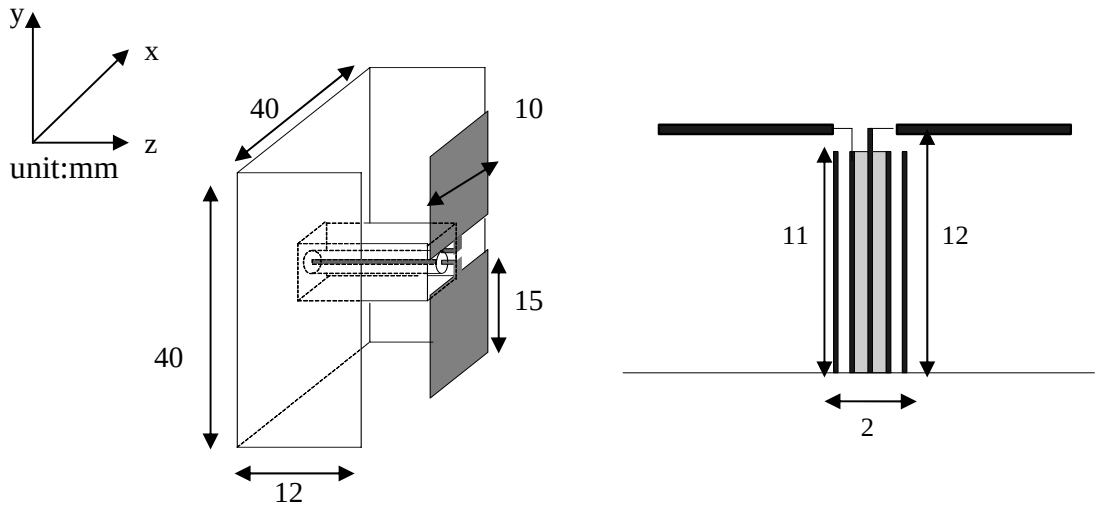
Figure 3 shows the VSWR characteristics of two antennas. VSWR characteristics of two antennas are almost same. The radiation efficiency of the antenna Model 1 deteriorates due to the

ISBN: 978-4-88552-223-9 C3055©IEICE



(a) Perspective view (b) Cross sectional view

Figure 1: Structure of antenna Model 1.



(a) Perspective view (b) Cross sectional view

Figure 2: Structure of antenna Model 2.

loss within the resistor. Figure 4 shows the directivity characteristics of two antennas. The directivities more than 9.8 dB are obtained at the frequencies from 7.1 GHz to 10.1 GHz.

Figures 5 and 6 show the electric field radiation patterns of the antenna Model 1 in yz and xz plane, respectively. The main beam direction does not change as the frequency becomes higher.

Figures 7 and 8 show the electric field radiation patterns of the antenna Model 2 in yz and xz plane, respectively. Although the backward radiation of this antenna becomes larger compared with the antenna Model 1, the directivity of this antenna is larger than that of the antenna Model 1..

4. Conclusion

Two types of the planar dipole antenna fed by the coaxial cable are numerically analyzed. The VSWR characteristics and the radiation characteristics of these antennas are analyzed at the frequencies from 7.1 GHz to 10.6 GHz. In the numerical analysis, the electromagnetic simulator "Fidelity" based on the FDTD method is used.

The resistance-loaded planar dipole antenna located within a rectangular parallelepiped cavity fed by two coaxial cables and the planar dipole antenna fed by coaxial cable with rectangular cylindrical sleeve has the unidirectional radiation patterns. Since the coaxial cable feed is easily realized, these antennas are useful for the UWB application.

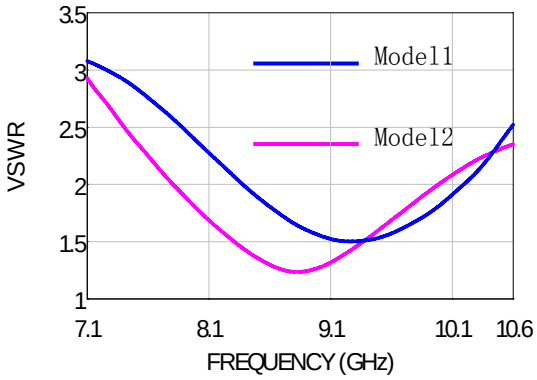


Figure 3: VSWR characteristics.

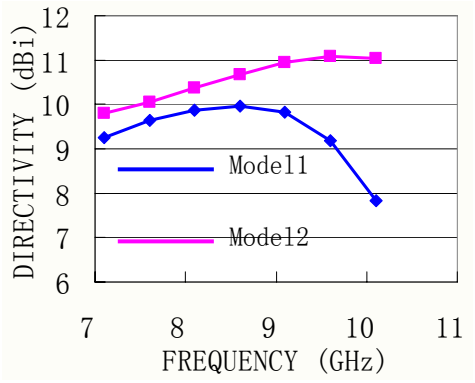
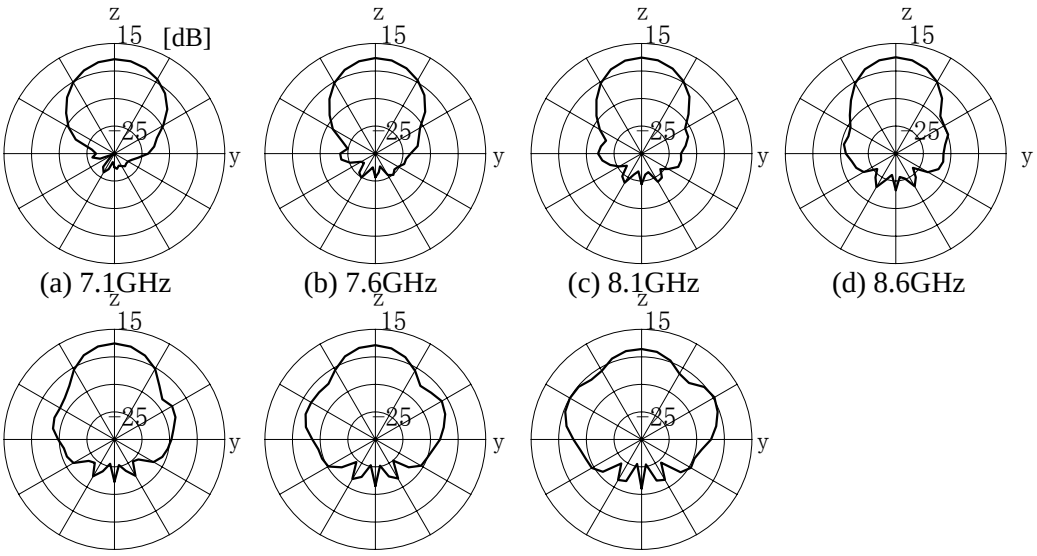


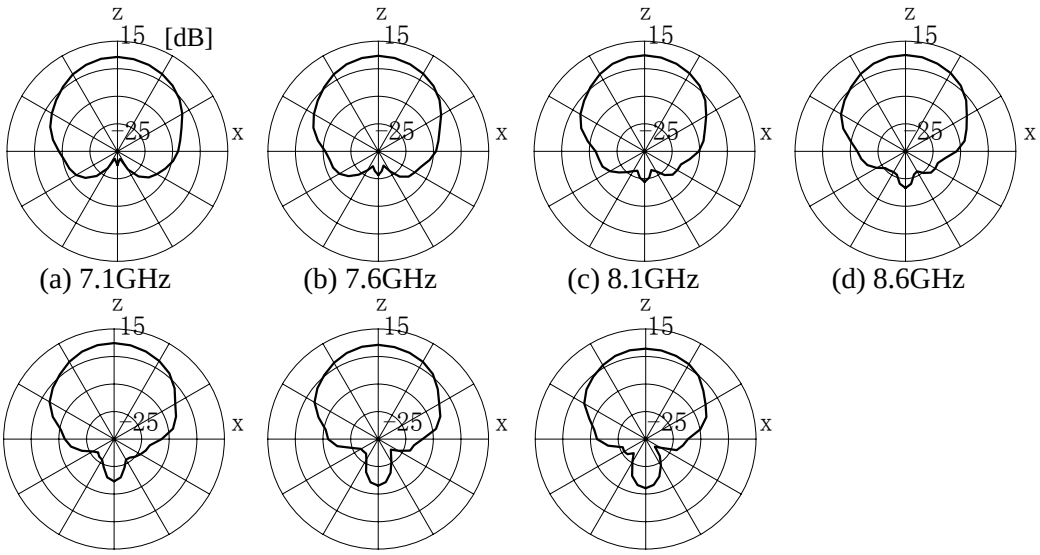
Figure 4: Directivity of two antennas.



(a) 7.1GHz (b) 7.6GHz (c) 8.1GHz (d) 8.6GHz

(e) 9.1GHz (f) 9.6GHz (g) 10.1GHz

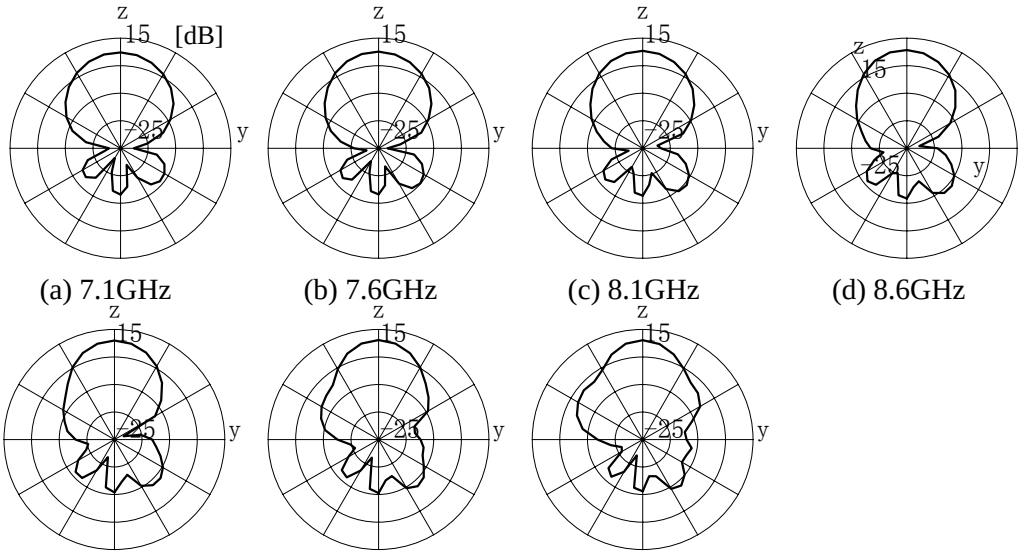
Figure 5: Electric field radiation patterns of antenna Model 1 in yz plane



(a) 7.1GHz (b) 7.6GHz (c) 8.1GHz (d) 8.6GHz

(e) 9.1GHz (f) 9.6GHz (g) 10.1GHz

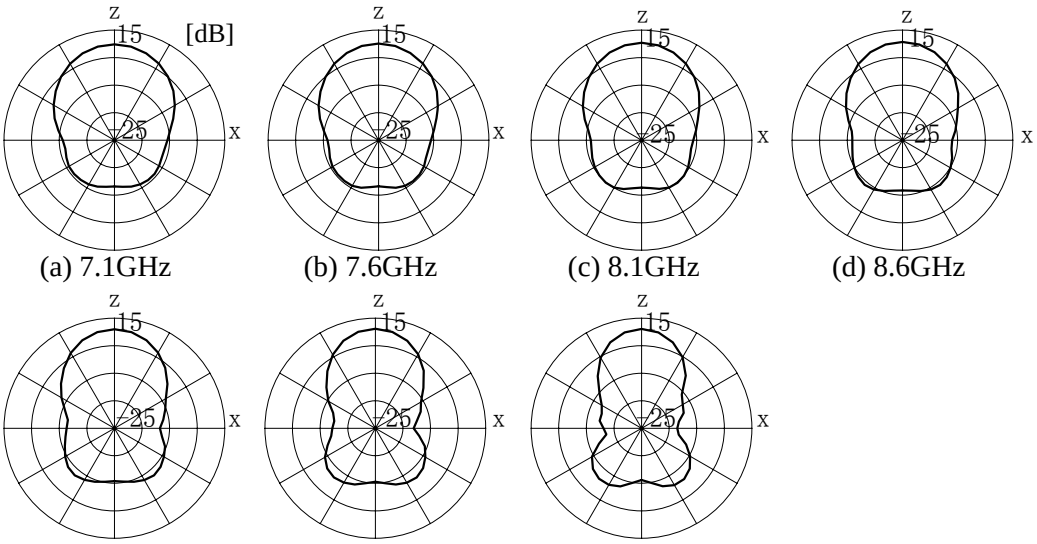
Figure 6: Electric field radiation patterns of antenna Model 1 in xz plane



(a) 7.1GHz (b) 7.6GHz (c) 8.1GHz (d) 8.6GHz

(e) 9.1GHz (f) 9.6GHz (g) 10.1GHz

Figure 7: Electric field radiation patterns of antenna Model 2 in yz plane.



(a) 7.1GHz (b) 7.6GHz (c) 8.1GHz (d) 8.6GHz

(e) 9.1GHz (f) 9.6GHz (g) 10.1GHz

Figure 8: Electric field radiation patterns of antenna Model 2 in xz plane.

References

[1] M. Taguchi, T. Ohashi and K. Tanaka: “Resistance loaded planar antenna within a rectangular parallelepiped cavity for UWB system” , Int. Journal on Wireless and Optical Communications, vol.3, no.2, pp.179-187, 2006.

[2] Zeland Software, “Fidelity User’s Manual”, April 2000.