Tilted Horn Antenna

1. Description

Horn antennas are widely used in radio frequency applications above 300 MHz. This type of antennas consists of a flaring metal waveguide shaped like a horn to direct radio waves in a beam. They are mostly used as feeders for standard calibration to measure other antennas' gains, and as directive antennas for radar guns, automatic door openers and microwave radiometers. They have low SWR broad bandwidth and simple construction and adjustment.

This example illustrates a pyramidal horn antenna with a twisted feed : the horn in the shape of a four-sided pyramid, with a rectangular cross section. They are a common type, used with rectangular waveguides, and radiate linearly polarized radio waves. The model is built in SolidWorks, and analyzed using the antenna module of HFWorks. The main areas of concern are the Scattering Parameters, the electric field inside the horn, and the far radiated field results such as the Gain, Directivity, Radiation...

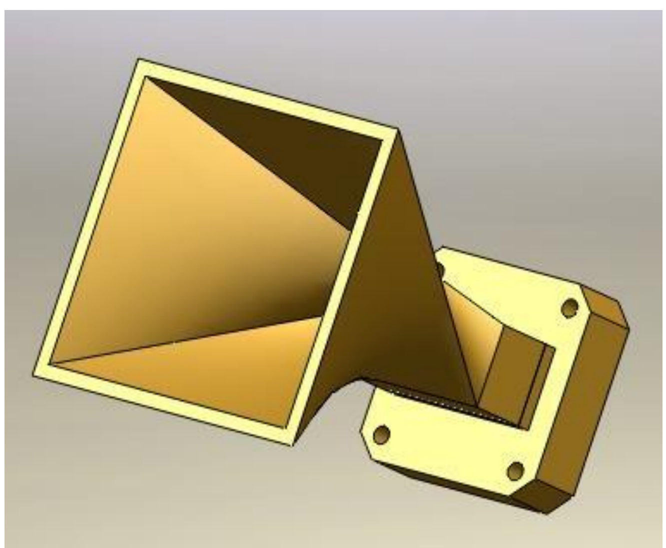

Figure 1: Tilted Horn Antenna

2. Simulation

The dimensions of this horn antenna have been adjusted to be conveniently operating at 4.5 GHz. The simulation uses the antenna solver. We can use the fast sweep frequency: For each of these frequencies, the solution is deduced from solving one user-specified frequency. This method is advantageous in reducing the simulation time.

3. Solids and Materials

The antenna is made up of copper. The whole modeled shape is assigned the copper material which is found in the predefined materials in the HFWorks library. The surrounding air is important for the simulation. Thus, the user has to correctly model the right volumes of air.

4. Load/ Restraint

Radiation boundaries are assigned to the faces of the air box. They should be well placed for further radiation pattern configuration. The port is placed at the back of the antenna and the material is treated as a perfect electric conductor..

5. Results

Various 3D and 2D plots are available to exploit, depending on the nature of the task and on which parameter the user is interested in. As we are dealing with an antenna simulation we plot the reflection coefficient along with the insertion loss for matching purposes. In a further step, we might plot the near and far field radiation of the antenna

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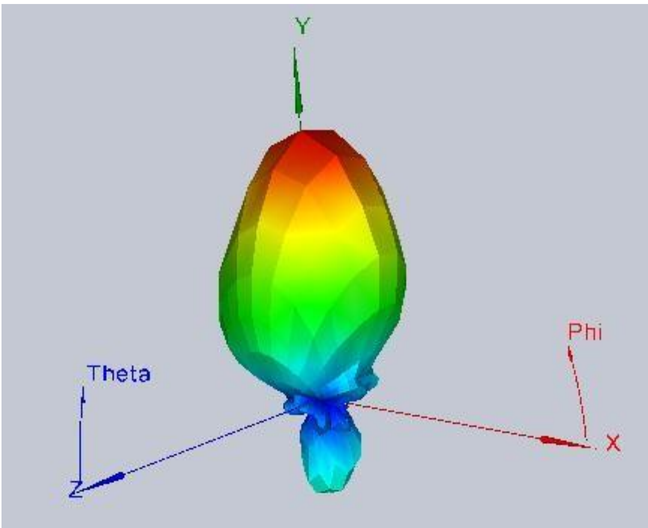

Figure 2: Figure 3: Far Electric Field distribution at 1.17 GHz

The anetnna is best matched at 2.54 GHz: the return loss is very low. The plot might be smoother if we apply a more accurate step of frequency and reduce the start and end of the frequency interval. We can plot the input reflection coefficient on a Smith Chart as well..

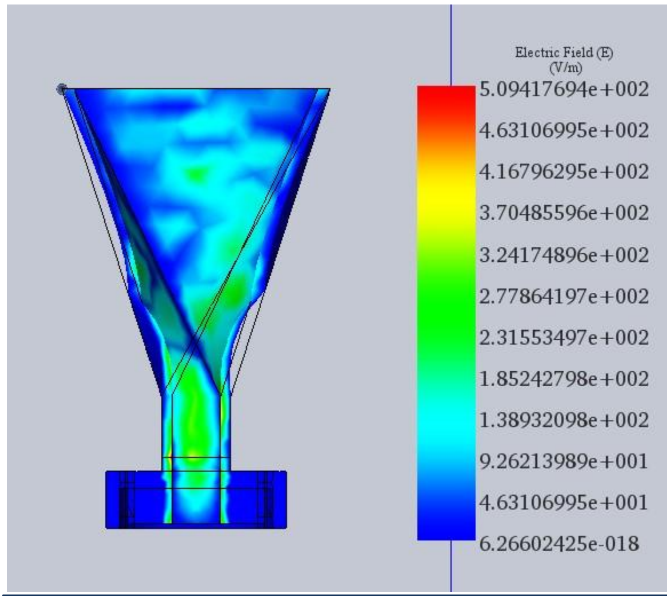

Figure 3: Section Clipping of the antenna at 2.5 GHz

This figure corresponds to the distribution of the electric field inside the horn: this is achieved by the use of the section clipping feature of HFWorks.

On the other hand, it is always important to know how much power is radiated by the antenna, therefore how much gain the antenna affords. So, in a first step we can plot the reflection coefficient at the antenna's port to know at which frequency the power is almost totally going through and being radiated.

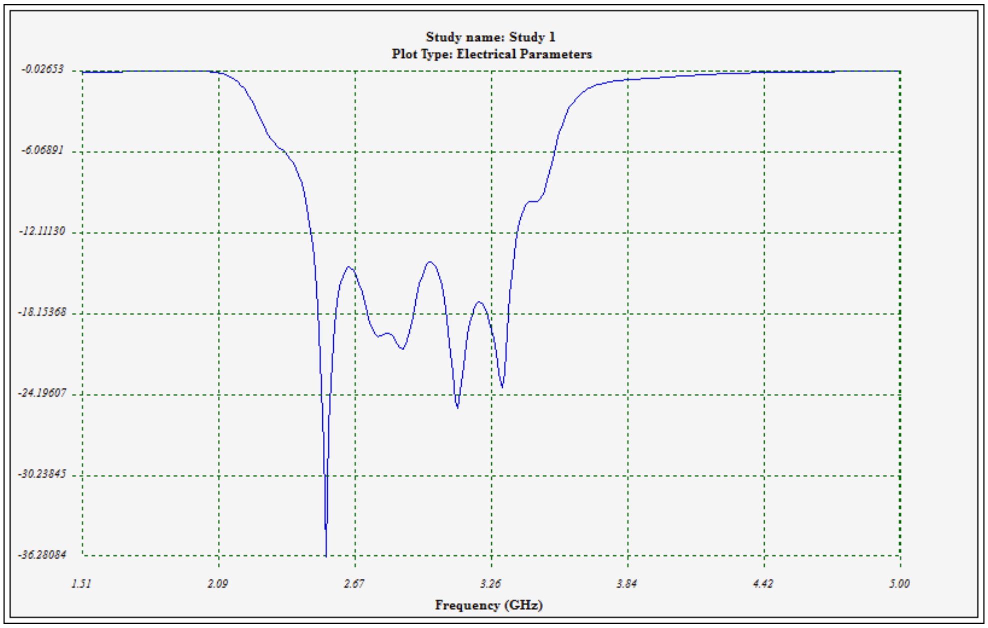

Figure 4: Reflection Coefficient at the antenna 's port