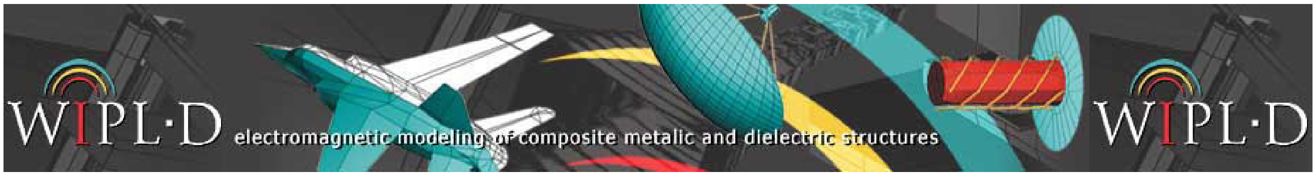

Ultra Wide Band Elliptical Antenna

Ultra wide band elliptical (UWB elliptical) antenna is a type of a printed antenna. It is small, simple, lightweight and economical, often used in UWB transmitters.

UWB antenna topologies are derived from works in circular and elliptical disc monopoles. The main characteristic of the given elliptical antenna is that it is broadband.

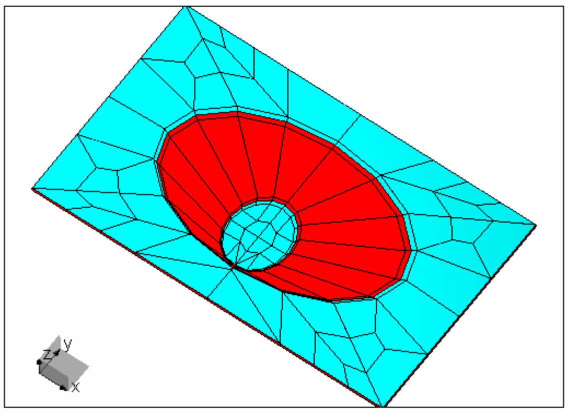

Figure 1. UWB elliptical antenna

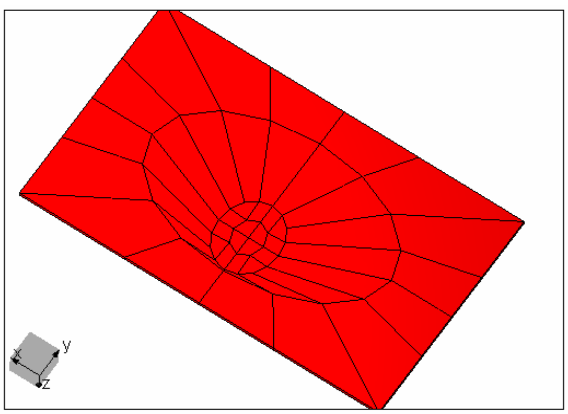

Figure 2. UWB elliptical antenna, bottom side

WIPL-D Simulation

In WIPL-D Pro, metallic plates are colored in blue and dielectric plates are colored otherwise, so we see that the given antenna is printed on a finite dielectric substrate (Fig. 1) and has no ground plane (reflector; Fig. 2), thus we expect low directivity and high radiation in both front and back directions.

In WIPL-D Pro, this antenna can be modeled in several ways in order to diminish simulation time and memory requirements. One can use the *Symmetry* feature, so only half of the given antenna is modeled (Fig. 3), thus saving both memory and time.

Antenna is analyzed in frequency band 2 GHz up to 20 GHz.

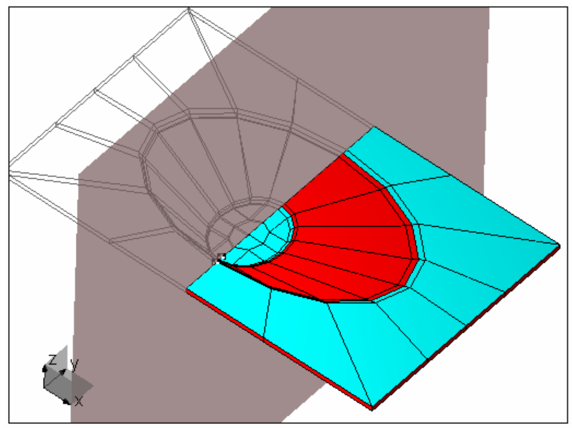

Figure 3. UWB elliptical antenna – half model

We will calculate S_{11} parameter in the entire range in order to determine antenna operating band and to analyze antenna matching, radiation pattern and near field at one frequency at which antenna is matched. Computer used for these calculations is Intel Core2 Quad @ 2.83 GHz clock.

Parameter S_{11} is shown in Fig. 4. We can see that antenna operating band is from 4 GHz up to 14 GHz (where, parameter S_{11} is roughly less than -10 dB).

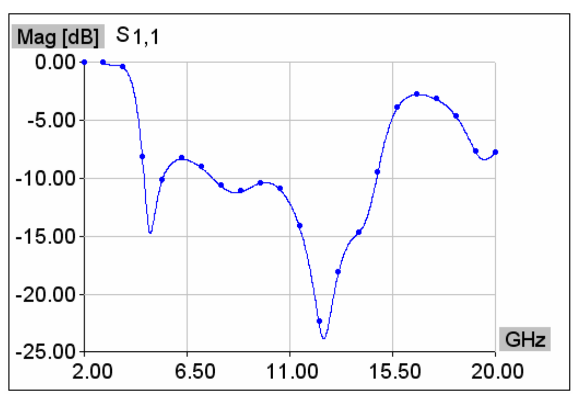

Figure 4. Parameter S_{11}

Antenna gain in 3D is shown in Fig. 5. We can see that gain is low (maximum is about 4.5 dB). Also, antenna is quasi-omni-directional (Fig. 5). Radiation pattern has minimums in four directions in the xOy plane, which are expected for this antenna design.

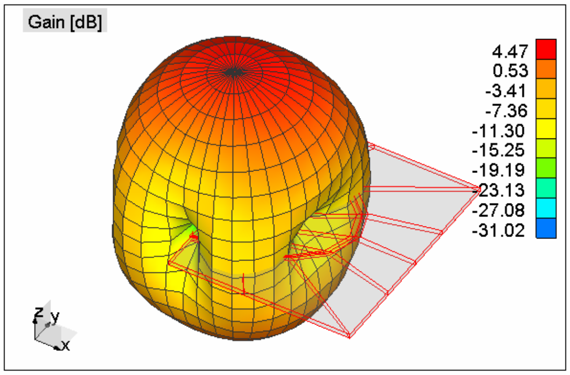

Figure 5. Radiation pattern in 3D

Calculated near field is shown in Fig. 6. We can see the transition from standing EM wave to free space EM wave. We should notice that only half of the antenna is shown in Fig. 5 because we used model symmetry.

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

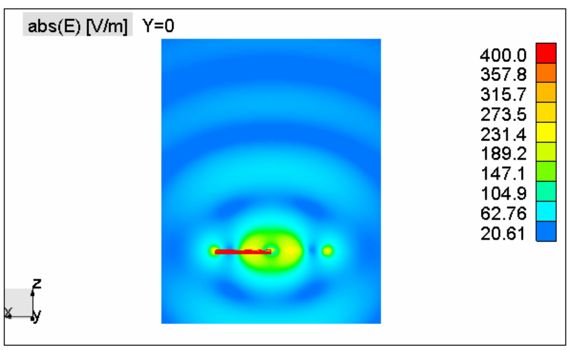

Figure 6. Near field

Table 1. Analysis characteristics

No. of unknowns	Time [sec]
2787	151

Conclusion

WIPL-D Pro is a frequency-domain software and analyzed structure is broadband (operating from 5 GHz up to 14 GHz). This type of simulation is usually challenging for frequency-domain solvers and time-domain solvers usually have much shorter simulation times. However, we can notice that simulation time in WIPL-D Pro is very short eventhough it was done in 21 frequencies, thanks to:

- very small number of unknowns this model requires as a result of higher order method of moments in combination with Edging technique for meshing,
- very fast numerical libraries implemented in WIPL-D Pro solver that use modern CPU architectures to full extent,
- *Symmetry* option is used in this problem and thus, number of unknowns is halved and simulation time decreased significantly.

Hence, WIPL-D Pro is probably the only frequency-domain solver that can compete with leading time-domain codes in terms of simulation times in UWB simulation. Results given by WIPL-D Pro and presented here coincide well with theoretical expectations.