The 5th IEEE International Conference on Electronic Information and Communication Technology

Corrugated Horn Antenna With High Isolation Using Differential Feeding Scheme

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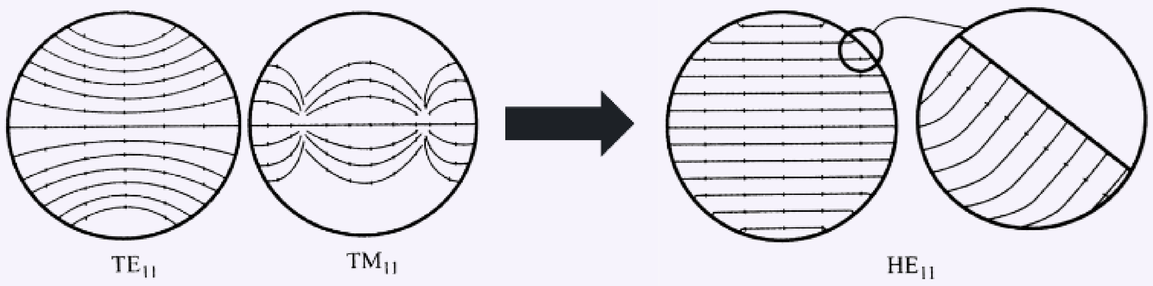
Introduction

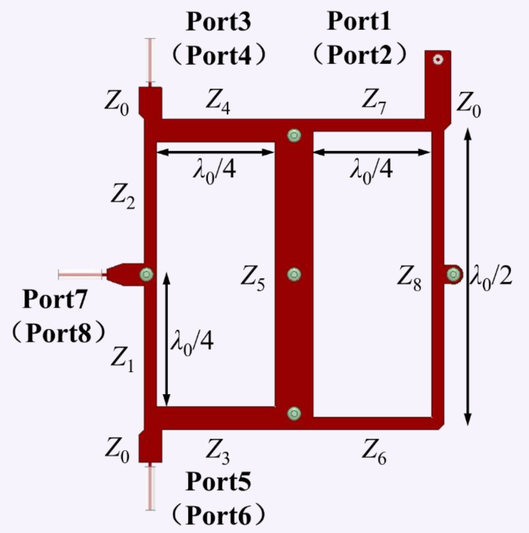
- The horn antenna has several advantages of high antenna efficiency, stable radiation patterns and reliable structures, which is widely used in communication, radar.
- A corrugated horn antenna with high isolation based on differential feeding scheme is proposed.

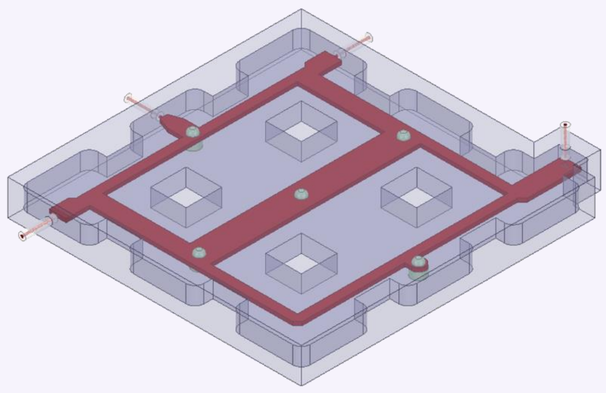
The generation of HE_{11} mode

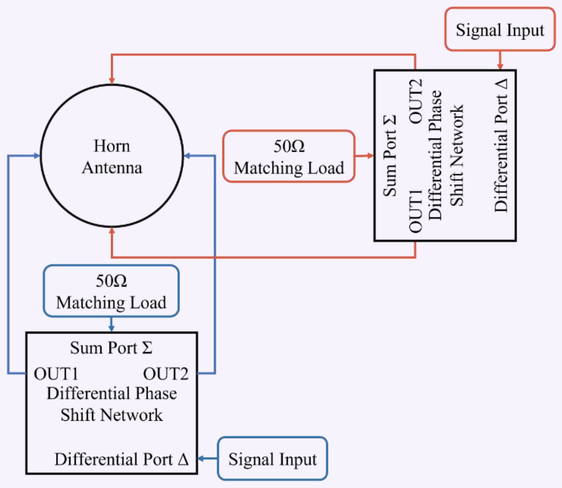


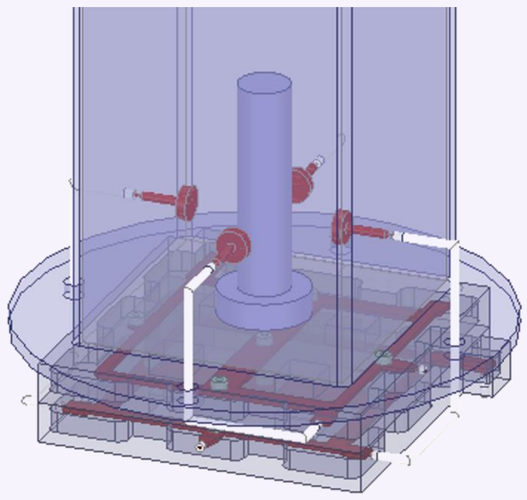
The corrugated horn with a wide flare angle is adopted to reduce the length of the horn section

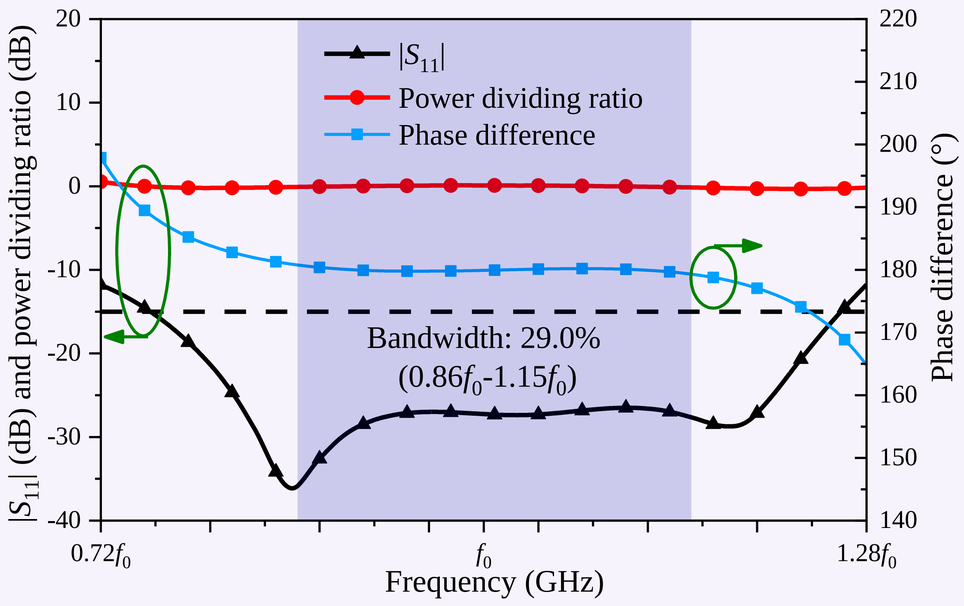
Differential Feeding Structure





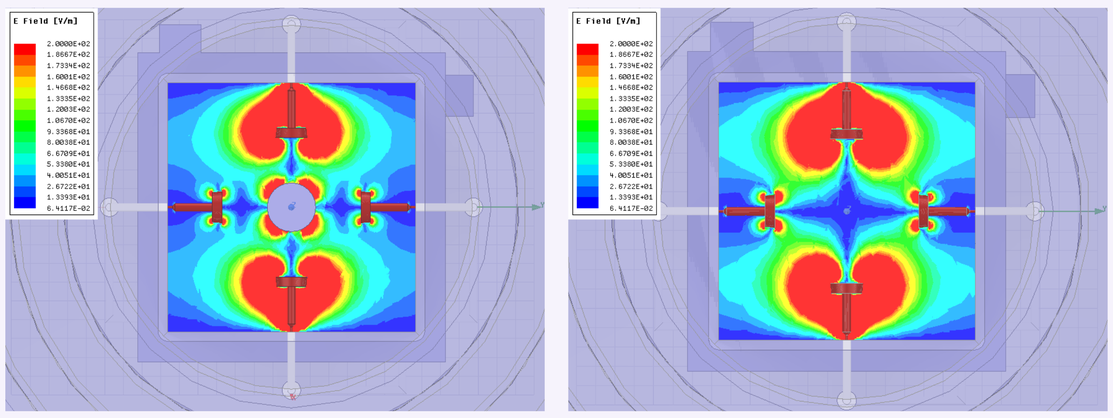






The Gysel type wideband hybrid ring can provide an ideal differential signal in a wide frequency band.

Comparison result of E_y component

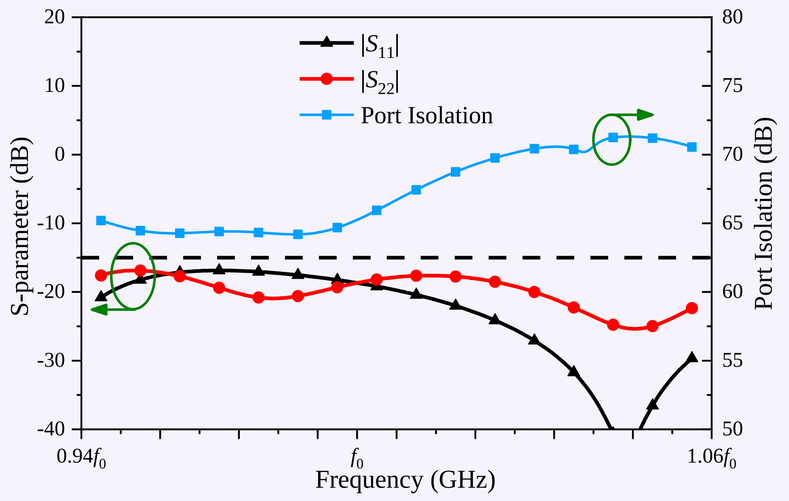


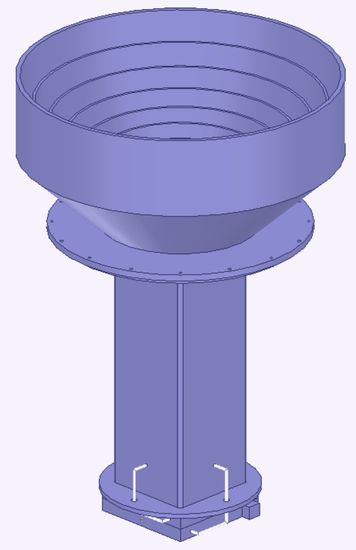
With the metal column | Without the metal column

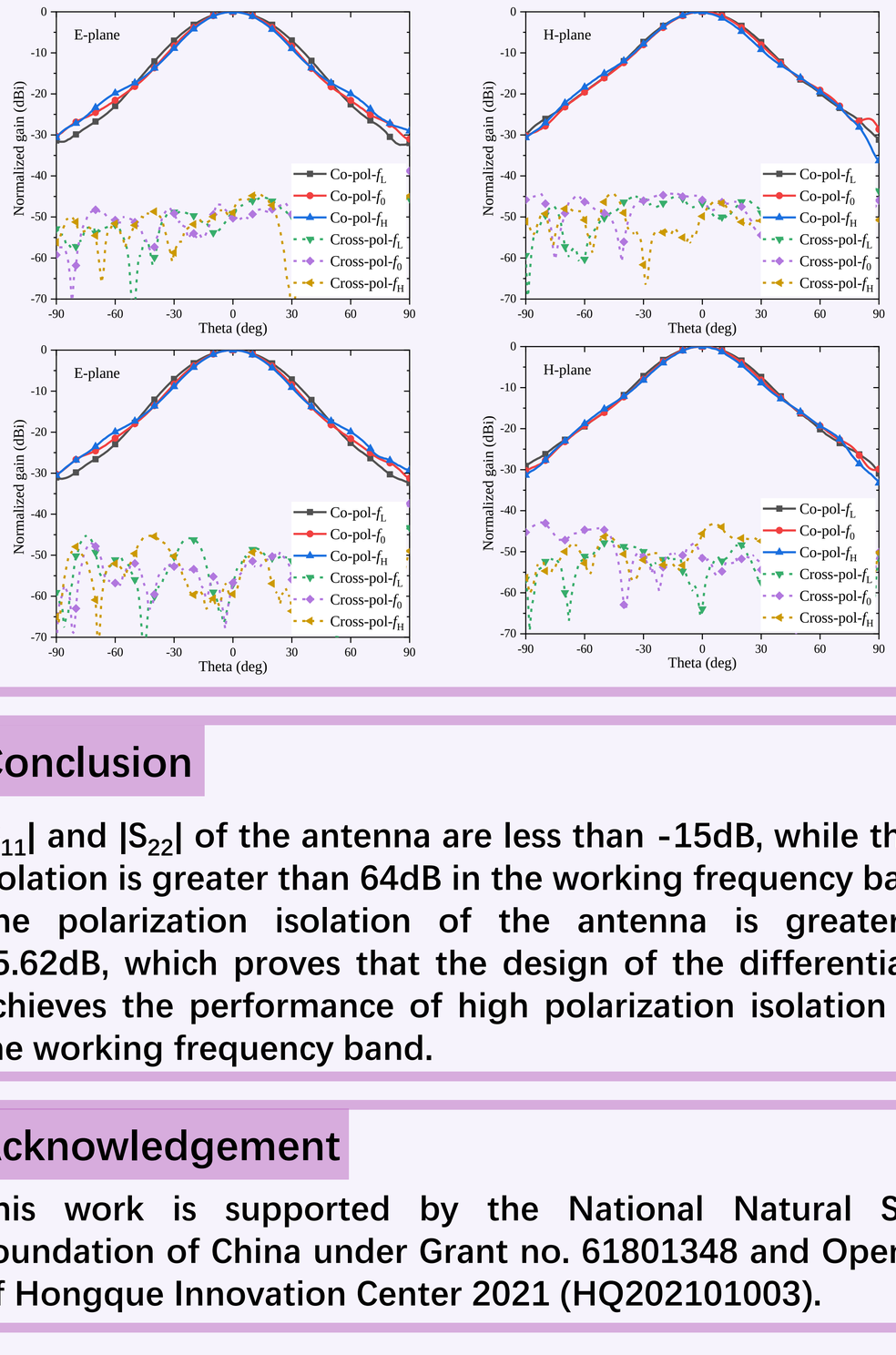
The total electric field can be decomposed into a vector comprising E_x component parallel to the main polarization and E_y component orthogonal to the main polarization.

$$\vec{E} = \vec{E_x} + \vec{E_y}$$

Results







Conclusion

- $|S_{11}|$ and $|S_{22}|$ of the antenna are less than -15dB, while the port isolation is greater than 64dB in the working frequency band.
- The polarization isolation of the antenna is greater than 45.62dB, which proves that the design of the differential feed achieves the performance of high polarization isolation within the working frequency band.

Acknowledgement

- This work is supported by the National Natural Science Foundation of China under Grant no. 61801348 and Open Fund of Hongque Innovation Center 2021 (HQ202101003).

Reference: [1] I. Agnihotri and S. K. Sharma, “Design of a 3D Metal Printed Axial Corrugated Horn Antenna Covering Full Ka-Band,” IEEE Trans. Antennas Propag., vol. 19, no. 4, pp. 522-526, Apr. 2020.
[2] R. Lehmensiek and D. I. L. de Villiers, "Wide flare angle axially corrugated conical horn design for a classical offset dual-reflector antenna," 2012 6th European Conference on Antennas and Propagation (EUCAP), pp. 3292-3294, Mar. 2012.
[3] J. E. McKay et al., “Compact Wideband Corrugated Feedhorns With Ultra-Low Sidelobes for Very High Performance Antennas and Quasi-Optical Systems,” IEEE Trans. Antennas Propag., vol. 61, no. 4, pp. 1714-1721, Apr. 2013.
[4] H. Shahi Gharehaghaji and H. Shamsi, “Design of Unequal Dual Band Gysel Power Divider With Isolation Bandwidth Improvement,” IEEE Microw. Wireless Compon. Lett., vol. 27, no. 2, pp. 138-140, Feb. 2017.
[5] C. Pan, Z. Zhao, X. Zhang and Z. Wang, "The Analysis of Balanced Feed Low Cross-Polarization Quad-Ridged Horn Antenna for OTA Testing," 2021 IEEE 4th International Conference on Electronic Information and Communication Technology (ICEICT), pp. 462-465, Aug. 2021.
[6] Z. Zhao, Z. Wang, J. R. Kelly and S. Gao, “Balanced Feed Low Cross-Polarization Quad-Ridged Horn Antenna With Center Cross Fusiform Loaded,” IEEE Trans. Antennas Propag., vol. 69, no. 9, pp. 6004-6009, Sept. 2021.
[7] T. S. Beukman, P. Meyer, M. V. Ivashina and R. Maaskant, “Modal-Based Design of a Wideband Quadruple-Ridged Flared Horn Antenna,” IEEE Trans. Antennas Propag., vol. 64, no. 5, pp. 1615-1626, May. 2016.
[8] N. -W. Liu, L. Zhu, Z. -X. Liu, G. Fu and Y. Liu, “Design Approach for Low-Profile Tri-Polarization Patch Antenna With Simultaneous Harmonic Suppression,” IEEE Trans. Antennas Propag., vol. 70, no. 4, pp. 2401-2410, Apr. 2022.
[9] N. -W. Liu, L. Zhu, Z. -X. Liu, M. Li, G. Fu and Y. Liu, “A Novel Low-Profile Circularly Polarized Diversity Patch Antenna With Extremely Small Spacing, Reduced Size, and Low Mutual Coupling,” IEEE Trans. Antennas Propag., vol. 70, no. 1, pp. 135-144, Jan. 2022.
[10] N. -W. Liu, L. Zhu, Z. -X. Liu, G. Fu and Y. Liu, “Radiation Pattern Reshaping of a Narrow Slot Antenna for Bandwidth Enhancement and Stable Pattern Using Characteristic Modes Analysis,” IEEE Trans. Antennas Propag., vol. 70, no. 1, pp. 726-731, Jan. 2022.