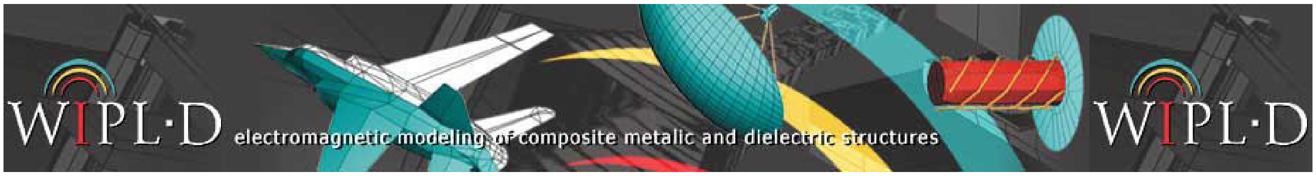

Cassegrain Antenna

Cassegrain antennas are a subcategory of reflector antennas. Reflector antennas have been used from discovery of electromagnetic wave propagation onwards. The most important applications of reflector antennas are in radar, space communications, radio astronomy and wireless communications.

Cassegrain antenna consists of two reflectors (primary and secondary) and a feeder. The main characteristics of Cassegrain antennas is their high directivity. The bigger diameter of antenna reflector is used, the better gain is achieved.

WIPL-D Simulation

A model of Cassegrain antenna created in WIPL-D Pro is shown in Fig. 1. We will assume that given antenna is used for satellite communications in Ka band. A close-up of the feeder and the primary reflector is shown in Fig. 2. Note that the primary reflector is curved, unlike in splash-plate reflector antennas.

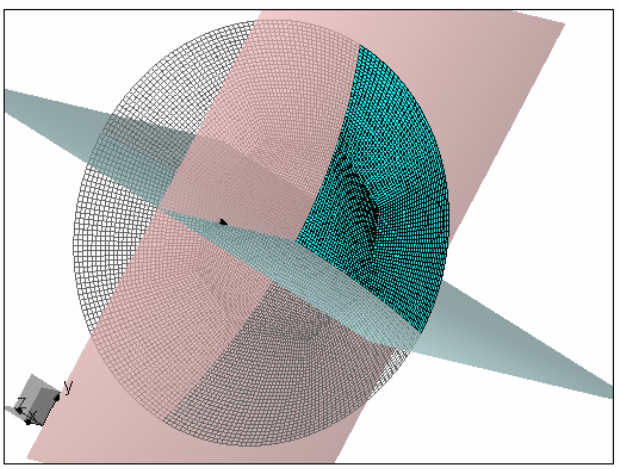

Figure 1. Cassegrain antenna

In reflector antenna systems, horn antennas are often used as feeders (Fig. 3). In this project, feeder is specially designed in order to suppress back radiation. That was done by adding a choke to horn aperture edge. Length of choke is equal to quarter of free-space wavelength (parameter Lam/4 on Fig. 3). Axial two-level design enables dual mode electromagnetic wave propagation.

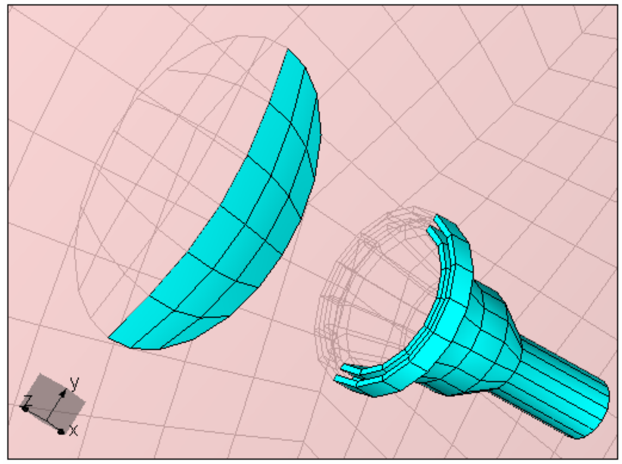

Figure 2. Cassegrain primary reflector, half antenna model

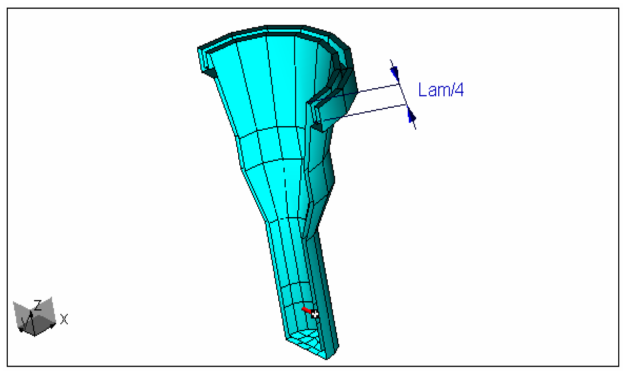

Figure 3. Feeder, half antenna model

In WIPL-D Pro, reflectors and feeders can be efficiently designed using built-in parameterized objects (*BoR*, *Reflector*, *Circle*, ...). One can use (*Anti-*) *Symmetry* feature to reduce the computational burden of simulation, so in this problem only quarter of the antenna is modeled (Fig. 1). All the antenna parts are considered to be perfectly conducting.

Operating frequency is 26.5 GHz (Ka-band).

For model parameters given in Tab. 1, we will calculate antenna gain. In this case, the dish radius is equal to 100 wavelengths, which makes this model challenging due to its vast electrical size.

Table 1. Dish radius

Parameter	Value [mm]	Value [multiplication wavelength]
Dish radius	1132	100

Radiation pattern in 2D (phi-cut), where *phi*=0, is shown in Fig. 4. Please note that the *theta* angle is measured with respect to the xOy plane.

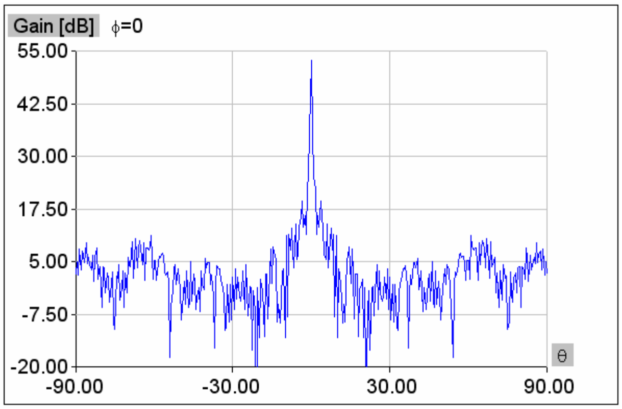

Figure 4. Radiation pattern, phi-cut

Number of unknowns, memory requirements, and simulation time of analysis are given in Tab. 2. Computer used for these calculations is Intel® Core2 Quad CPU at 2.83 GHz, 8 GB RAM.

Table 2. Simulation data

Model	No. of unknowns (memory [GB])	Time @ 26.5 GHz [min]
quarter	38525 (11.9)	117.2

Conclusion

WIPL-D Pro offers specialized geometrical objects to be used as building blocks for complex antenna system models. Reflector shapes can also be imported from a CAD file, or they can be customized according to a user-defined shape (script file). Hence, practically any type of a reflector antenna can be easily modeled.

Proper usage of WIPL-D Pro features (for example, *Symmetry*), enables simulation using only quarter of structure, which is very important for analysis of electrically big structures, since we reduce memory used and simulation time dramatically.

Cassegrain antenna of this size is a challenging simulation task and this sort of antenna is usually analyzed using geometrical optics methods. However, WIPL-D Pro successfully simulates this antenna using very accurate higher order MoM.