UHF Panel Antenna

Ultra-High Frequency Panel antennas (UHFP antennas) are antennas used in UHF band. UHFP antennas consist of radiating surfaces and reflector. They have been used in TV systems.

Theoretical Characteristics

Main characteristics of UHF plate antenna are:

- Almost omni-directional radiation pattern in forward directions,
- They have reduced dimension and easier implementation than many of the other UHF antennas.

UHFP antenna (radome covered) is simulated in WIPL-D (Fig. 1). Note that presence of dielectric cover is marked with red colored plates.

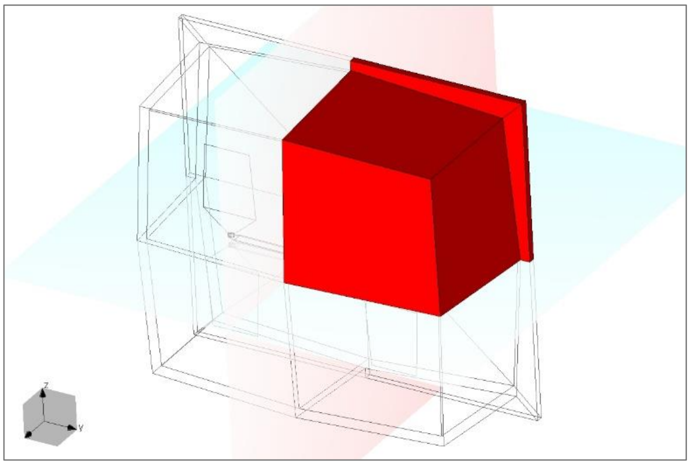

Figure 1. UHFP antenna

In order to speed up simulations and to simplify the modelling process, two symmetry planes can be applied. Using symmetry allows to view quarter of the model as shown in Fig. 2.

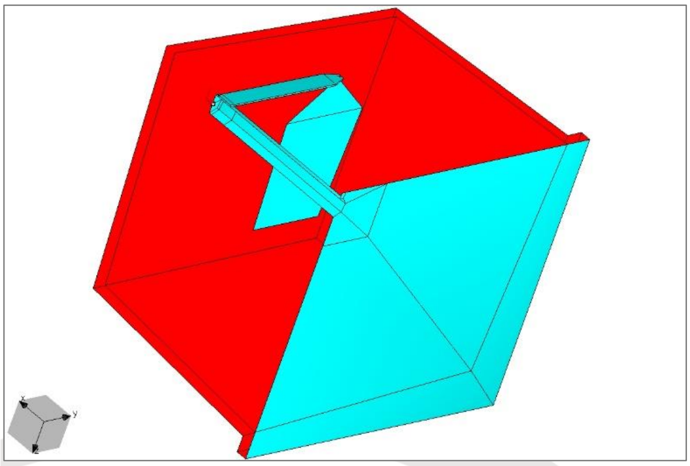

Figure 2. UHFP antenna. Quarter model

WIPL-D Simulations

UHFP antenna shown in Fig. 1, can be modeled in several ways in order to decrease simulation time and number of unknowns. Using the WIPL-D feature Symmetry is the most efficient one. For this problem, only quarter of the given antenna is modelled (Fig. 2). Metallic parts are considered to be perfectly conducting and they are shown in Fig. 3. The metallic losses can be added via the Distributed loading feature. This does not affect number of unknowns or the simulation time required to solve the EM problem.

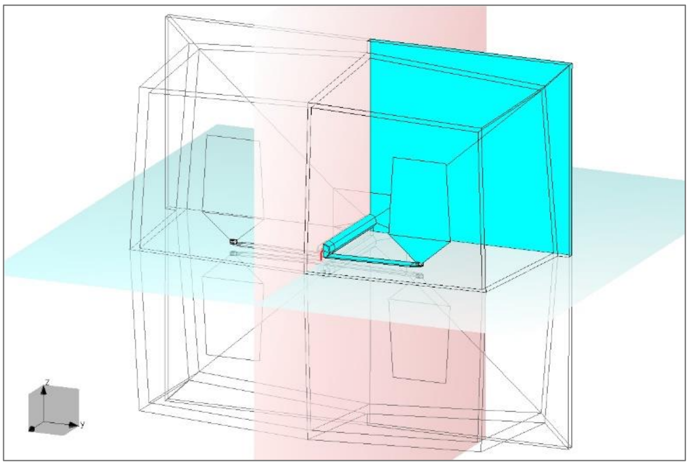

Figure 3. UHFP antenna. Metallic parts in quarter model

The antenna is simulated in the frequency band 0.47 GHz up to 0.86 GHz in only 9 points. The powerful built in interpolation algorithm allows simulation in minimum number of points.

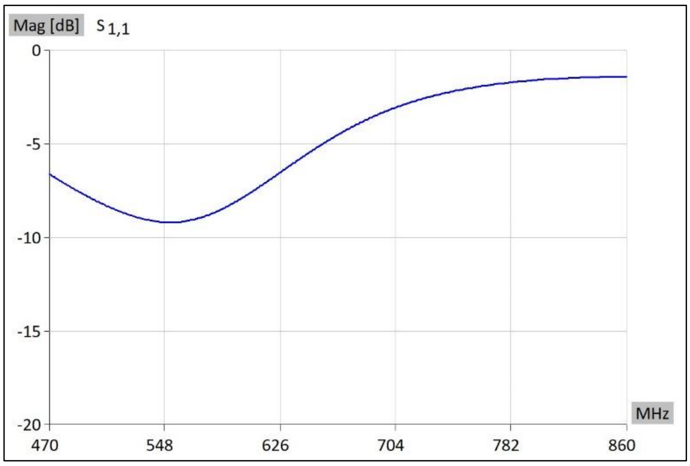

Figure 4. Return loss

This application note also shows antenna gain and near field, both at a single frequency point. PC used for these calculations is a standard desktop quad core Intel® Core(TM) i7 CPU 7700@3.60 GHz.

Antenna gain as a 3D pattern is shown in Fig. 5. We can see that maximal gain is about 10 dB. Antenna gain in single theta cut is shown in Fig. 6. Also, radiation in backward direction is small because of the reflector presence.

Calculated near field as a 2D cut is shown in Fig. 7. We can see EM wave transition from standing wave to free space EM wave. We should notice that only quarter of the antenna is shown in Fig. 7.

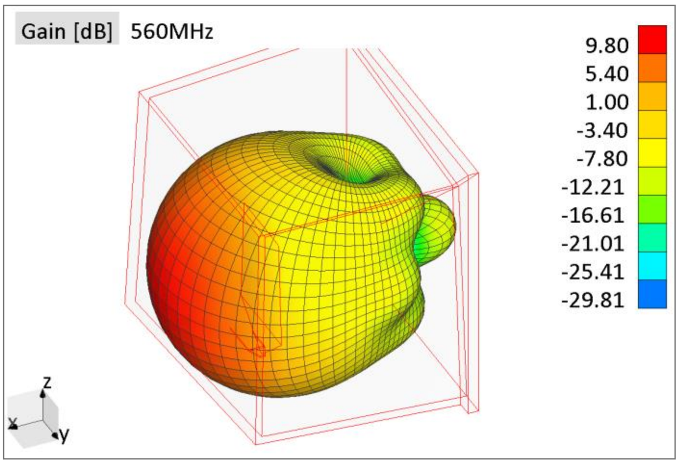

Figure 5. Radiation pattern in 3D

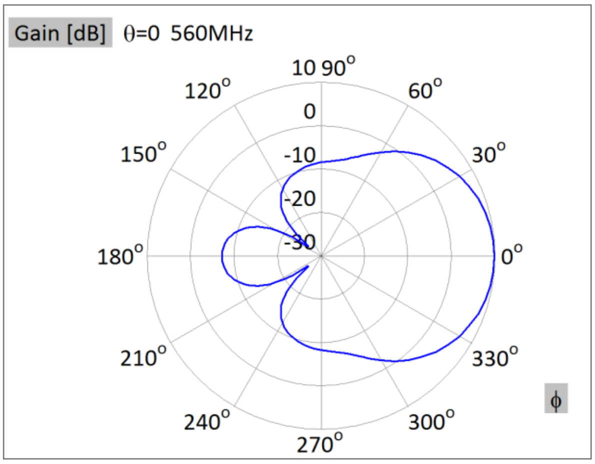

Figure 6. Radiation pattern in theta cut

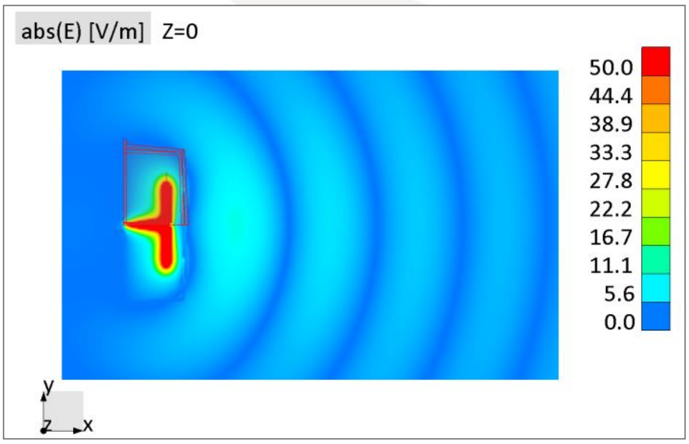

Figure 7. Near field

Number of unknowns and simulation time are given in Tab. 1. Simulation time is shown per frequency point.

Table 1. Analysis characteristics

Number of unknowns	Simulation time [sec]
552	0.65

Conclusion

The discussed antenna is modelled in a very simple way, but it consists of several parts. Thus, it is very interesting for a full wave EM simulation. We can notice that:

- Antenna is covered by dielectric radome,
- Reflector is used,
- Coaxial cable is used for feeding,
- Plates are primary radiating elements.

However, WIPL-D successfully analyzes this antenna for only a few seconds. This is possible due to efficient implementation of the default simulation Method of Moments. WIPL-D uses unique higher order basis functions which allows modelling of large mesh elements (up to 2 wavelengths). Also, the mesh is realized via generalized quadrilaterals so the code requires two times less unknowns than for the standard triangular mesh. No bounding box is required for open region problems.

This all results with a simulation requiring only around 500 unknowns, despite modelling antenna covered with radome and the reflector present. Memory consumption is negligible. The antenna can be simulated at any standard desktop or laptop PC. Since the execution of the code is highly efficiently parallelized, the execution of the code at standard desktop quad core CPU lasts only fraction of the second per frequency point. A powerful built-in interpolation method allows simulation in small number of frequency points, even for wide band antennas.