Design of a Software Tool for Array Antenna Analysis

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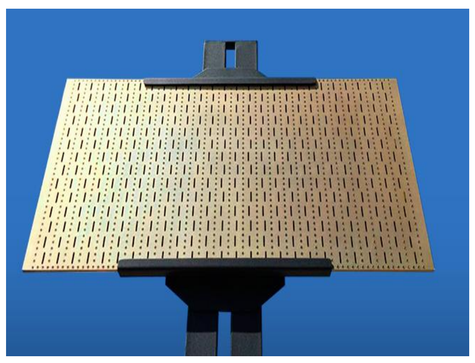
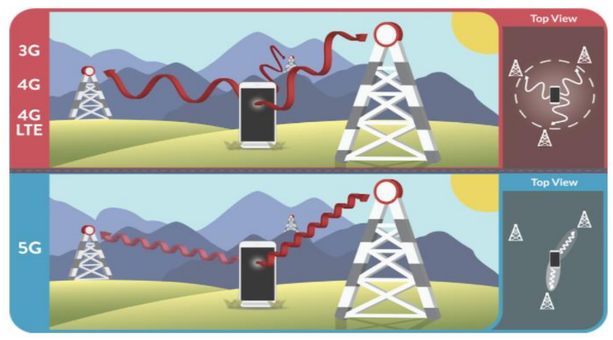
Introduction

- Antennas are an indispensable tool of wireless communication. An antenna is a metallic structure that captures and/or transmits radio electromagnetic waves.
- Array geometry is used to make the most efficient use of antennas and to change their orientation.
- In this project,1D,2D&3D array geometrices were used. Used the Matlab GUI interface while simulating these geometries.

Application Areas



Radar



Mobile Communication

Specifications and Design Requirements

- Among many interface programs, Matlab GUI has been chosen as the easiest to use, resourceful and most common program.

Solution Methodology

- In general,the array factor formula for designing the antenna array by using the Matlab GUI is like below:

$$AF = \frac{1}{N}\,\frac{\sin(\frac{N}{2}\,kd.\cos\theta+\varphi)}{\sin(\frac{1}{2}\,kd.\cos\theta+\varphi)}, \qquad 0 \le \theta \le \pi$$

Results and Discussion

- As seen in the figure below, 3D rectangular shaped array antenna radiation pattern is visualized. The radiation patterns of 1D, 2D and 3D antennas were simulated with active variables (θ, ϕ and frequency).
- The requirements of the project were to draw 1D, 2D and 3D antenna arrays. The user first selects the antenna type. Then, the number of antennas on the axes and the distance between the antennas are entered. Finally, angle values (θ, ϕ) and frequency are selected. Active elements were used to see θ, ϕ and frequency effects more easily.
- As seen in the red graph (azimuth plane), when ϕ 72 degrees is selected, 72 degrees radiates in polar graph. As seen in the blue graph (elevation plane), when θ 36 degrees is selected, 36 degrees radiates in polar graph with 180 reference.
- Different geometries can be added for the development of the project in the future (circular etc.)

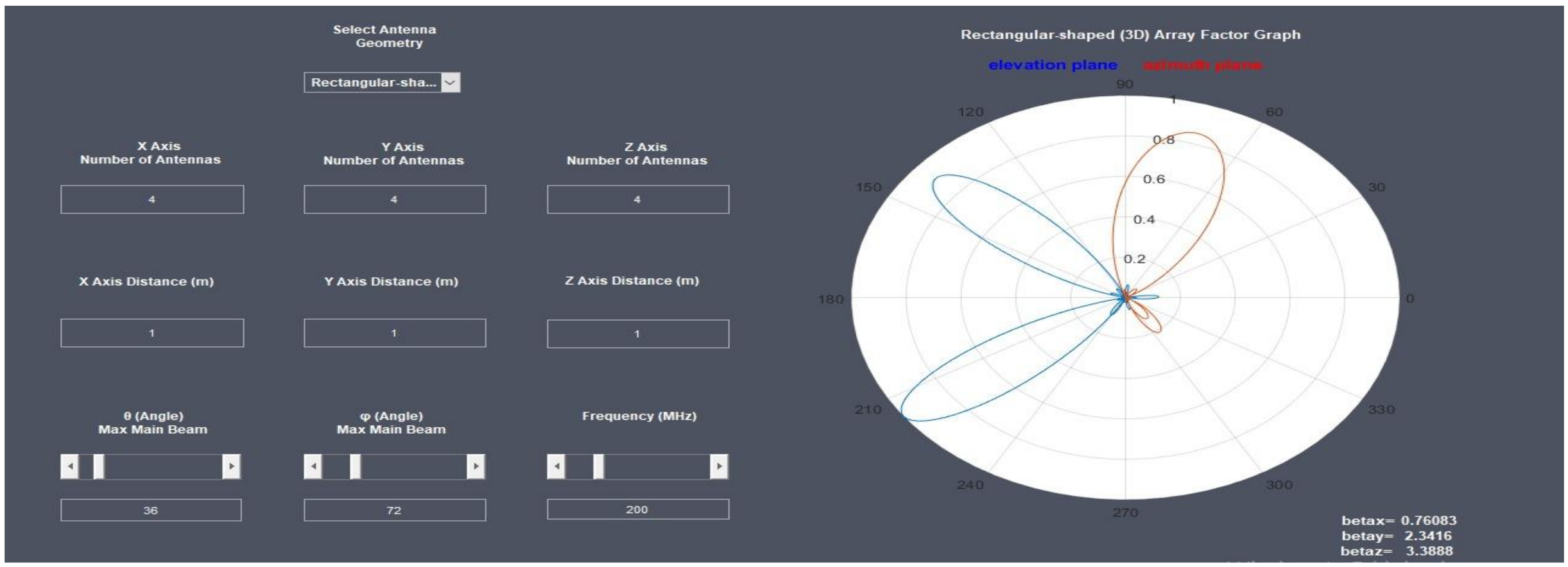


Figure: Radiation pattern of the 3D rectangular shaped array

References

- Balanis, C.A., Antenna Theory, John Wiley and Sons, New York, 1997.
- https://www.mathworks.com/

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