WIPL-D Pro CAD: What is New in v2017?

New features/improvements introduced in v2017 are:

1. Waveguide and Microstrip loads – New types of loads were introduced in WIPL-D Pro CAD to simplify the termination specification for waveguide and microstrip structures. The new types of loads are:
   a. Waveguide loads (rectangular, circular or coaxial)
   b. Microstrip loads
2. Circular polarization and orthogonal modes for a waveguide port excitation – The user can choose to add the analysis of the orthogonal mode to basic, dominant mode analysis. Circular polarization of a mode is also supported for a circular waveguide port.
3. Outer shell selection – Automatic selection of the faces on the outer shell.
4. Advanced Import options, including automatic Repair, Simplify and Sew.
5. Improved topology validation and automatic Boolean Unite of all of the bodies before EM simulation starts.
6. Direct mesh algorithm parallelization – Parts of the meshing algorithm which are identified as most time-consuming are parallelized.
7. Modification of the meshing algorithm in order to improve division of complex faces.
8. New types of transformation of the working coordinate system (WCS) are introduced for:
   a. Align WCS to 3 points
   b. Align WCS to edge
   c. Align WCS to face
9. Align body to working coordinate system – This option provides transformation (translation and/or rotation) of a body/bodies by aligning one of the faces of selected body/bodies to the working coordinate system.
10. Additional snap modes have been introduced – The new snap to topology modes simplifies the creation process of a primitive. Starting from this version a primitive can be created simply by using points of a

topology that has already become a part of the model, like a vertex, edge center and face center.
11. Other options/improvements:
   a. Translate operator allows drawing of a translation vector in 3D view and using the advantages of snap modes.
   b. Unused entity – The user can specify the entities that will be excluded from the final mesh and consequently from EM simulation.
   c. Smart port analysis.
   d. Abort mesh procedure while meshing the model.
   e. Edit History List in an ASCII edit box.

1. Waveguide and Microstrip Loads

New types of loads were introduced in WIPL-D Pro CAD to enable appropriate termination of waveguide and microstrip structures.

a) Waveguide Load

Waveguide loads are used to specify terminations of waveguide structures. There are three types of waveguide loads in WIPL-D Pro CAD:

- Rectangular waveguide load
- Circular waveguide load
- Coaxial waveguide load

After a flat face is selected, a load can be specified by using the Set Waveguide Load option. The following parameters can be defined for a waveguide load:

- Orientation – the direction which is opposite to the direction of the incident wave propagating toward the load
- Polarization – polarization of the electric field
- Termination – type of termination of the waveguide, for the dominant mode. Three types of terminations are available: **matching**, **short** and **open**
- Orthogonal mode – switches the orthogonal mode analysis on or off. A type of termination for orthogonal mode can be specified independently

from the type of termination for the dominant mode.

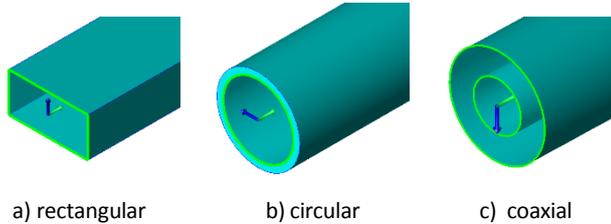Structures terminated with different types of waveguide loads are shown in Figure 1.

a) rectangular   b) circular   c) coaxial

Fig. 1. Different types of waveguide loads.

b) Microstrip Load

Microstrip loads are used to represent terminations of microstrip structures.

A microstrip load can be specified on a single flat dielectric face. After a face has been selected, the Set Microstrip Load option should be invoked. The following parameters can be defined for a microstrip load:

- Orientation – the direction which is opposite to the direction of the incident wave propagating toward the load

- Impedance – type of termination. Three types are available: **matching**, **short** and **open**.
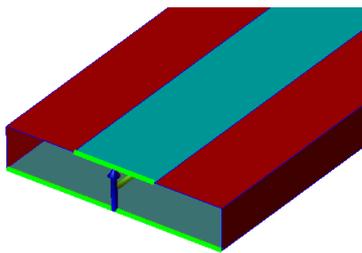
The microstrip load is shown in Figure 2.

Fig. 2. Microstrip load.

2. Orthogonal Mode and Circular Polarization for Waveguide Excitation

WIPL-D Pro CAD supports three types of waveguide ports:

- Rectangular waveguide port

- Circular waveguide port

- Coaxial waveguide port

For the case of the rectangular ports, only linear polarization of the incident wave can be specified. Unlike

rectangular ports, for circular waveguide ports, the user can specify circularly polarized incident wave as well.

In WIPL-D Pro CAD 2017 the user can include the orthogonal mode into analysis for rectangular and circular waveguide ports. The orthogonal mode is orthogonally oriented to the dominant mode. It is the matter of choice or convention which mode will be referred to as the dominant mode and accordingly which one will be referred to as the orthogonal. Therefore, the same set of parameters can be specified for the orthogonal mode as for the dominant mode.

Polarization of the orthogonal mode is:

- Linear, in case the dominant mode has been chosen as linearly polarized. The second mode is oriented 90 degrees relative to the first mode,

- In the case of a circular waveguide port, if the dominant mode is LHC polarized, the orthogonal mode is RHC polarized, and vice versa.

As an example, an X-band conical horn antenna is shown in Figure 3. The antenna is fed by a waveguide port with Right Hand Circular polarization of the dominant mode. Gain of the antenna as well as the ellipticity in the main beam direction in the frequency range between 8 GHz and 12 GHz are shown in Figures 4 and 5.
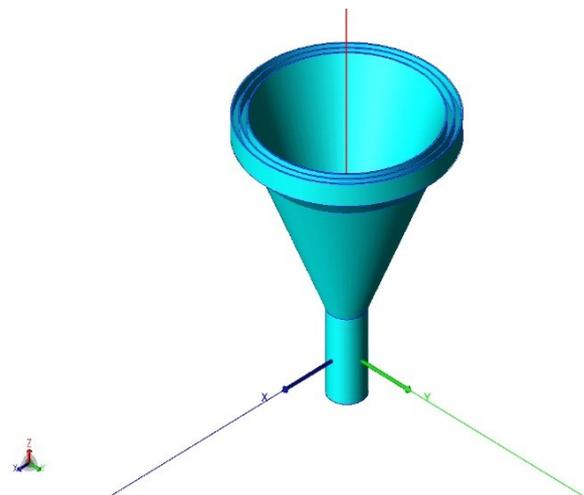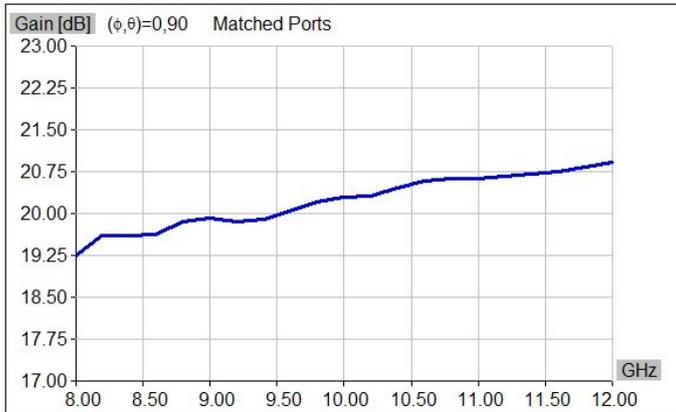

Fig. 3. Conical horn antenna.
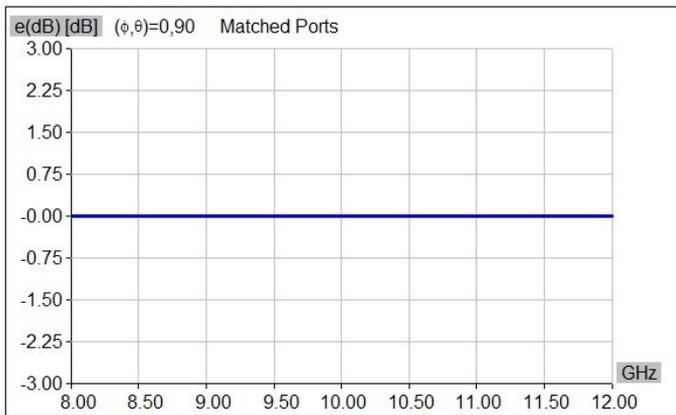
Fig. 4. Conical horn antenna – gain.

Fig. 5. Conical horn antenna – ellipticity.

3. Outer Shell Selection

This option provides the possibility to automatically select faces that belong to the outer shell. It is useful in situations where a model is imported from another CAD format into WIPL-D Pro CAD, and contains many inner details. The details are very often insignificant in the scope of electromagnetic simulation. By selecting and hiding the outer shell, inner details can be easily deleted or set as unused.

In Figure 6, a model of a helicopter is presented. The outer shell appears as transparent, while the inner details are colored yellow.

Fig. 6. Helicopter with a transparent outer shell.

4. Advanced Import Options

Applying advanced import options the user can choose whether to perform repairing, simplifying and/or sewing operations on imported geometry or not. While importing geometry from another CAD format, irregular geometry and gaps may occur. The advanced options help the user to automatically fix the irregularities.

5. Improved Topology Validation

In WIPL-D Pro CAD 2017 options for checking model geometry and general topology inconsistencies have been enhanced. In addition to features introduced in previous versions, auto-unite operations prior to meshing and EM simulation have been added.

If a unite operation has not been applied, unconnected mesh may occur. Therefore, where required, this new feature notifies the user to reconsider unification of bodies before meshing and simulation processes have been started. Hence, it prevents the occurrence of the unconnected mesh problem.

6. Direct Mesh Algorithm Parallelization

Meshing a very complex CAD model can take a significant amount of time. Therefore, the most time consuming parts of the algorithm are detected and the parallelization is performed. Efficient parallelization of some parts of algorithm is not possible, as Parasolid kernel prevents parallel execution of some functions.

7. Mesh Algorithm Modifications

Meshing of complex faces which contain multiple inner loops is improved. The improvements result in a smaller number of mesh elements and an increased mesh quality factor. The increased mesh quality factor not only

decreases the simulation time, but also improves the simulation accuracy.

Furthermore, the algorithm for division of complex faces has been modified in order to minimize time required for this phase of the mesh. The modification, together with meshing parallelization, significantly reduces the time required for meshing of the structure.

8. Align Working Coordinate System

New types of alignment of the WCS are available in WIPL-D Pro CAD 2017 for:

a. Align WCS to 3 points
b. Align WCS to edge
c. Align WCS to face

In addition to the previous options for alignment of the WCS, where the alignment of the WCS was based on its minimal rotation, a new method of alignment was introduced. The new method has been made sensitive to an entity which the WCS should be aligned to. The method overcomes the problems during a sweep or optimization process where a variable dimension can result in misalignments and therefore introduce unwanted changes in model geometry.

Alignment to 3 points can be performed so that the axes orientation depends on the order of point selection. WCS can be aligned to an edge, so that x-axis is aligned towards the edge direction. Regarding the WCS alignment to a face, the x-axis of the Working CS coincides with the direction of the increasing u-parameter of the face, while z-axis is aligned with the face normal at the center of the face.

The user can also align WCS to the center of curved edges or faces. For a curved edge, x-axis coincides with the tangent line in the center of edge. For a curved face, z-axis is oriented toward the face normal in the center of the face.

9. Align Body to Working Coordinate System

This option transforms (translation and/or rotation) a body or a set of bodies. The transformation is specified as alignment of one of the selected bodies to WCS, i.e. by aligning a selected face, to WCS. All of the selected bodies will be jointly transformed according to the specification.

The option is very useful in antenna placement problems. Having the working coordinate system aligned to the platform, in a single click the antenna can be placed to it.

Figure 7 shows a patch antenna array for automotive radar at 77 GHz mounted at the front of a vehicle.
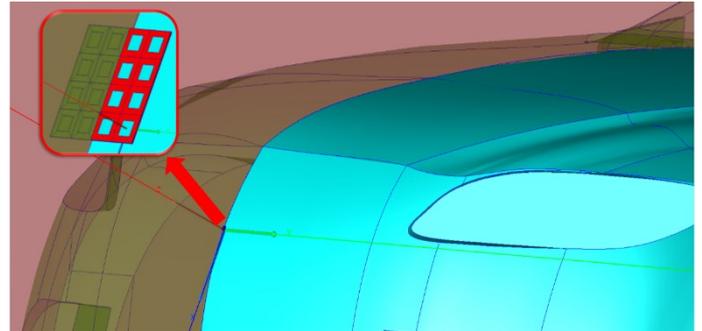
Fig. 7. Patch antenna mounted on a vehicle using the align body transformation.

10. New Snap Modes

The new Snap to Topology modes have been introduced in WIPL-D Pro CAD 2017. Unlike the Snap to Geometry modes where a primitive is created by using numerical coordinates (either from working plane, grid or vertex), the Snap to Topology modes links a primitive to a specific point of another entity. That point can be a vertex, an edge center or a face center. Topologies like curved edges or curved faces can also be used as snapping entities.

If Snap to Topology has been selected when drawing a primitive, it will "breathe" with every change in a dimension and/or position of the entity it has been snapped to. For example, if a primitive has been drawn by using an edge center of another entity, the particular point of the primitive that was snapped to the edge center will remain at the center of that edge, regardless of the changes in the edge geometry or geometry of the body containing the edge.

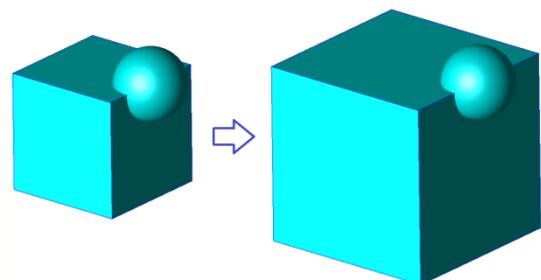A sphere with its center placed at the center of one of the cube's edges, is shown in Figure 8.

Fig. 8. Center of the sphere snapped to the center of cube's edge.

11. Other Options/Improvements

a) Translate Operation

The translation option has been upgraded with a very powerful feature. Options for the translate operator have been expanded so that the user can now pick translation vector points in the 3D view. Depending on the snap modes selected, the vector can contain numerical coordinates and/or coordinates linked to a specific point of another entity (topology) in the model. In this manner, a translation vector adapts to the changes of dimensions and/or changes in a position of other entities in the model.

The translation vector for the selected body, defined by the center of an edge and center of the face, is shown in Figure 9.
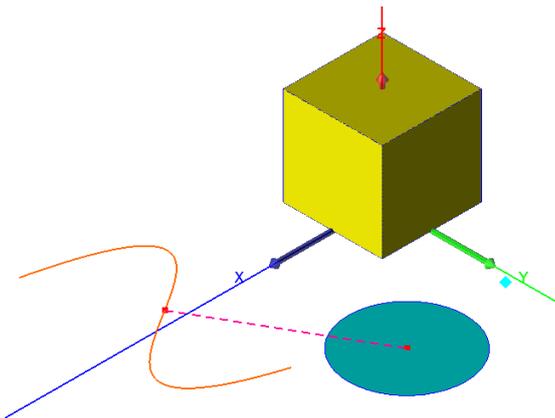

Fig. 9. Translation vector defined by the center of an edge and center of the face.

b) Unused Entity

This option can be useful if one wants to exclude parts of the model from the final mesh, and thus from the EM simulation. It could be applied to both, bodies and faces, as long as there are no excitations or loads defined on them.

c) Smart Port Analysis

If this option is enabled, different port feeders with the same dimensions, number of modes and polarization of the modes are analyzed only once. This reduces the simulation time. Otherwise, when the option is not checked, all the feeders will be analyzed separately, regardless that some of them have identical dimensions and modal parameters.

d) Abort Mesh Procedure

The user can abort the mesh procedure at any time and at any stage of the meshing process.

e) Edit History List in an ASCII Edit Box

The history list can be opened as an ASCII file and then edited, i.e. a command or a set of commands can be added, modified or removed.