



Horn Antenna Design for Ku-band Applications Using 3D Printer

Burak DEMİRBÜKEN, Mustafa Berkay İLKAR

Supervisor

Prof Dr. Birsen SAKA

Electrical and Electronics Engineering, Hacettepe University



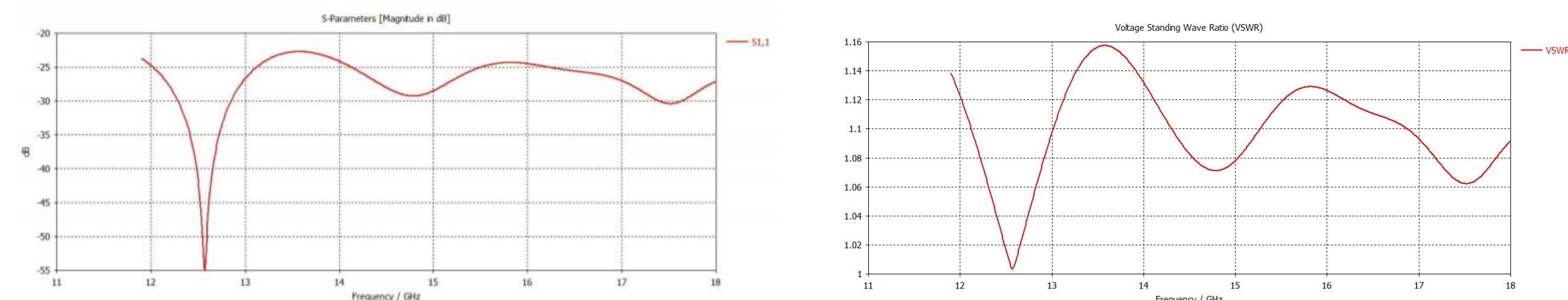
Introduction

- ❖ Antenna is defined basically as a metallic device, rod or wire for radiating or receiving radio waves.
- ❖ The IEEE Standard Definitions of Terms for Antennas defines the antenna or aerial as “a means for radiating or receiving radio waves.”
- ❖ The Horn antenna was used in the late 1930s with increasing interest in microwaves and waveguide transmission lines during the period of World War II

Specifications and Design Requirements

Specifications of our antenna are:

- ❖ Gain 15 dBi
- ❖ Return loss -55 dBi at desired frequency , max -23 dBi
- ❖ VSWR 1.01 at desired frequency, max 1.16



Solution Methodology

- ❖ Design of the horn antenna starts with researching antenna lengths. Simulations takes place and if they are appropriate for design specifications, manufacturing process starts with choosing material for 3D printer. After selecting material prototype constructs and coating process with a selecting material initiates.

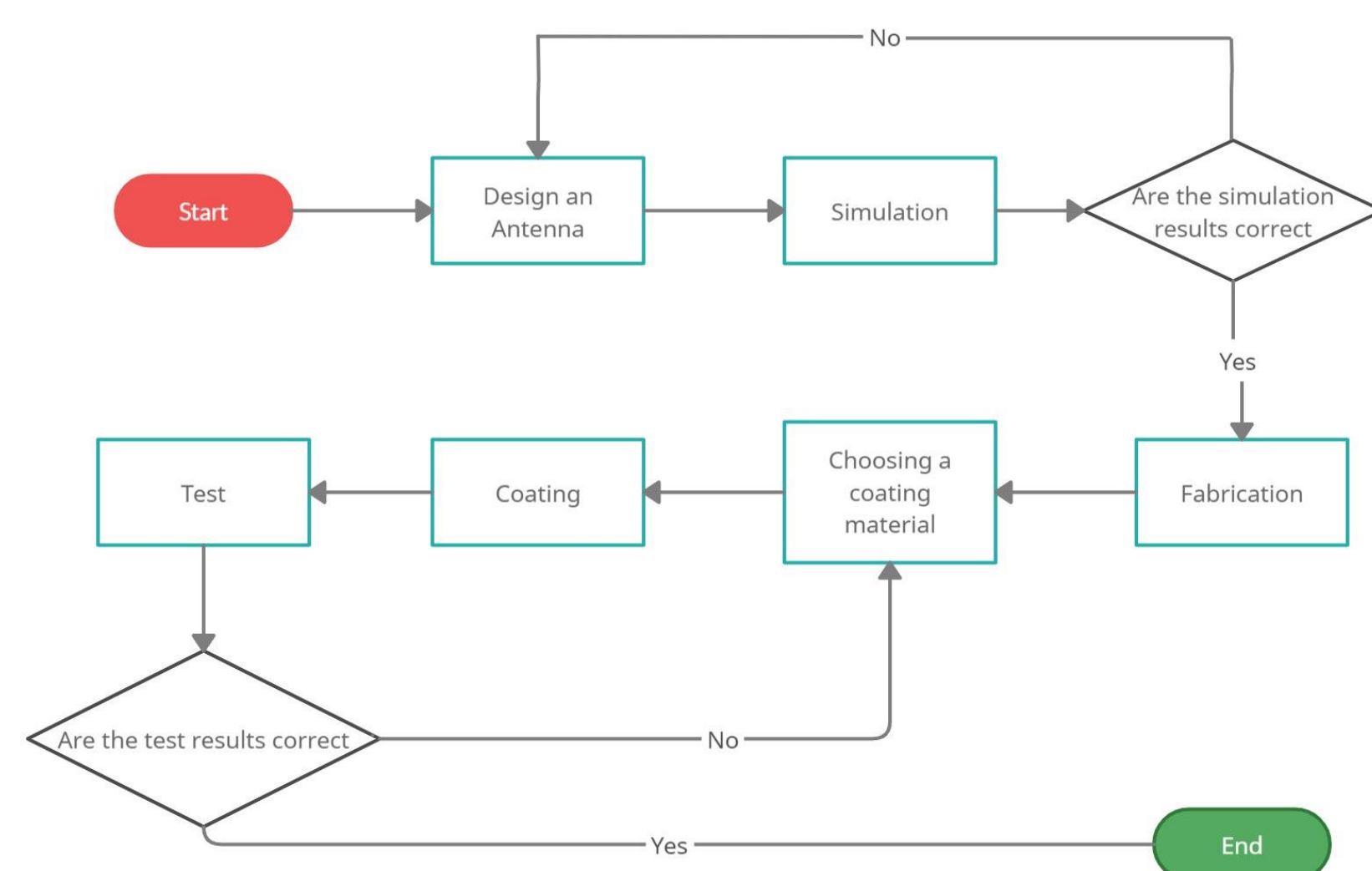


Figure: Flowchart of designing horn antenna

- ❖ ABS filament is chosen in this project as plastic skeleton of the horn antenna

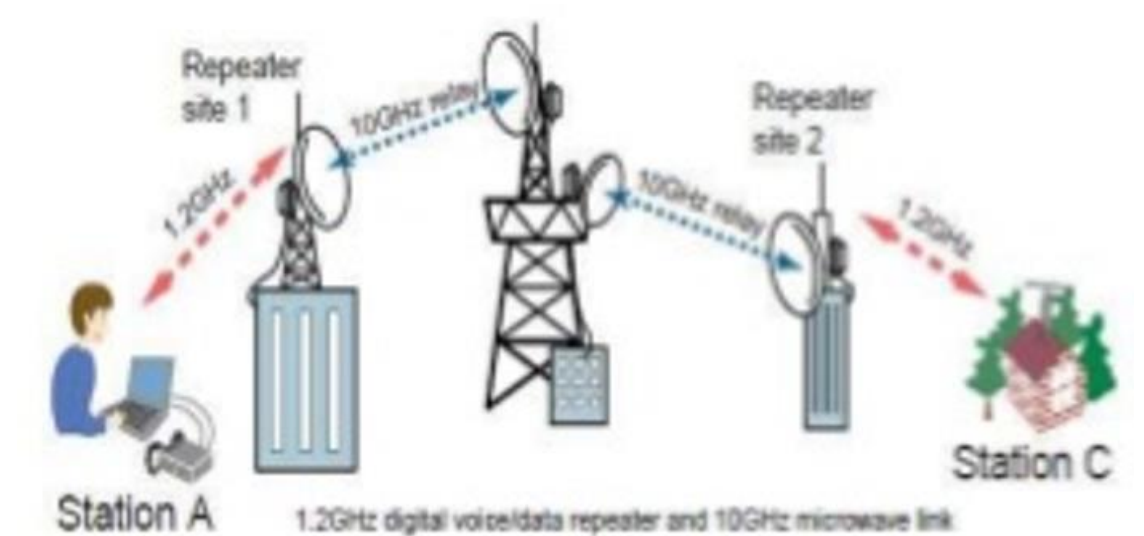
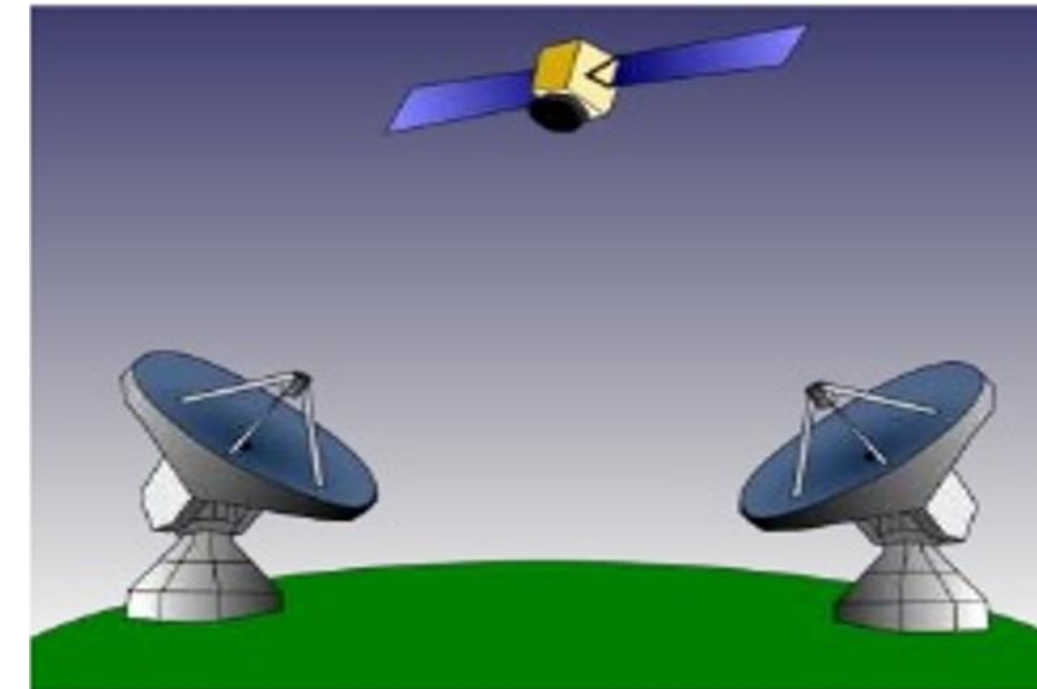


- ❖ Aluminium is chosen as coating material of the horn antenna

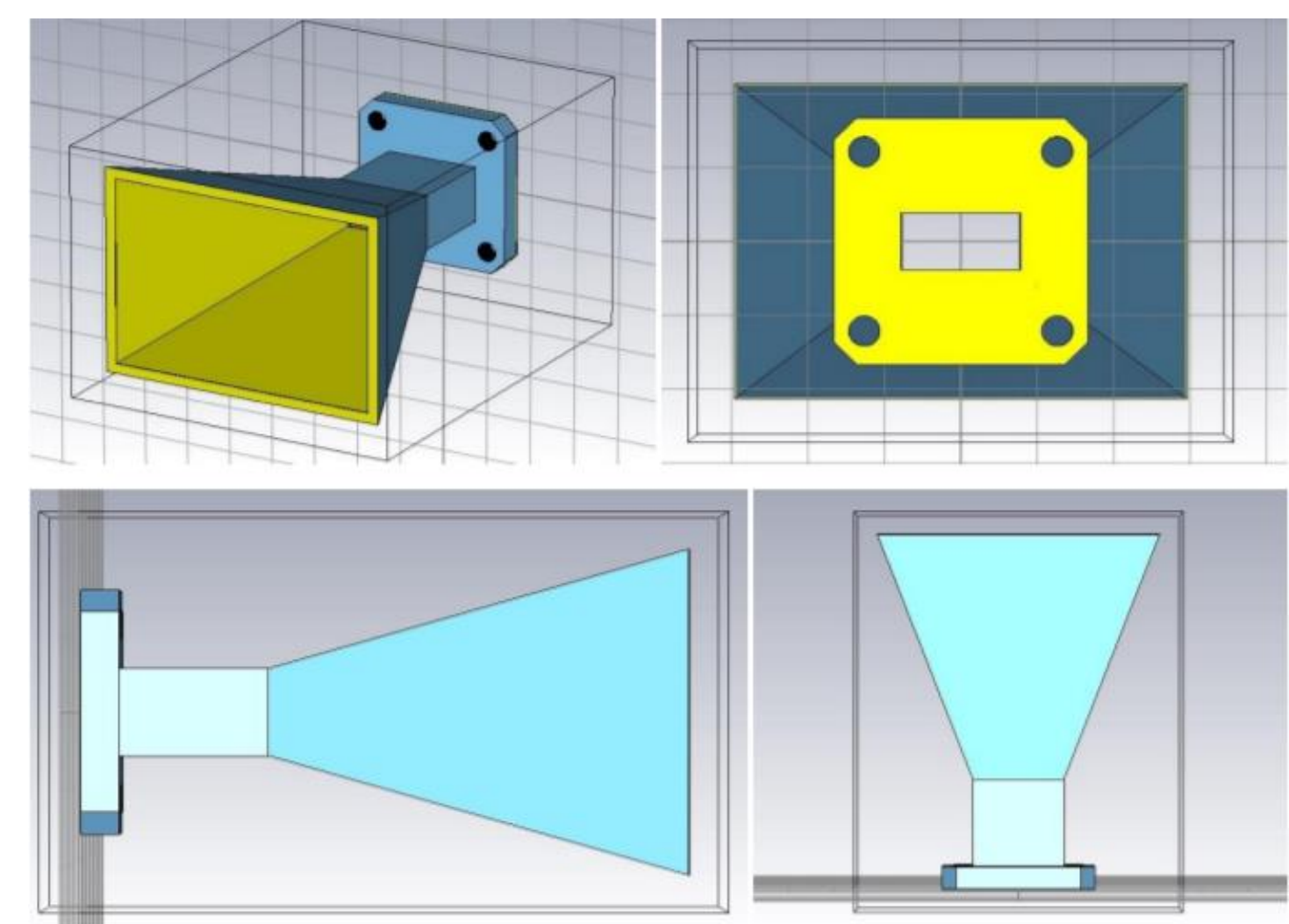


Application Areas

- ❖ They are used as feeders for larger antenna structures such as parabolic antennas, as directive antennas for such devices as radar guns, automatic doors openers, microwave radiometer.
- ❖ A common element of phase array.
- ❖ Satellite and microwave communications.
- ❖ Used in the calibration, other high gain antenna.
- ❖ Used for making electromagnetic interference measurement.



Results and Discussion



- ❖ Designed antenna is working for Ku-band (12-18 GHz) with -55 dB return loss at 12.5 GHz. The fabricated antenna has -27 dBi return loss at 12.5 GHz.
- ❖ Material search for the horn antenna is important. There are possible alternatives even conductive materials but conductive filament resistivity is higher than aluminium coating.
- ❖ Designed horn antenna could be use as a feeding element for radio astronomy.

References

- C.A. Balanis, “Antennas,” in Antenna Theory: Analysis and Design, 4.th ed., John Wiley and Sons Inc. 2016.
- D. E Cozzens, "Tables Ease Horn Design," in Microwaves, pp.37 -39, March 1966.
- K. Liu, C. A. Balanis, C. R. Birtcher and G. C. Barber, "Analysis of Pyramidal Horn Antennas Using Moment Method", in IEEE Trans Antennas Propagat., vol. AP41, pp. 1379-1389, October 1993.
- E. V. Jull, "Errors in the Predicted Gain of Pyramidal Horns" in IEEE Trans Antennas Propagat., vol. AP-21, pp. 25-31, January 1973.

Acknowledgements

- ❖ This project was completed within the context of ELE401-401 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.
- ❖ We thank Prof Dr. Birsen SAKA for her invaluable contributions to our project.