HORN ANTENNA DESIGN FOR KU-BAND APPLICATIONS USING 3D PRINTER

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Introduction

- In this project, my goal is designing a horn antenna working for Ku-band (12-18 GHz) applications using CST Microwave Studio. In the simulation 3D print ink and filaments are used. After simulation part, the designed antenna has fabricated using 3D printer and measured in antenna laboratory.
- Main purpose of my project is using a cheaper, lighter, and basic material instead of a heavier metal correlate. To accomplish this I used a plastic skeleton fabricated by 3D printer and a aluminium coating.

Specifications and Design Requirements

- As a reference, antenna with 15 db gain sold on Pasternack's website is used. I modeled this antenna on CST microwave studio. I tried to design an antenna working better than reference antenna. To look at the reference antenna, it has a pick point near --45 dB at 14.5 GHz and for other frequency interval S parameter is near -30 dB. After few trials I achieved a better result than this reference antenna. It has a pick point -72 dB at 13.2 GHz and for other frequency Ku-band frequency interval, it gives a S parameter below -30 dB. This shows that, this antenna can be used in the project.

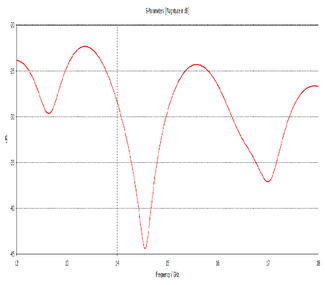

Figure 1: Reference antenna S parameters

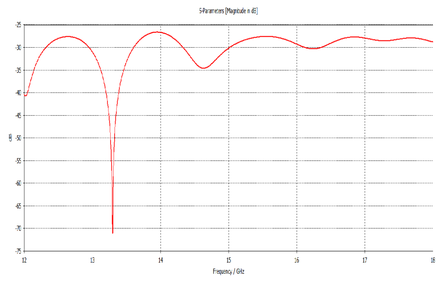

Figure 2: Designed antenna

Solution Methodology

- Project design starts with choosing the correct material for skeleton fabricated by 3D printer. Then in the second stage choice of coating material takes place. After choosing the materials used at inside and outside, antenna lengths are adjusted to work for Ku-band. In the project ABS plastic is chosen as skeleton material. For the coating, aluminium is chosen. Antenna length is adjusted to reach a better result than reference antenna.

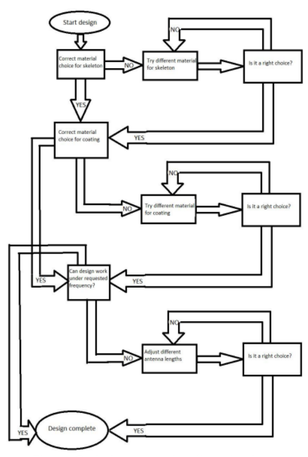

Figure 3: Antenna design flowchart

- Antenna consists of a plastic skeleton

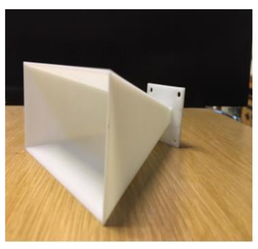
Figure 4: ABS skeleton

- A coating material

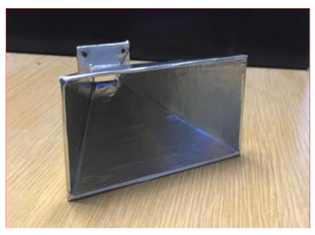
Figure 5: Aluminium coated skeleton

Application Areas

- This prototype can be used as a feed element for large radio astronomy, satellite tracking, and communication dishes found installed throughout the world. In addition to its utility as a feed for reflectors and lenses, it is a common element of phased arrays and serves as a universal standard for calibration and gain measurements of other high gain antennas.

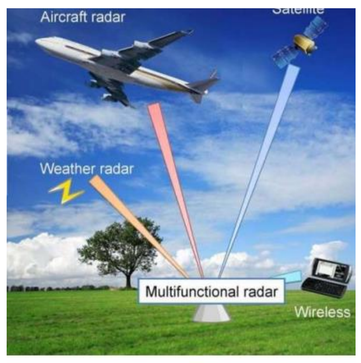

Figure 6: Aircraft, satellite feed element

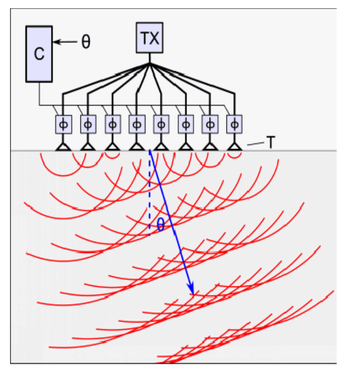

Figure 7: Array antenna

Results and Discussion

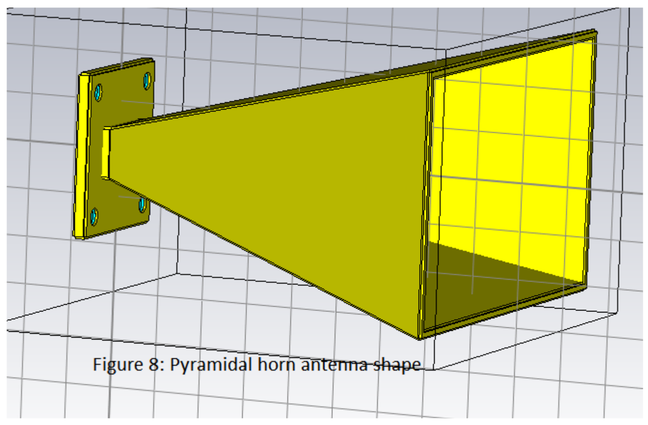
Figure 8: Pyramidal horn antenna shape

- With the antenna designed, I reached the expected result. Antenna is working for Ku-band (12-18 GHz) with -75 dB peak for 13.3 GHz and S11 parameter is below -30 dB within that interval.

- I achieved the project specifications with CST Microwave Studio by taking a reference antenna sold on Pasternack. On the simulation programme, I tried each type of plastic material available for 3D printing and metal coating material that I can easily found and this resulted in ABS plastic for skeleton and aluminium coating material.

- In the future work, this project can be used as a feed element for large radio astronomy.

Acknowledgements

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