Co-aperture dual-band waveguide monopulse antenna

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Abstract- **This paper describe a novel design of dual band monopulse antenna array ,which is made of a X-band and a K-band in the same planar radiating surface. The K-band array is the traditional waveguide slot antenna ,which is interfaced to the X-band antenna. The simulated and measured radiation patterns at center frequency are both presented. The side-lobe level for the sum pattern of two frequency are all less than -22dB , which have been achieved in the experiment .**

I. INTRODUCTION

Dual mode compound guidance system has many advantages, such as long distance, high-precision and high hit probability, which has wide application foreground and becomes the precision-guided weapon development orientation in future.

Compound monopulse dual-frequency antenna array is the key component of dual mode guidance system, which may provide the information of the elevation, azimuth and distance through one pulse. This information can be used to realize the precise bearing and tracking. In Traditional monopulse radar system, the common type of the dual band antenna are Cassegrain parabolic antenna with double feeds [1], which is acceptable when the available aperture dimensions are enough wide with respect to the wavelength. In paper[2],the dual-band feed of the lower band with four horns and the higher band feed with a monopluse multimode horn is presented , while the efficiency of lower band antenna is only 15% due to the space between two adjacent horn in two-dimensions

In order to reduce the profile of parabolic antenna, a dual band antenna have been made also as reflect array [3], with the advantage of employing planar instead of parabolic re-radiating surface. This implies cost reduction, but less efficiency and power gain, which is similar to parabolic antenna.

In this paper, a novel planar dual band monopulse antenna is presented, the K-band array is the traditional waveguide slot antenna to satisfy the need of lower sidelobe levels and greater efficiency. On the same planar radiating layer ,the X-band antenna array is interlaced to K-band slot array. The lower levels include the feeding waveguides and the monopulse comparators of X-band and K-band respectively .The simulated and measured radiation patterns at center frequency are both presented. Its structure and experimental results are presented as follow.

II. DESCRIPTION OF THE ARRAY

The proposed dual-band monopulse antenna array as shown in Fig.1, K-band array is the traditional waveguide slot antenna ,which can accurate control the aperture excitation amplitude through changing the offset of cutting slots into the broad wall of waveguide .The X-band radiator is rectangular waveguide ,which can be fed from end. The X-band antenna array is interlaced to K-band slot array on the same aperture. This planar array is made of 8×8 radiating elements in X-band and 18×18 slots in K-band, both divided in four sub-arrays and arranged in a circle .

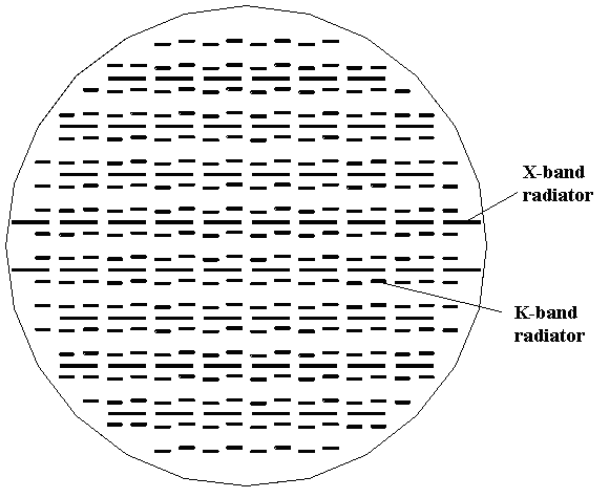
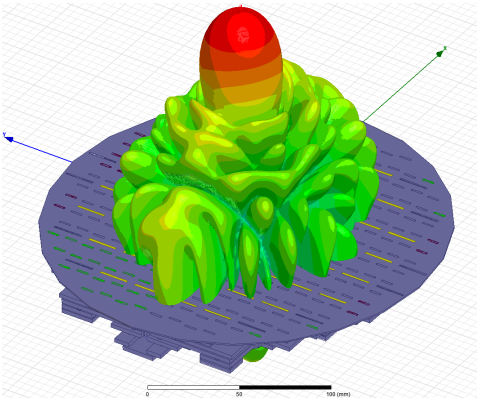


Figure 1. Schematic of Dual-band Antenna

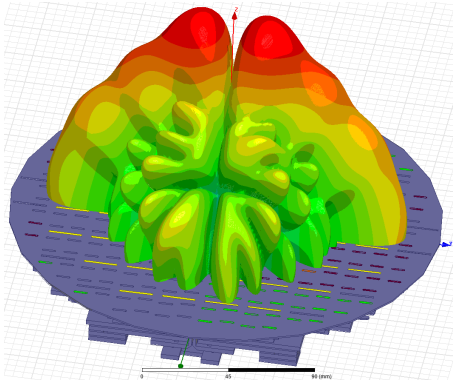
The feeding networks and comparators are all on the lower levels ,which use waveguide structure . The comparators of different frequency are all formed by four 3dB hybrid junctions. The four inputs of the comparator are connected with four sub-arrays ,four outputs of the comparator are connected to the sum ,H-plane difference, E-plane difference and matching load respectively.

III. SIMULATED RESULTS

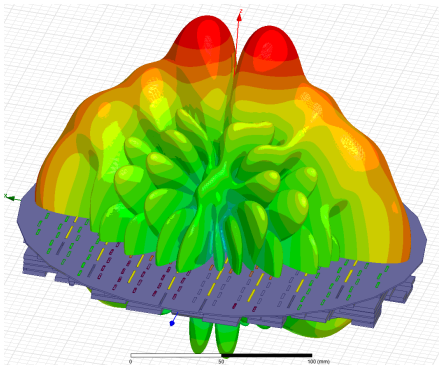
The simulated 3-dimentional radiation patterns both for sum and for difference beams at X-band and K-band are shown in Fig.2 and Fig.3,and it is seen that the first side lobe of sum are all below -22dB at different frequency. The gain of X-band and K-band is 23.0dB and 30.0dB respectively.



(a) Sum pattern

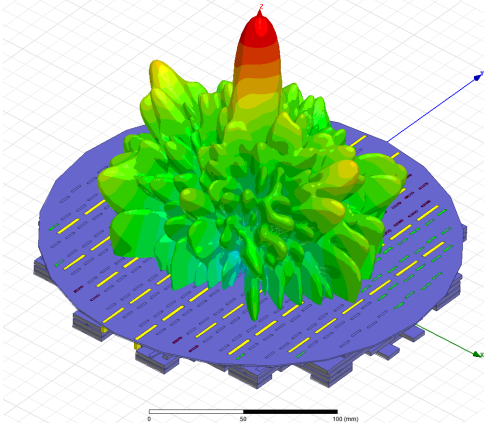


(b) E-plane difference pattern

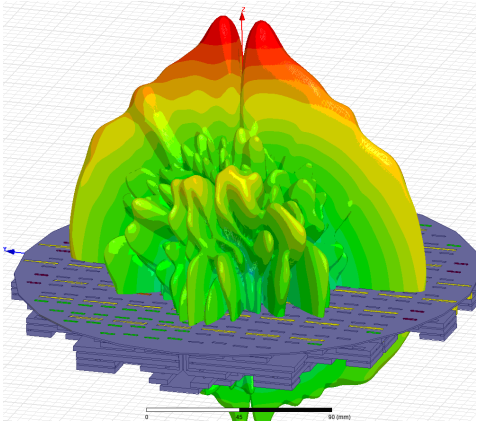


(c) H-plane difference pattern

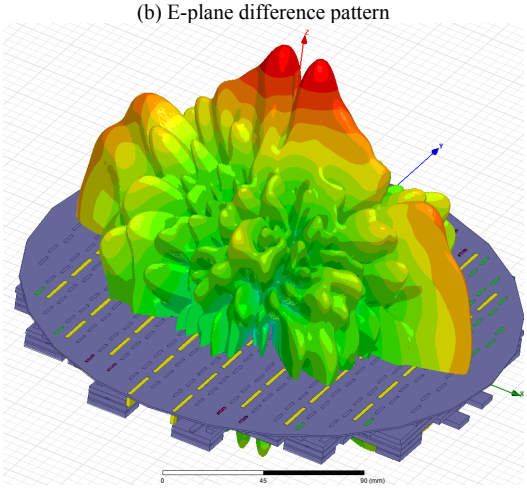
Figure 2 simulated 3-dimensional patterns at X-band



(b) Sum pattern



(b) E-plane difference pattern



(c) H-plane difference pattern

Figure 3 simulated 3-dimensional patterns at K-band

IV. MEASURED RESULTS

A test antenna was fabricated and the radiation patterns were measured in an anechoic chamber. The figures highlight a good agreement between theory and experiment.

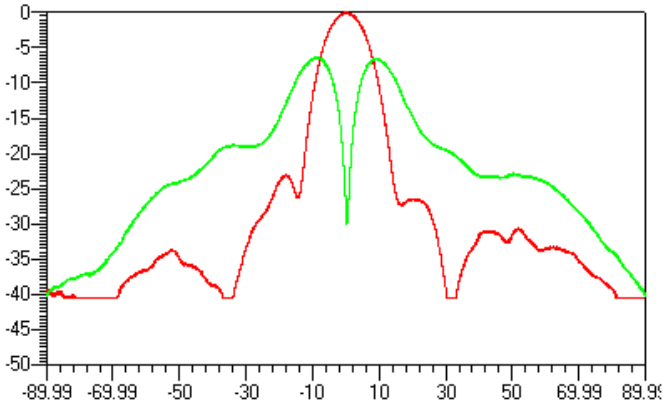


Figure 4 measured sum and difference patterns at X-band

In detail, the first side lobe of X-band and K-band for sum pattern are -22dB and -27dB respectively, the null depth of different frequency for difference pattern are -30dB and -28dB

respectively. At dual band ,the efficiency of this compound antenna array is above 40 percent ,which is similar to one frequency antenna.

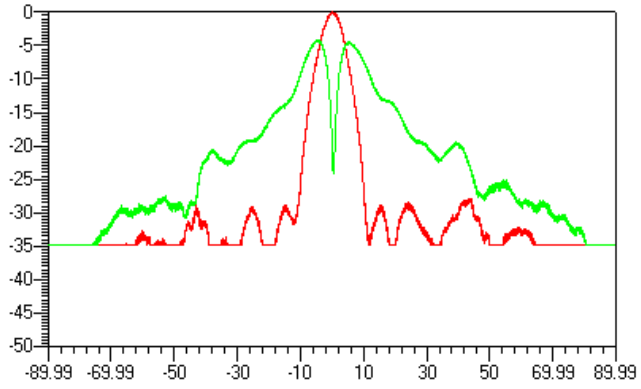


Figure5 measured sum and difference patterns at K-band

V. CONCLUSION

A novel dual band monopulse planar antenna has been introduced in this paper, which is made of a X-band array and a K-band array in the same radiating surface. The -22dB side-lobe level for the X-band sum pattern and -27dB side-lobe level for the K-band sum pattern have achieved in the experiment at center frequency and the efficiency is above 40 percent, which is similar to the efficiency of single frequency monopulse antenna.

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