WIPL-D Pro CAD: What is New in v2018?

New features/improvements introduced in v2018 are:

1. **Advanced auto-repair options for imported CAD models – automatic detection and removal of redundant model parts:**
   a. **Coinciding faces**
   b. **Small edges and faces**
   c. **Open loops**
   d. **Isolated vertices**
2. **New built-in geometric primitives:**
   a. **Analytical surface**
   b. **Segmented loop/arc**
   c. **BoR - Body of Revolution**
   d. **BoCC - Body of Constant Cut**
3. **Improved meshing**
   a. **Reduces the number of mesh elements**
   b. **Meshing of faces which was not possible earlier**
   c. **Accelerated meshing procedure**
4. **Smart port analysis available for parametric sweep and optimization**
5. **Support for Sweep, Optimization and Time Domain simulations in Batch runs**
6. **Other options/improvements:**
   a. **Unite all in Multiple Copy manipulation**
   b. **Delete vertex and edge**
   c. **Custom defined cutting planes**
   d. **Circular and slant-polarized mode excitations now include waveguide ports intersected by (A)Symmetry planes**
   e. **Improved Sew faces operation**
   f. **Control points insertion via text box for polyline-like primitives…**

1. Advanced Auto-Repair Options

To minimize the effort when obtaining EM-simulation ready model of complex imported CAD geometries it is crucial to have a set of helpful auto-repair tools. WIPL-D Pro CAD now introduces some advanced healing tools suitable for facilitating the whole model preparation process. These tools perform automatic detection and removal of redundant model parts:

a) Coinciding Faces

Very often, upon the import of CAD geometry, some coincident faces may occur. Coincident faces can be problematic when performing Boolean operations. Furthermore, they also cause the mesh elements to overlap, which is not suitable for EM simulation. In v2018, the new feature performs the automatic detection and removing of such faces.

b) Small Edges and Faces

Another issue commonly occurring when working with imported geometry is the presence of very small edges and faces. These elements, due to the size, require different, smaller and often nor-regular mesh elements causing the whole structure to have low-quality mesh and unnecessarily increasing the number of mesh elements. Increase of the number of mesh elements automatically yields the increase of the required number of unknowns, hence the simulation time is longer.

The new option enables removal of faces and edges with dimensions below a predefined threshold. The removal operation is followed by automatic healing i.e. filling of gaps or sewing/unification of adjacent faces, so the original geometry remains unaffected. The examples for removing small faces and edges are shown in Fig. 1 and 2, respectively.
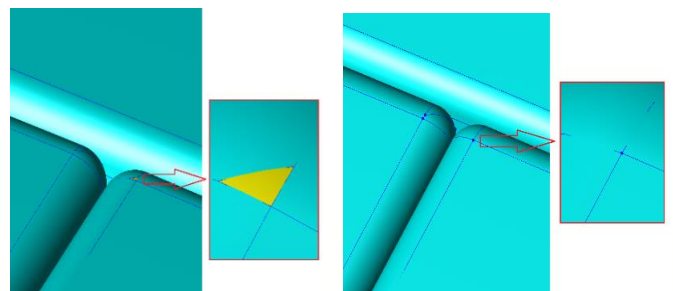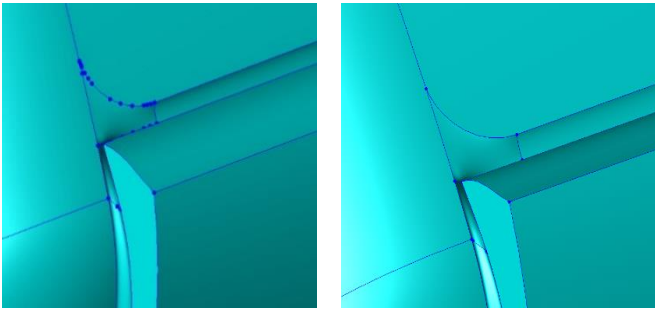

Fig. 1. Remove small faces.

Fig. 2. Remove small edges.

c) Open Loops

Sometimes, the imported geometry includes open loops. An open loop is considered a single edge, or a sequence of several connected edges, having at least one of the ends open. Open loops increase the number of mesh elements, and accordingly the simulation time. Therefore, the removal of open loops is recommended and does not affect the overall geometry of the model and subsequent simulation results.

d) Isolated Vertices

An isolated vertex is a vertex that doesn't belong to any edge. As other abovementioned irregular entities, isolated vertices may also unnecessarily increase the number of mesh elements, and should be removed.

2. New Built-in Geometric Primitives

In order to make the model creation process in WIPL-D Pro CAD easier, besides improvement in adjustments of the imported model parts, the users will always benefit from the addition of new solids-making tools. The built-in primitives added in v2018 include: analytical surface, segmented loop/arc, BoR (Body of Revolution) and BoCC (Body of Constant Cut).

a) Analytical Surface

In addition to the analytical curve primitive available in earlier versions, the *Analytical Surface* primitive from v2018 allows creation of a surface in one of 3 coordinate systems (Cartesian, cylindrical or spherical) by entering analytical formulae. An example is shown in the Fig. 3, where the surface is created in the Cartesian coordinate system by using the following analytical expressions:

$$x(u,v)=u*cos(v),\quad y(u,v)=u*sin(v),\quad z(u,v)=2*v,$$

where the ranges for *u* and *v* parameters are:
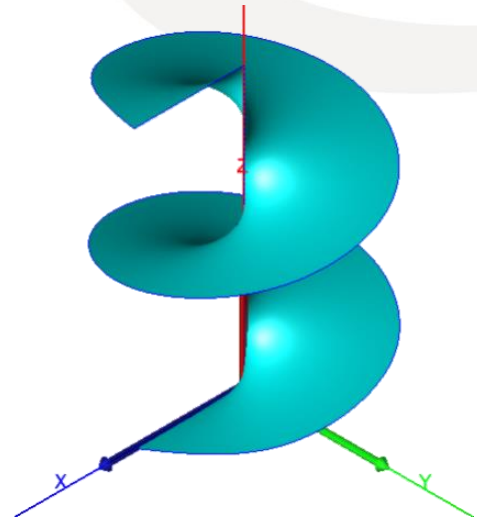
$$u=[0,10],\ v=[0,4*\pi].$$

Fig. 3. Analytical surface.

b) Segmented Loop/Arc

Segmented loop and segmented arc are introduced as special cases of loop and arc primitives. Segmented versions appear as the segmented polylines in contrast to the smooth loops or arcs. The new primitives are shown in Fig. 4.
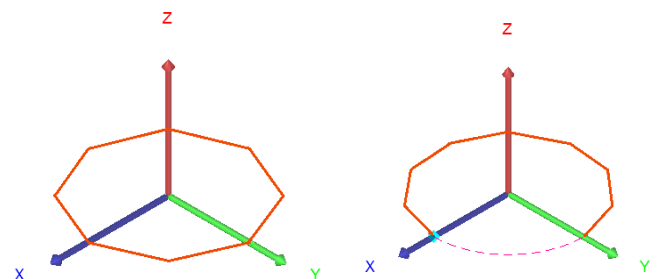

Fig. 4. Segmented loop and arc.

c) BoR- Body of Revolution

A BoR object is obtained when a polyline generatrix placed in the ρ-z plane, is rotated around the z-axis from a start to a stop angle, following the path defined by another generatrix in the xOy plane. The path can be a circle, an ellipse, a regular polygon or custom defined.
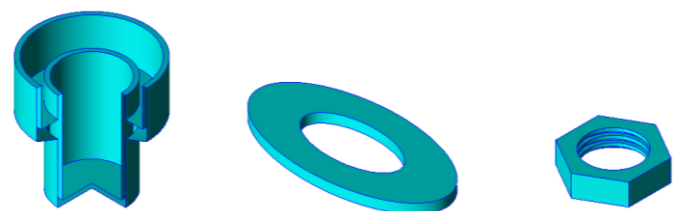
Some examples of BoR entites are shown in Fig. 5.

Fig. 5. BoR entites.

d) BoCC- Body of Constant Cut

A BoCC object is obtained by sweeping a generatrix placed in the ρ-z plane along another generatrix placed in the xOy plane, and a body of constant cross-section in each point of the path is generated. Both generatrices can be one of the following: a circle, en ellipse, a regular polygon or custom defined.

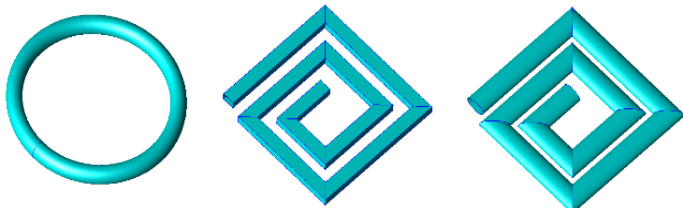Some examples of BoCC entites are shown in Fig. 6.

Fig. 6. BoCC entites.

3. Improved Meshing

Meshing of multi-curved and other complex faces is improved.

The improved algorithm reduces the number of mesh elements from 5 to 10%, reducing simulation time. On the other side, the improved algorithm produces better meshing of faces which gave a large number of mesh elements, avoids the mesh elements with poor quality factor, and successfully meshes the elements where meshing was impossible in the previous versions.

Meshing is accelerated, especially for the models with a large number of symbols in the symbol list. Acceleration of meshing together with smart port analysis results in a very efficient simulation and optimization.

4. Smart Port available for Parametric Sweep and Optimization

If the smart port option is enabled, all of the port feeders having the same dimensions, the number of modes and polarization of the modes are analyzed only once. Otherwise, the feeders are analyzed separately. In successive runs in a Sweep or an Optimization process, feeds are simulated only if their dimensions change between the iterations reducing the overall simulation time.

5. Batch supports Sweep, Optimization and Time Domain Simulation

Batch run allows successive simulations of a number of projects from a custom defined list. For each project (besides a "usual" simulation) a choice whether to perform

an optimization, a parametric sweep or a time domain simulation can be made.

6. Other Options/Improvements

a) Unite all in Multiple Copy manipulation

This option specifies whether a Boolean Unite is to be performed after a multiple copy operation. The user can choose whether to unite all of the copies, all of the copies and the original, or not to perform any Unite after a copy operation.

This option ease the creation of antenna arrays, where the number of array elements can change during the optimization process.

b) Delete Vertex and Edge

Besides body and face deletion, the deletion of edges and vertices is introduced. Vertices at a smooth connection of two edges, at the end of an open edge, or isolated ones, can be deleted. Also, an attempt to delete edges at smooth connections of two faces is made so that no changes in geometry shape occur. Some examples are shown in Fig. 7 and 8.
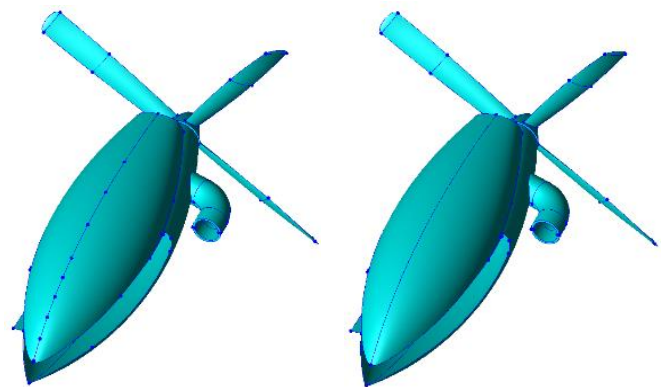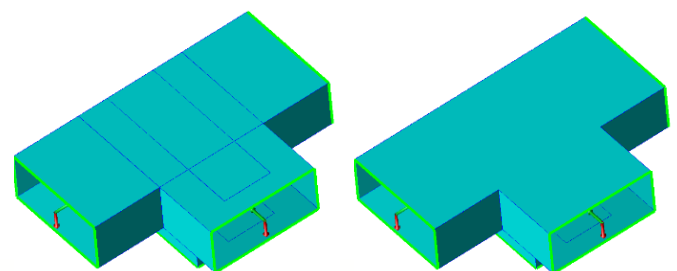

Fig. 7. Delete vertices.

Fig. 8. Delete edges.

c) Custom Defined Cutting Planes

Cutting planes facilitate operations like viewing, selecting and modifying interior parts of a model.

Custom defined cutting planes are introduced which allow the user to create cutting layers or cross-sections in the model, by using analytical expressions. An example is shown in Fig. 9.
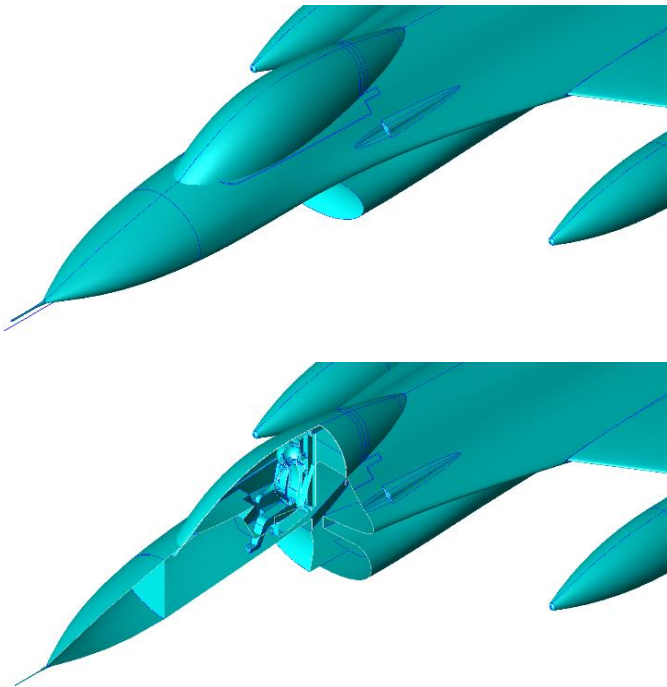
Fig. 9. Custom defined cutting planes.

d) Circular and Slant Polarized Excitations with (A)Symmetry Planes

For waveguide ports intersected by (a)symmetry planes, circular (Right Hand Circular Polarization - RHCP, Left Hand Circular Polarization - LHCP) and slant polarization modes are introduced.

An example of a horn antenna with two (a)symmetry planes is shown in Fig. 10. The antenna is fed by a waveguide port with LHCP of the dominant mode. Gain of the antenna as well as the ellipticity in the main beam direction in the frequency range between 24 GHz and 27 GHz are shown in Fig. 11 and 12.

e) Improved Sew faces operation

WIPL-D Pro CAD 2018 brings improved sewing of faces, by extending the scope of problems this operation can be applied to.

f) Text Box for Control Points

All polyline-like primitives (polyline, NURBS, fitted spline, irregular polygon) can now be created, inter alia, by entering points in a text box.
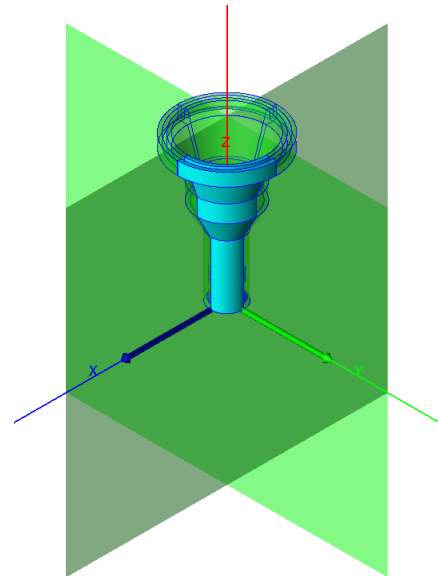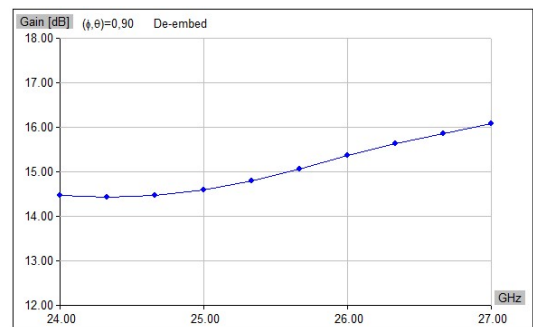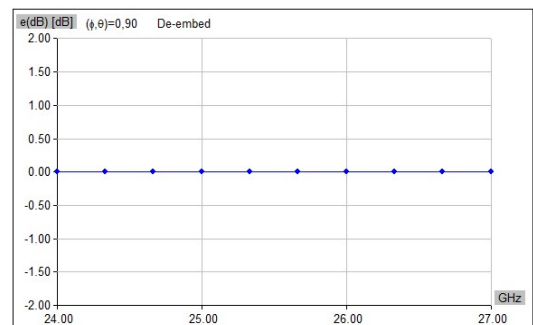
Fig. 10. LHCP horn antenna.

Fig. 11. LHCP horn antenna – gain.

Fig. 12. LHCP horn antenna – elipticity.