

## Luneberg Lens Antenna Illuminated by Corrugated Horn

Lenses are used to collimate incident energy to prevent it from spreading in undesired directions.

Luneburg's lenses are broadband. These kinds of lenses are usually used in microwave frequencies. They are used in antenna constructions, radar calibrations, satellite systems and they are predicted to be used in some of the internet communication systems.

Corrugated horn antennas are specie of horn antennas developed for achieving high efficiency. Horn antennas are used in satellite systems, radar applications...

### Theoretical Preferences

Luneburg lens is a spherically symmetric structure with variable index refracting. It forms geometrical images of two concentric spheres onto each other. Refracting index of Luneburg decreases radially out from its center. Luneburg's lens creates two conjugates foci outside of the lens. Each point on the surface of an ideal Luneburg lens is the focal point for parallel radiation incident on the opposite side.

Placing grooves on the walls of a horn antenna is realized that the same boundary conditions to all polarizations are achieved and that the field distribution is tapered at the aperture in all the planes. Same boundary conditions eliminate the spurious diffractions at the edges of the aperture.

We will focus on Luneburg's lenses.

Main characteristics of Luneburg's lenses are

- Broad band,
- Dielectric influences on signal transition.

One antenna model consisted of Luneburg's lens and corrugated horn is designed and analyzed using WIPL-D 3D EM solver. Full model is shown on Fig. 1. Quarter model, where dielectric layers can be clearly seen, is shown on Fig. 2, while corrugated horn model is shown on Fig. 3.

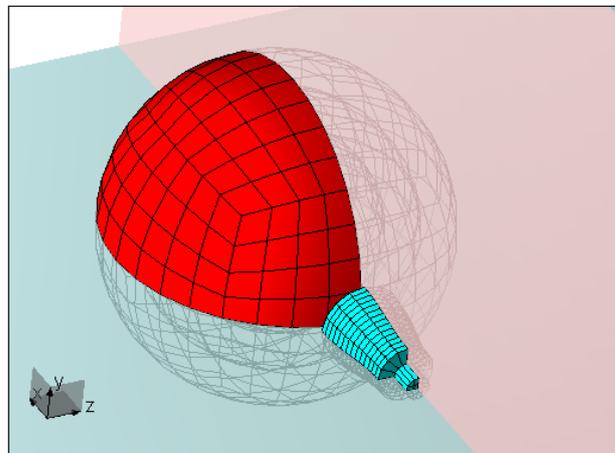


Figure 1. Luneburg lens and corrugated horn antenna

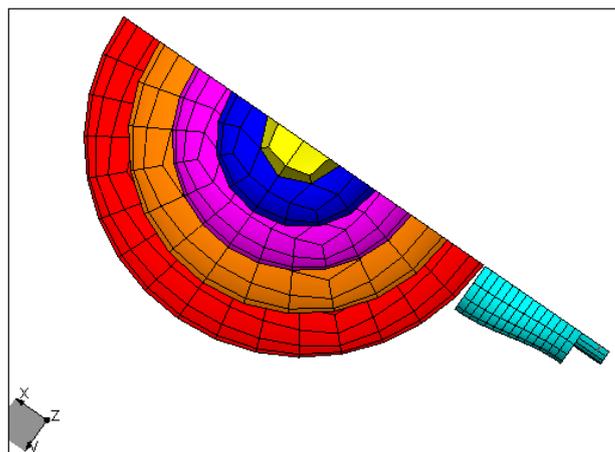


Figure 2. Quarter model of Luneburg lens and corrugated horn antenna

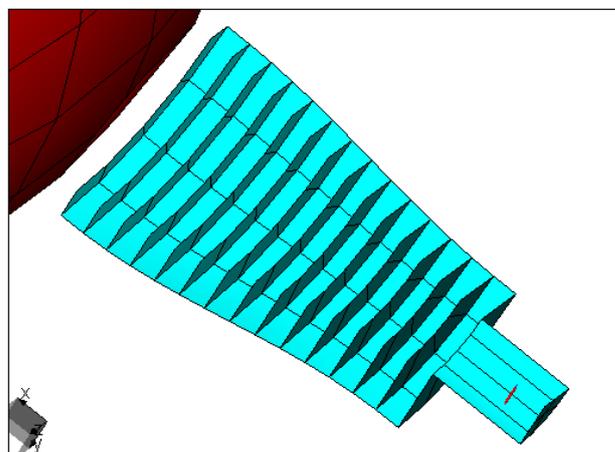


Figure 3. Corrugated horn antenna

Our aim is to inspect simulation times, radiation pattern and near field for operating frequency.

Operating frequency is 1414 MHz (D band – NATO band classification).

### WIPL-D Calculation

Computer used for these calculations is Intel® Core(TM) i7 CPU 950 @3.07 GHz, 8GB RAM, 1 GPU card Nvidia GeForce GTX 470.

Radiation pattern in 3D and in phi cut are given on Figs 4-5, respectively. Distribution of near field is shown on Fig. 6 All figures are presented for total electric field.

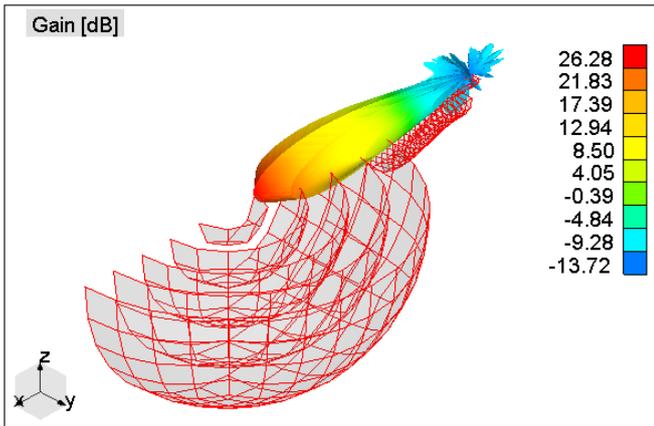


Figure 4. 3D radiation pattern

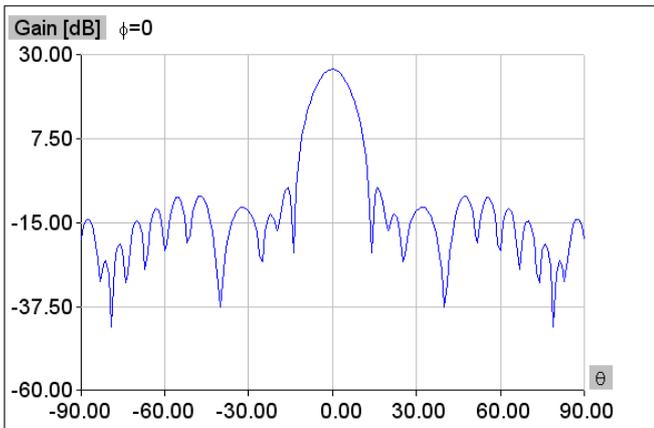


Figure 5. Radiation pattern in phi cut

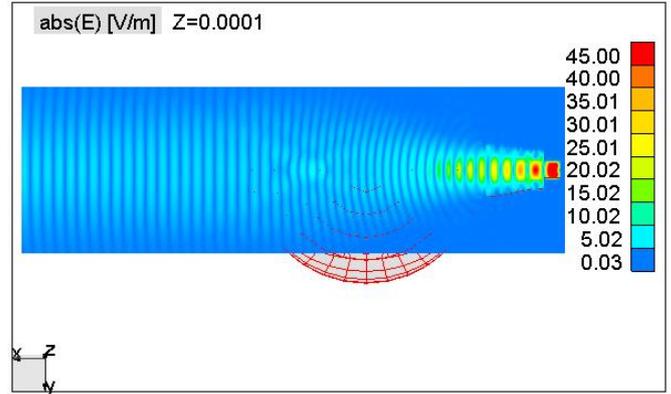


Figure 6. Near field

Number of unknowns and simulation time are given in Tab. 1.

Table 1. Analysis characteristics

Number of unknowns	CPU Time [sec]	GPU Time [sec]
17174	235	112

### Conclusion

Advantages of presented antenna system are its good directivity and easy relatively easy implementation in real life.

Dielectric used here is necessary because multilayered dielectric structure focuses EM rays. In real life dielectric also inserts losses.

In near field simulations, it is clearly seen focusing system capabilities.

Simulation times are relatively small.

Results given by WIPL-D and presented here coincide with theoretically assumptions.