

Analysis of The Radial Line Slot Array Antenna with Cross Slot Mutual Coupling Effects

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Abstract - The purpose of this study are realizing ultimate speed wireless LAN and manufacture of video transmission antenna for disaster prevention helicopter due to the radial line slot array antenna in millimeter-wave band. We went the entire analysis by the finite element method by the electromagnetic field analysis workstation loaded with memory of 512GB and scale model 38GHz.

Index Terms — RLSA, Waveguide, Slot array, Millimeter-wave, FEM analysis, Concentric array, Rotate mode

1. Introduction

Radial line slot array antenna. (RLSA) [1] has the structure in two high frequencies provided with a slot on the emission surface of the parallel metal plates is one of the simple antenna already concentric attempt of the entire structural analysis by slot computational load reduction by the slot has been carried out.

In this paper, showing an overall analysis of the radial line slot antenna, including the power sources for the feed structure that is rotated mode generated by the cross-slot.

2. Rotate mode feed structure

For production there is how to cut a slot, called a cross-slot powerful method that can easily and circular polarization feed as show in Fig.1 [2]. The cross polarization made from two polarization waves which are equal amplitude and 90 degree phase difference. To use two slots of different slot length which is used feeding point. RLSA's feeding structure needs circularly polarized wave by appending a phase difference [3]. However, the radiation dose was designed from a single analysis of the 45-degree polarization slot roasted, axial ratio suit poor circular polarization conditions slot is not present.

To improve axial ratio, we analysis the whole model to obtain circularly polarization including the mutual coupling effect of the feeding cross-slot and radial line structure.as show in Fig.2. In the case of 4 slot pairs, when the length of feeding cross slot L_a and L_b are optimized, the TEM wave has rotate mode as shown in Fig.3.

3. Radiating concentric slot array pair

The radiating slot pairs for circularly polarization are arranged concentrically [4] on the slot plate of RLSA. The side of the standard waveguide to the equivalent of analysis conditions and within the radial line by a periodic boundary,

wearing a 90 degree phase difference by attaching a difference in $1/4$ lambda position as show in Fig.4.and Fig.5.

Was looking for the most out of the radiated power resonant length. As a result, the resonant slot length become almost 3.82mm in 38GHz.

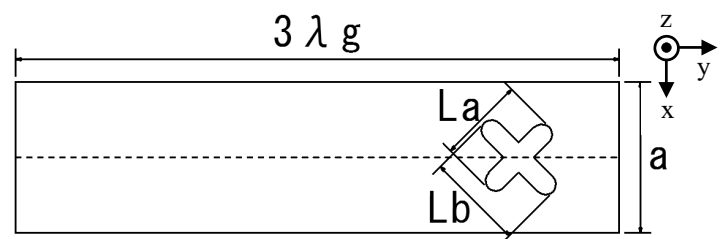


Fig.1. The structure of the rectangular feed waveguide with cross-slot.

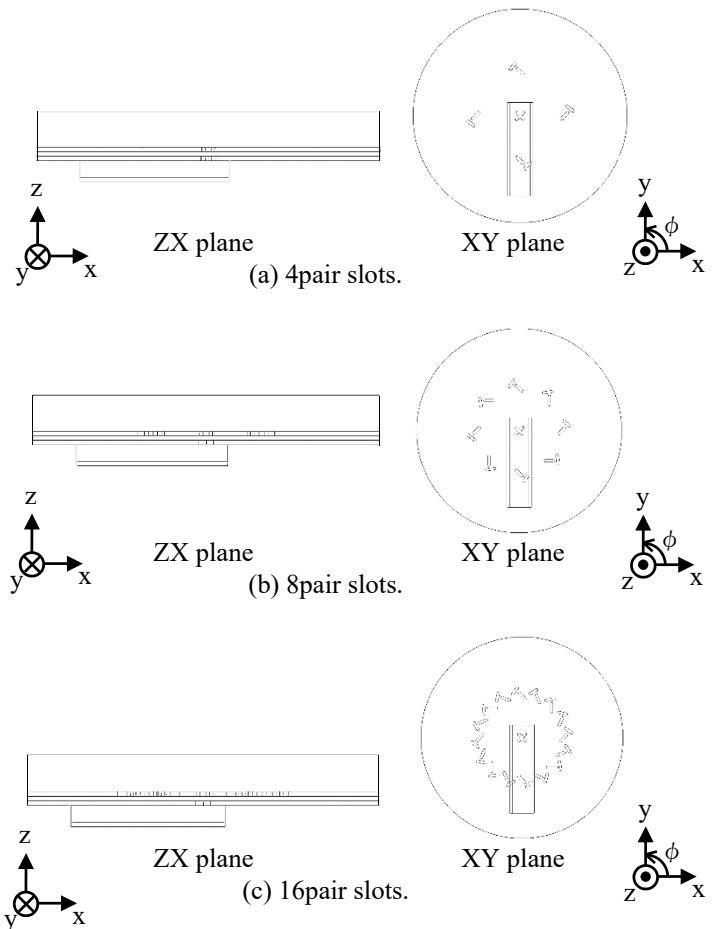


Fig.2. The structure of RLSA in the case of 3 types slot pair numbers.

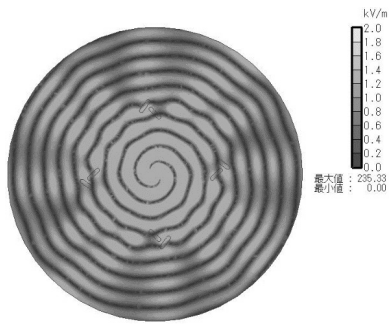


Fig.3. The amplitude of E-field in the radial line.

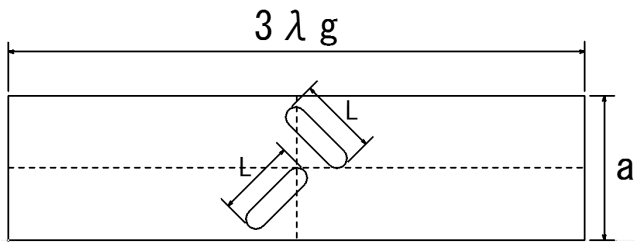


Fig.4. Radiating slot pair for circular polarization

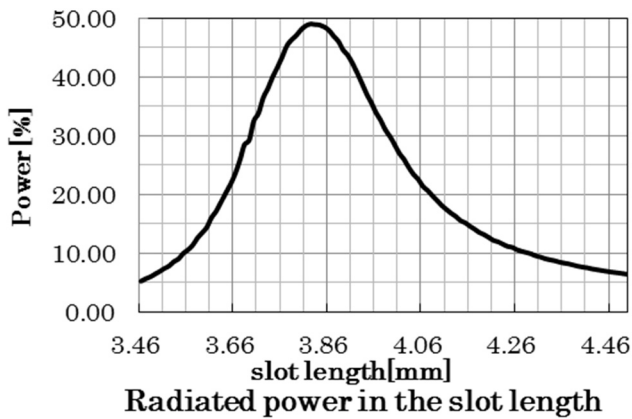


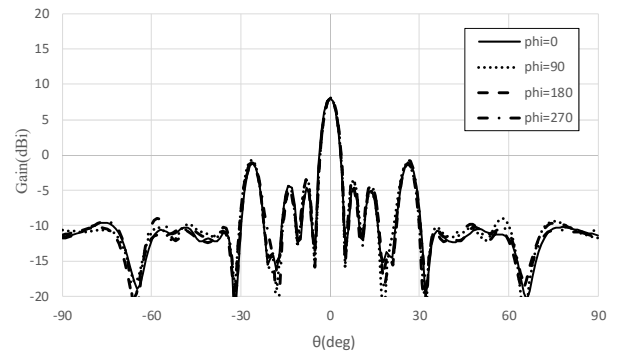
Fig. 5. The radiation power by the slot length

4. Confirmation by the radiation directivity

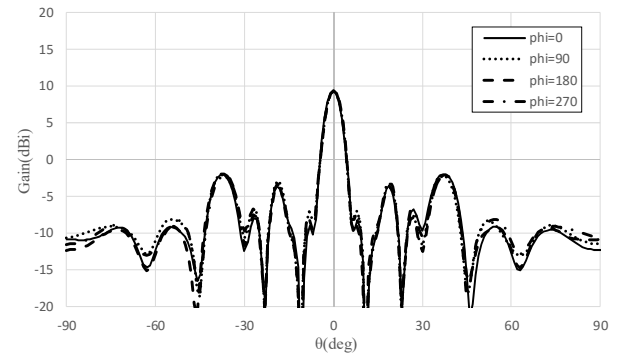
To indicate that the power supply to the radial line in accordance with rotation mode feed structure is made, and four sets placing shaped slot pairs in concentrically arranged as shown in Fig. 2 (a). Electromagnetic radial in line results but if a rotation mode, was the entire analysis of the radial line slot antenna, including the power supply section by using the electromagnetic field analysis simulator Femtet by the main beam so that the faces. The finite element method in the bore-sight direction, it was confirmed that the main beam is formed on the emitting surface direction as shown in Fig.6.

5. Conclusion

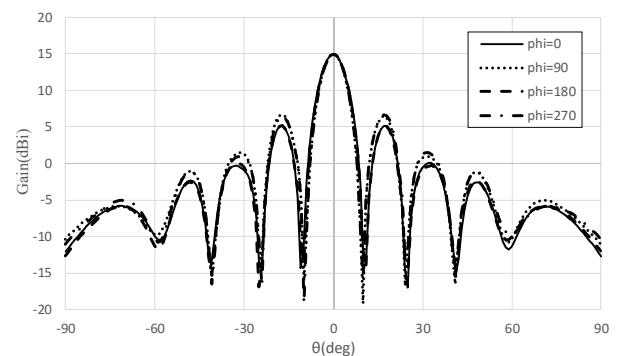
It was realized the millimeter-wave band due to cross-slot rotation mode excitation radial line slot array antenna. Future issues are experiments according to the prototype.



(a) 4pair slots.



(b) 8pair slots.



(c) 16pair slots

Fig. 6. Radiating characteristics of circular polarization in the case of 3types slot pair numbers.

References

- [1] Naohisa Goto, and M. Yamamoto, "Circularly Polarized Radial-Line Slot Antennas", Technical Report of IECE, AP80-57, pp.43-46, Aug. 1980.
- [2] Sudo, Hirano, Hirokawa, and Ando, "A Radial Line Slot Antenna Fed by a Rectangular Waveguide through a Crossed Slot," IEICE TRANS. COMMUN., Vol.E86-B, no.10, Oct. 2003.
- [3] S. Hosono, J. Hirokawa, M. Ando, N. Goto and H. Arai, "A rotating mode radial line slot antenna fed by a cavity resonator." IEICE Trans. Commun. vol.E78-B, no.3, pp.407-413, Mar.1995.
- [4] Kaoru SUDO, Takuichi HIRANO, Jiro HIROKAWA, Makoto ANDO, "A Radial Line Slot Antenna Fed by a Rectangular Waveguide through a Crossed Slot." IEICE TRAANS COMMUN., VOL.E86-B, no 10 Oct 2003