Spiral Antenna

Main characteristics of spiral antennas are

- Circular polarization,
- Broad-band,
- Low directivity.

Models of duofilar spiral antennas, simulated in WIPL-D Pro are presented here. One model is made without the substrate (Fig. 1), while the other model is a spiral printed on dielectric substrate (Fig. 2). Parameters of the dielectric are:

- $\varepsilon_r = 2 + j \cdot 0$,
- $\mu_r = 1 + j \cdot 0$.

Both models have a reflector.

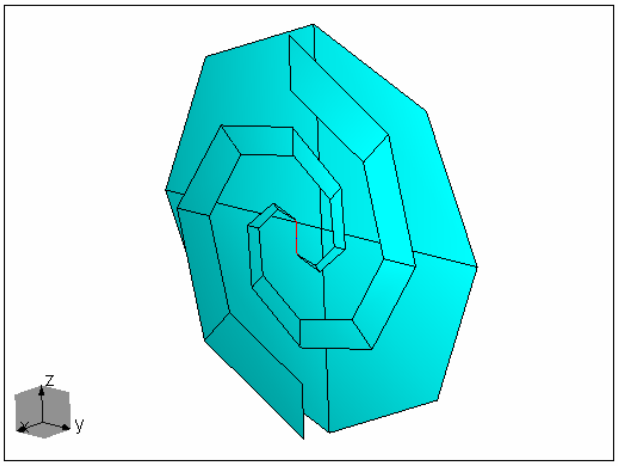

Figure 1. Spiral antenna

Dimensions of metallic radiating elements are the same in both models. Difference exists only in added dielectric in the second model.

Our aim is to investigate the influence of the dielectric and to compare simulation times and numbers of unknowns for these two models. We will observe antennas' gain starting from 1 GHz up to 5 GHz (D, E, F and G bands–NATO band classification).

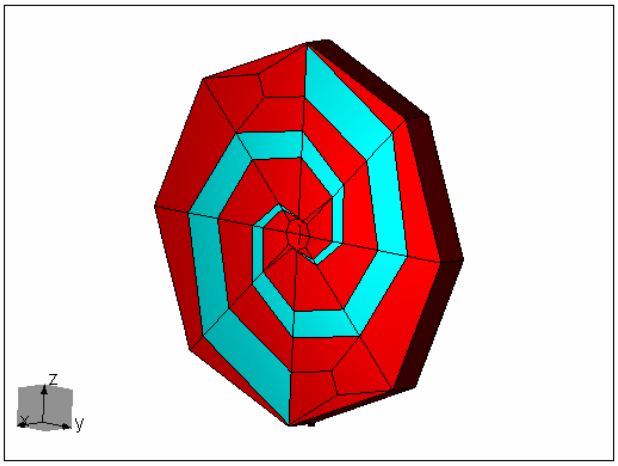

Figure 2. Spiral antenna printed on dielectric

WIPL-D Simulation

In WIPL-D Pro, helix antennas can be designed using the built-in *Helix* object. Antenna shown in Fig. 1 can be also modeled "manually" (using individual plates as building blocks) but that would make modeling difficult.

Frequency for calculation of radiation pattern and near field is 3 GHz.

Computer used for these calculations is Intel Core2 Quad CPU @ 2.83 GHz.

The 3D radiation pattern of the spiral antenna without the dielectric is shown in Fig. 3. Overlaid 2D radiation patterns for main direction are shown in Fig. 4, for cases with and without the dielectric.

Near fields of the model immersed with no dielectric is given in Fig. 5.

Number of unknowns, memory requirements, and simulation time at a single frequency are given in Tab. 1.

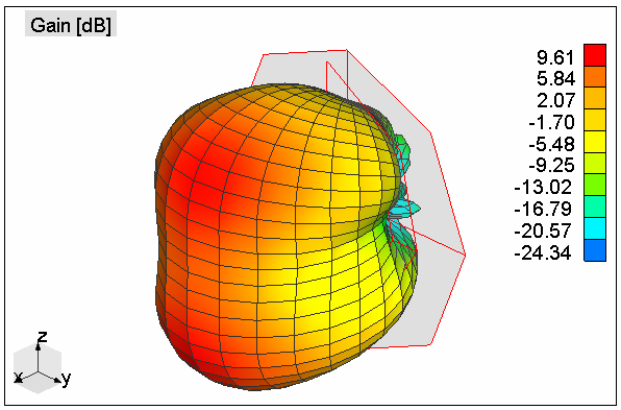

Figure 3. Radiation pattern of spiral antenna without dielectric

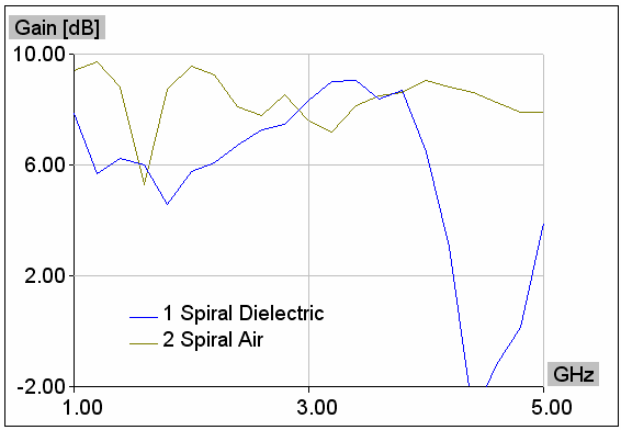

Figure 4. Overlaid gains for main radiation direction

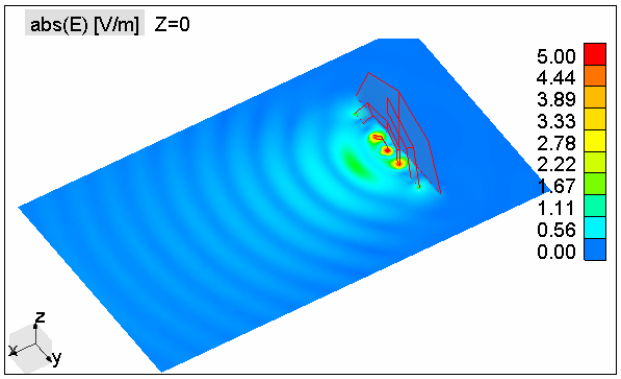

Figure 5. Near field of spiral antenna

Table 1. Simulation data

Model	No. of unknowns (memory [MB])	Time @ 3 GHz [sec]
Air	797 (5.1)	<1
Dielectric	5643 (254)	13

Conclusion

Using WIPL-D Pro *Helix* object with the possiblities for parameterization, we can easily create and manipulate spiral antenna structures.

We can see that a great difference exists between gain of antenna without dielectric and antenna printed on dielectric (Fig. 4). Dielectric is necessary in antenna design in order to increase structure solidity. Its presence shifts gain vs. frequency characteristic, (changing maximal gain) and exact its electrical properties need to be taken into account during the antenna design. Inclusion of the dielectric significantly increases number of unknowns and simulation time (Tab 1), but still the overall simulation performed in WIPL-D Pro is very fast.

Results given here by WIPL-D Pro coincide with theoretical expectations.