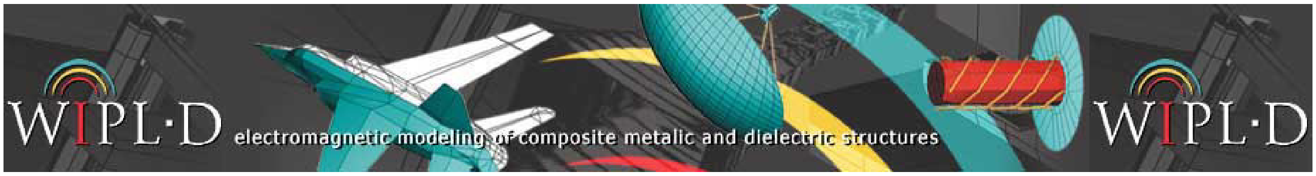

Vivaldi Antenna

The conventional Vivaldi antenna typically has at least octave bandwidth and thus it can be used in many applications. Vivaldi antenna is placed on dielectric substrate and because of its complex shape and size, it is considered to be not so easy for modeling and simulation.

Antenna shown here is a balanced antipodal antenna which consists of a microstrip line and its ground plane which both gradually flare out. Thus, the lower operating band limit is determined by the cut-off mechanism of the flare. The skew in the electric field across the slot makes poor cross-polar polarization performance which degrades with frequency rising. Antenna is considered as triplate based structure. That is done by adding additional dielectric and metallization layer, which is provided for balancing the E-field distribution in the flared slot. The configuration of antenna uses arcs and elliptically tapered geometry what is serious test for some software in terms of providing accurate meshing and far field results.

In November 2000, presented antenna was used for EM solver comparison, when six software vendors took part in benchmarking. Although WIPL-D didn't take part in the benchmarking, we will show here that it the software is capable for designing and simulating this Vivaldi antenna.

Main characteristics of Vivaldi antenna are

- Broad band,
- Dielectric substrate influence on signal transition.

The picture of Vivaldi antenna with flared slot aperture (taken from the 2000 benchmark) is shown in Fig. 1.

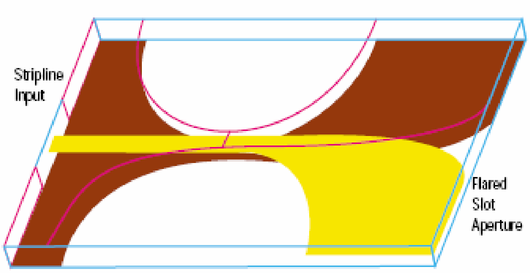

Figure 1. Vivaldi antenna

Because of complex geometry, full explanation of antenna model is appropriate here, so we add Figs 2-3 to show dimensions and shape of the antenna from both sides.

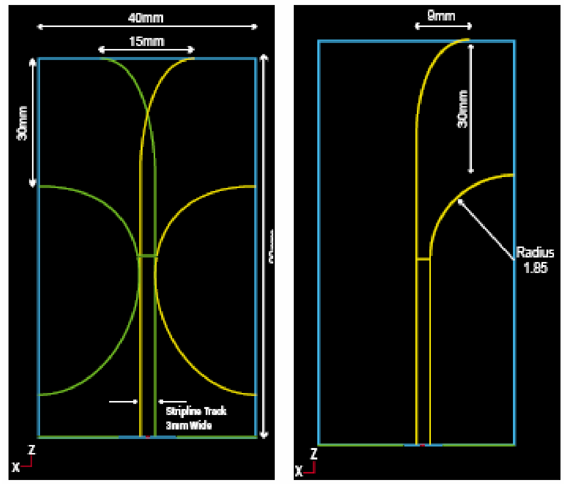

Figure 2. Vivaldi antenna, dimensions

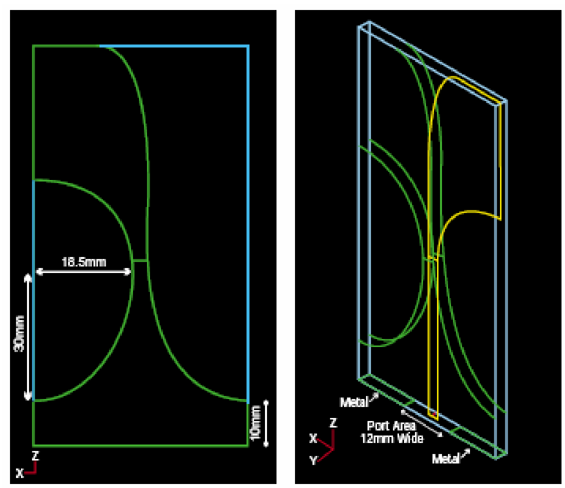

Figure 3. Dimensions and explanations of Vivaldi antenna

Our aim is to inspect S_{11} parameter from 1 GHz up to 20 GHz, radiation pattern and near field for two operating frequencies. Also, we will see what is the simulation time, i.e. how long do we need to simulate this model in entire frequency range. For near field and radiation pattern, frequencies 3 GHz and 15 GHz will be used.

WIPL-D Simulation

The model of Vivaldi antenna designed and simulated using WIPL-D Pro is shown in Fig. 4. The antenna (blue) is printed on dielectric substrate (red). Dielectric used has permittivity of 2.32 and height of 3.15 mm.

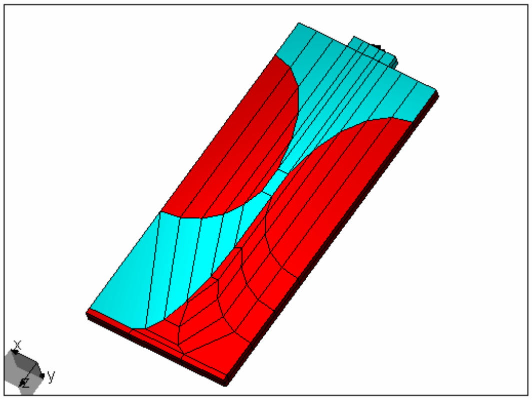

Figure 4. Vivaldi antenna model in WIPL-D Pro

Computer used for these calculations is Intel® Core2 Quad CPU @ 2.83 GHz. Memory requirements and simulation times are given in Tab. 1.

Parameter S_{11} is shown on Fig. 5.

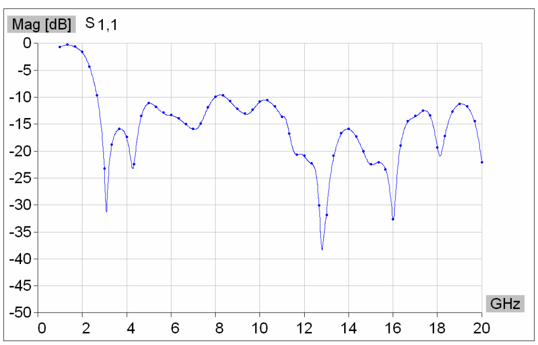

Figure 5. S_{11} parameter for Vivaldi antenna

Radiation patterns and distribution of near field for 3 GHz and 15 GHz are given on Figs 6-9.

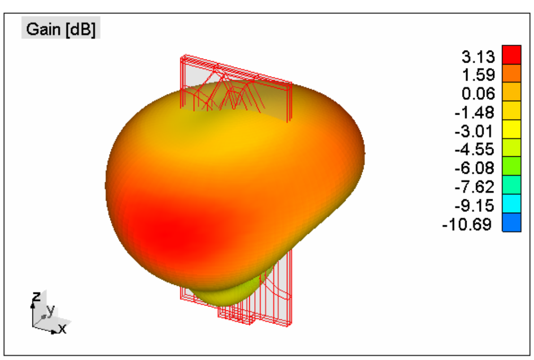

Figure 6. Radiation pattern at 3 GHz

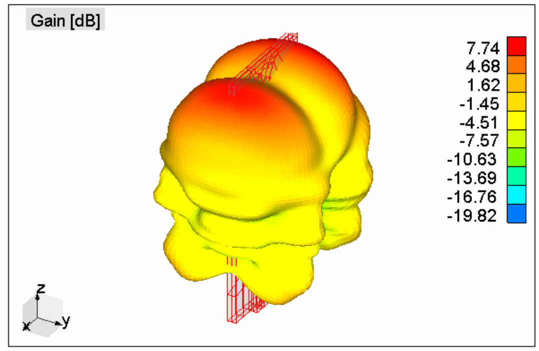

Figure 7. Radiation pattern at 15 GHz

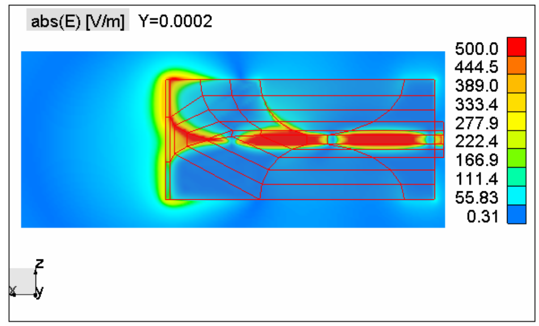

Figure 8. Near field at 3 GHz

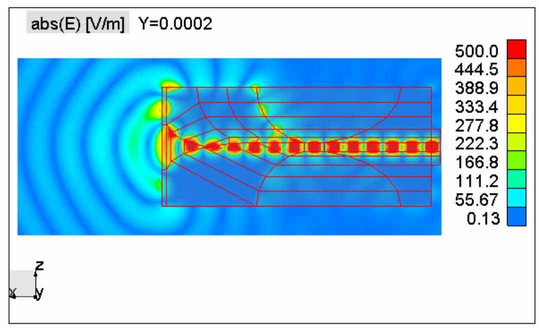

Figure 9. Near field at 15 GHz

Table 1. Simulation characteristics

Model	Number of unknowns	Memory [MB]	Time [sec]
3 GHz	3160	80	217
15 GHz	17339	2400	1344

Conclusion

WIPL-D Pro offers very efficient simulation of a Vivaldi antenna.

Results given by WIPL-D Pro, presented here, coincide with theoretical expectations, and agree well with the results presented by most other software vendors in the software benchmark published in 2000.