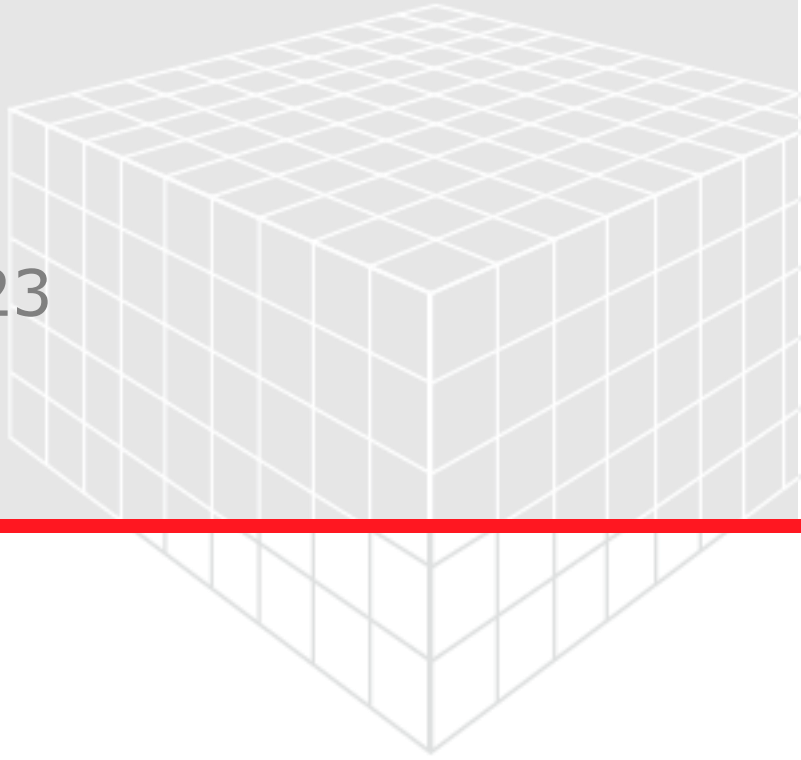
ImportGeo-CAD



User Guide

GeoDict release 2023

Published: February 14, 2023

GeoDict

https://doi.org/10.30423/userguide

Citation:
Jürgen Becker, Andreas Griesser, Barbara Planas. GeoDict 2023 User Guide. ImportGeo-CAD handbook. Math2Market GmbH, Germany,
doi.org/10.30423/userguide.geodict

The handbooks in the User Guide series of Math2Market GmbH can be obtained from:

Math2Market GmbH
Richard-Wagner-Strasse 1
67655 Kaiserslautern
Germany

Phone: +49 631 205 605 0
Fax: +49 631 205 605 99
Email: info@math2market.de
Web: www.math2market.de

ImportGeo-CAD

CAD models are usually not stored as volumetric data. Rather, such models are described by the surface(s) of the modeled objects. Commonly, those surfaces are modeled as a set of connected triangles.

ImportGeo-CAD is GeoDict's module to read such triangulations, and to transform them into a volumetric voxel mesh.

Supported File Formats

Two file formats can be imported with ImportGeo-CAD:

- **STL** (STereoLithography CAD format) surface triangulation files describe only the surface geometry of a three-dimensional object without any representation of color, texture, or other attributes.

  The STL format specifies both ASCII and binary representations. Binary files are more common, since they are more compact.

  For more information see: https://en.wikipedia.org/wiki/STL_(file_format).

- **OBJ** is a geometry definition file format first developed by Wavefront Technologies for its Advanced Visualizer animation package. The file format is open and has been adopted by other 3D graphics application vendors as well.

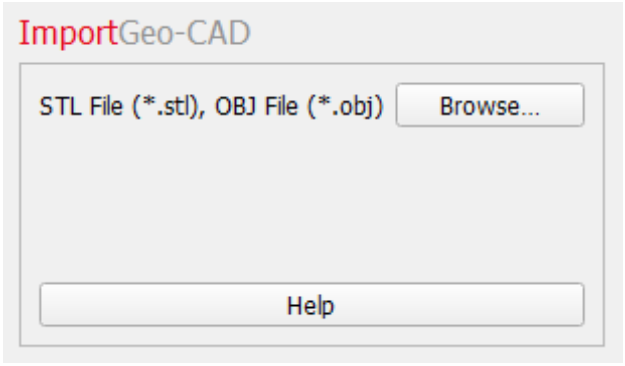
  The OBJ file format is a simple data-format that represents 3D geometry alone — namely, the position of each vertex, the UV position of each texture coordinate vertex, vertex normals, and the faces that make each polygon defined as a list of vertices, and texture vertices. Vertices are stored in a counterclockwise order by default, making explicit declaration of face normals unnecessary. OBJ coordinates have no units, but OBJ files can contain scale information in a human readable comment line.

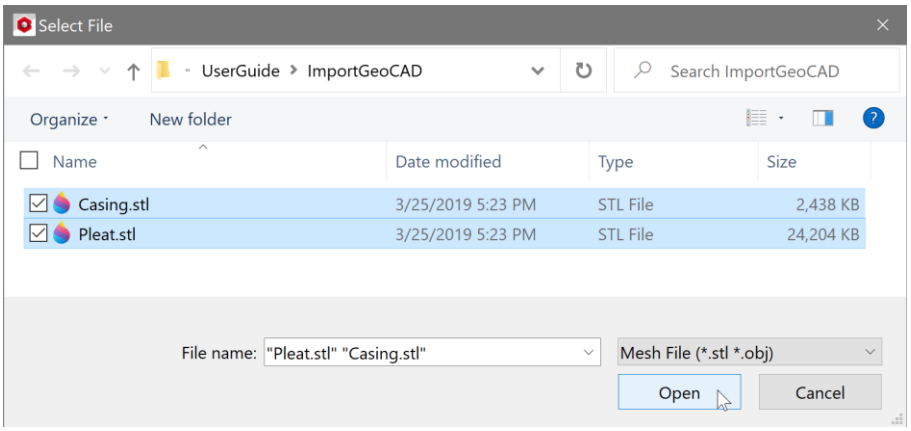
  For more information see https://en.wikipedia.org/wiki/Wavefront_.obj_file.

IMPORTING CAD FILES

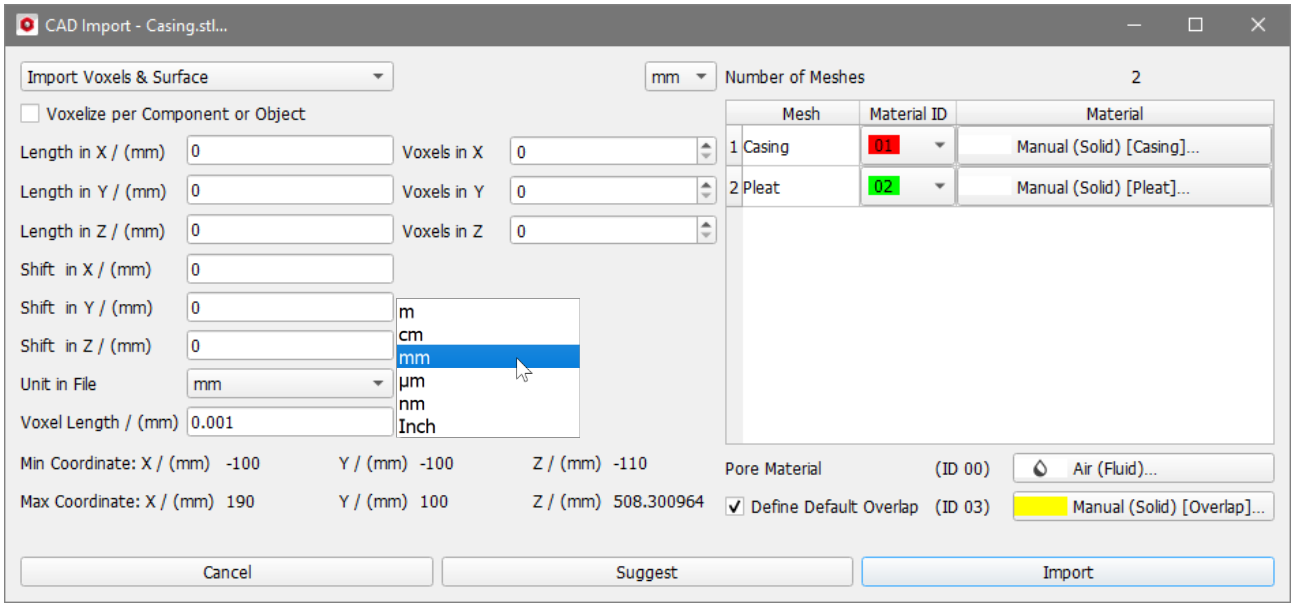
To import CAD models in GeoDict formats, select **Import → ImportGeo-CAD** in the menu bar. The **ImportGeo-CAD** section opens at the left of the GeoDict GUI.

Data in the *.stl and *.obj formats can be selected by clicking **Browse...**. Through the opening **Select File** dialog, locate a file of that format in the chosen project folder. Select the file name and click **Open**. A single file or multiple files can be chosen at once.





When all files to import have been selected, click **Open**. The CAD Import dialog that opens already shows how many meshes are contained in the selected files.

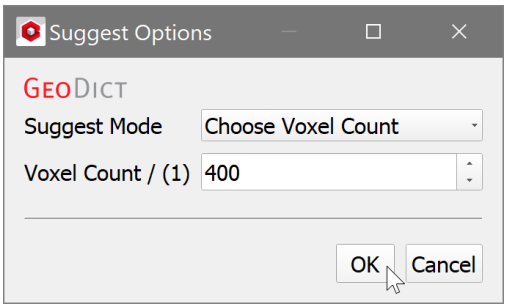


First, set the **Unit in File**. The floating point values stored inside an STL file may denote different units. This information is not stored in the STL file itself, so it has to be set manually.

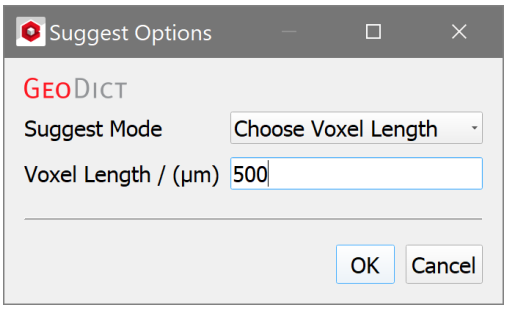
After the unit has been set, the extension of the CAD objects in X,Y,Z direction are shown in the **Min Coordinate** and **Max Coordinate** fields at the bottom of the dialog. In this example, the structures span a range from -100 mm to 100 mm in Y-direction.

Next, define the bounding box (domain size) of the voxel structure. It is possible to enter the values manually or to find a box that completely contains the structures to import automatically by clicking **Suggest**. Two options are available:

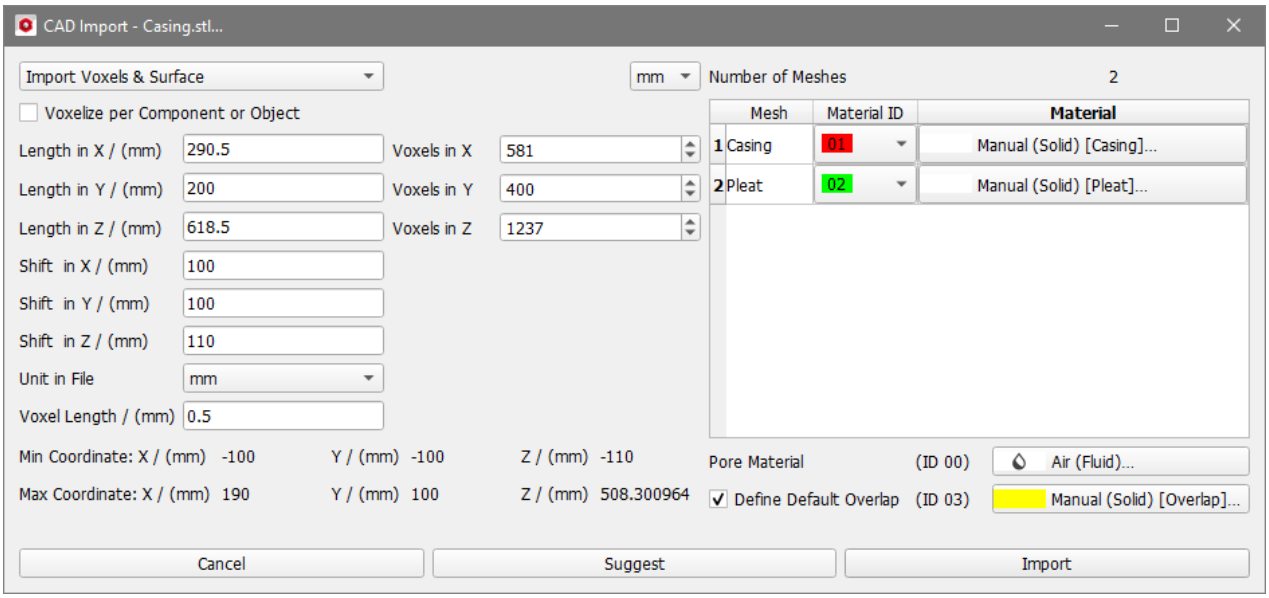
With **Choose Voxel Count**, the suggested resolution is set in such a way that the imported structure spans roughly the given **Voxel Count** grid cells in its longest direction.



With **Choose Voxel Length**, the resolution is fixed to the given **Voxel Length**.

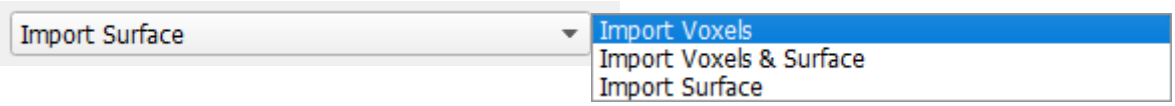


After clicking on **OK**, the selected STL files are parsed and the values of the suggested bounding box are entered in the dialog.



Import Voxels and/or Import Surface

In the selection on the top left, choose what ImportGeo-CAD should import



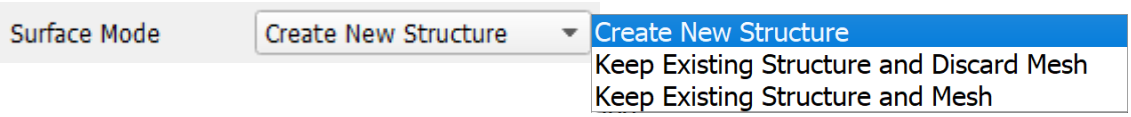
Import Voxels creates a voxel mesh, that can afterwards be used by all GeoDict modules for simulations and analysis. To turn the surface mesh into a volumetric voxel mesh, each voxel is assigned a material based on the location of the voxel center. If the center lies *inside* of the triangulated surface, it is assigned to the selected material. Here*, inside* and *outside* are defined by the face normals of the triangles.

Import Surface loads the triangulated surface as stored in the STL or OBJ file into GeoDict. The surface can then be visualized in GeoDict. It can also be modified with MeshGeo and the modified surface can be exported again with ExportGeo-CAD. The loaded surface triangulation cannot be used to run simulations with any of GeoDict's other modules.

Import Voxels & Surface loads the surface and creates a voxel mesh as described above.

Surface Mode

This option is only available when **Import Surface** has been selected.



Create New Structure erases the current structure (if present) and creates a new domain around the imported surface(s).

Keep Existing Structure and Discard Mesh adds the imported surfaces into the current domain, keeps any existing voxel structures, but discards all previously imported or created surface meshes.

Keep Existing Structure and Mesh adds the imported surfaces into the current domain, keeps any existing voxel structures, and also keeps all previously imported or created surface meshes.

When the structure is kept, the parameters **Length in X, Length in Y, Length in Z, Voxel Length**, and **Voxels in X**, **Voxels in Y**, **Voxels in Z** are fixed and cannot be changed. Only the **Shift** values can be modified to move the imported object into the right position. If you need to distinguish the newly imported surfaces from any previously imported ones, make sure to select a new Material ID for it.

Domain Size (Length in X, Y, Z) and Shift

The domain size and shift values are automatically suggested in such a way that the complete surface mesh(es) is(are) inside of the domain.

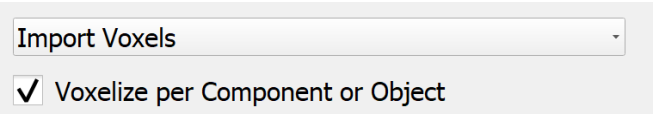
The domain size is defined by the parameters **Length in X, Length in Y** and **Length in Z**. The chosen **Voxel Length** defines the number of **Voxels in X**, **Voxels in Y** and **Voxels in Z** in each of the space directions.

The origin of the created domain is fixed at (0,0,0). To move the imported meshes inside of the domain, **Shift in X**, **Shift in Y** and **Shift in Z** are added to the coordinate values when importing the surface meshes. In the above example, the min.

coordinate value in X-direction lies at -0.1 m, which is shifted by 100 mm to end up at 0.0 at the exact boundary of the domain.

Voxelize per Component or Object

This option is only available when **Import Voxels** or **Import Voxels & Surface** has been selected.



If checked, each triangle mesh is subdivided into connected components first, and then each component is imported and voxelized separately. Be aware that choosing this option might strongly increase the runtime of importing the mesh. Additionally a Label image is created that stores the id of the components to allow later modification of individual components. When object IDs are present in a STL file these are used as component indices.

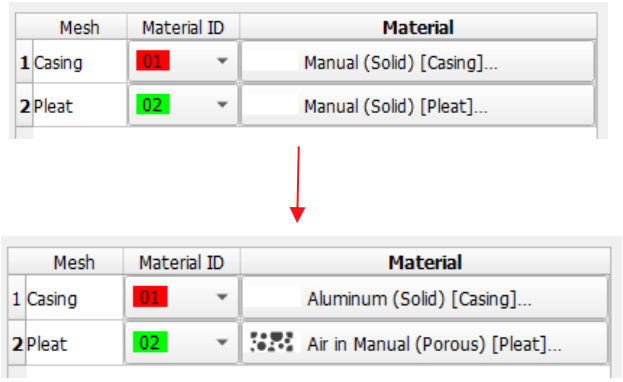
Number of Meshes

The number of meshes present in the selected files is automatically entered. Typically, the number of meshes corresponds to the number of chosen files, but OBJ files might contain multiple meshes.

Material and Material ID selection

The table is automatically filled when **Suggest** inputs the parameters into the dialog. The first column contains the name of the mesh file. It may include the name of the mesh plus a number if a file contains several meshes.

A material can be assigned to the listed mesh by clicking its button in the second column.



For example, the material of the **Casing** can be set to Aluminum, and the material of the **Pleat** to a porous material filled with air.

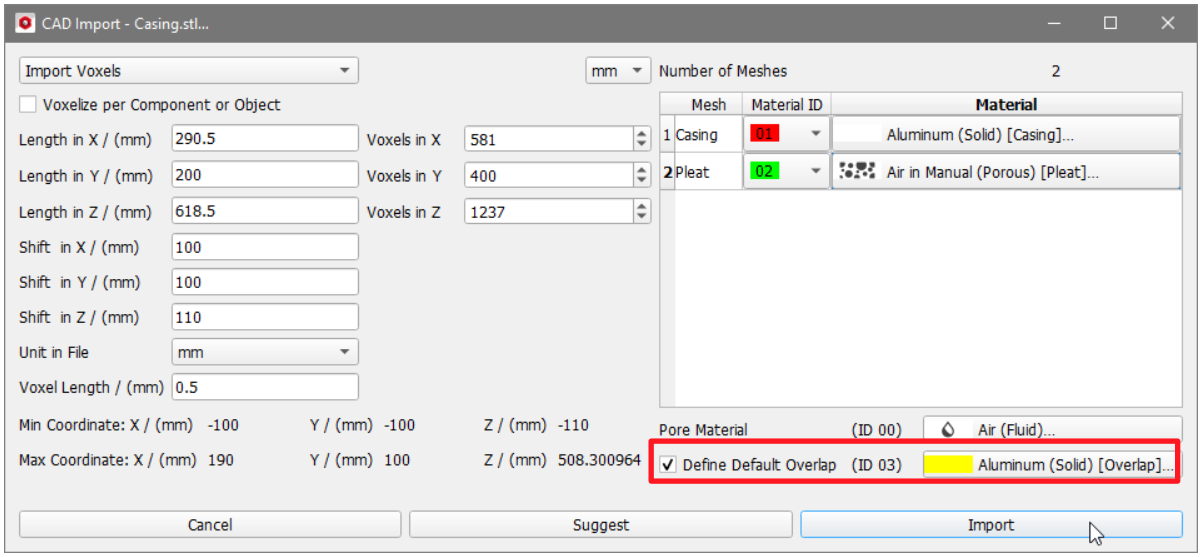
Pore Material

Below the table, set the background material. The background material always hat material ID 00.

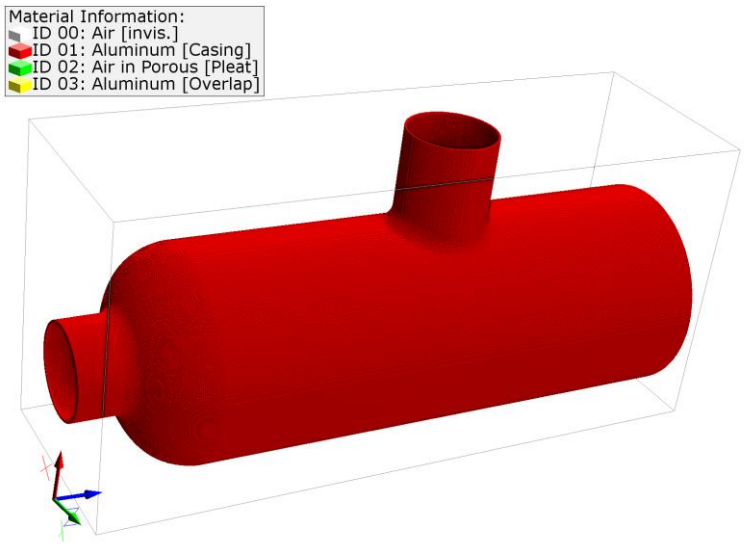
Meshes might overlap if several files for meshes are imported, so that some voxels possibly belong to several materials.

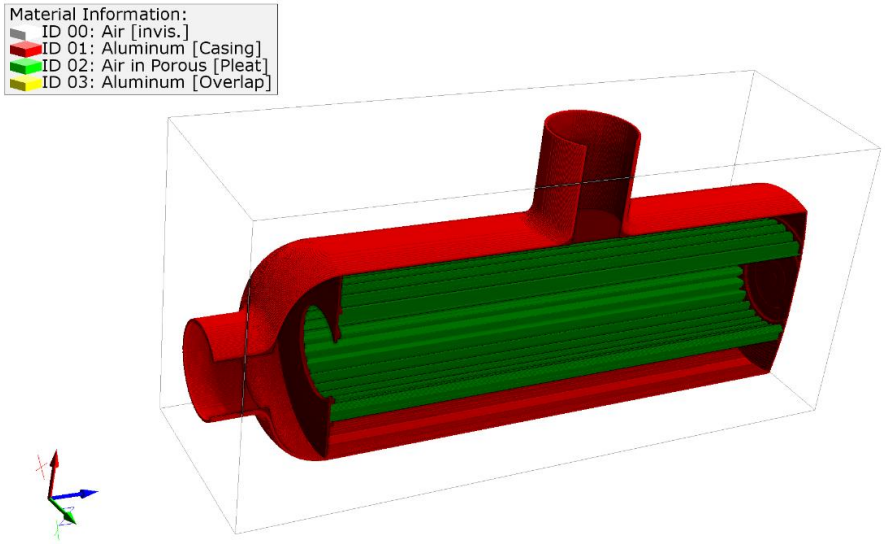
With this option, the user can assign a specific material to overlap regions. If no default overlap is defined by the user, the material ID of the overlapping regions is automatically computed through a binary addition of the IDs of the overlapping materials.

When all settings have been checked, click **Import** to load the structure.



If **Import Voxels** was selected, the structure is available as voxel grid afterwards for further computations with other GeoDict modules. It can be visualized as any other generated or imported voxel mesh. See the Visualization handbook of this User Guide for more details.



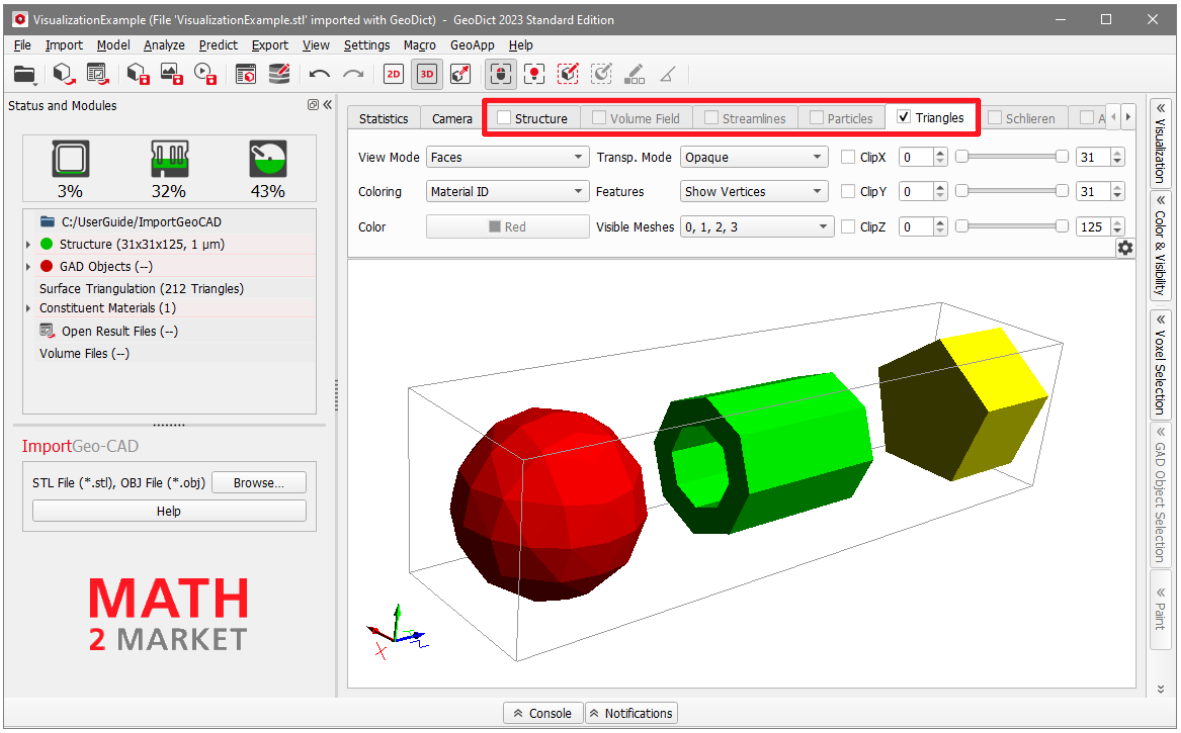


If **Import Surface** was selected, the original surface triangulation is loaded and can be visualized as described in the following chapter.

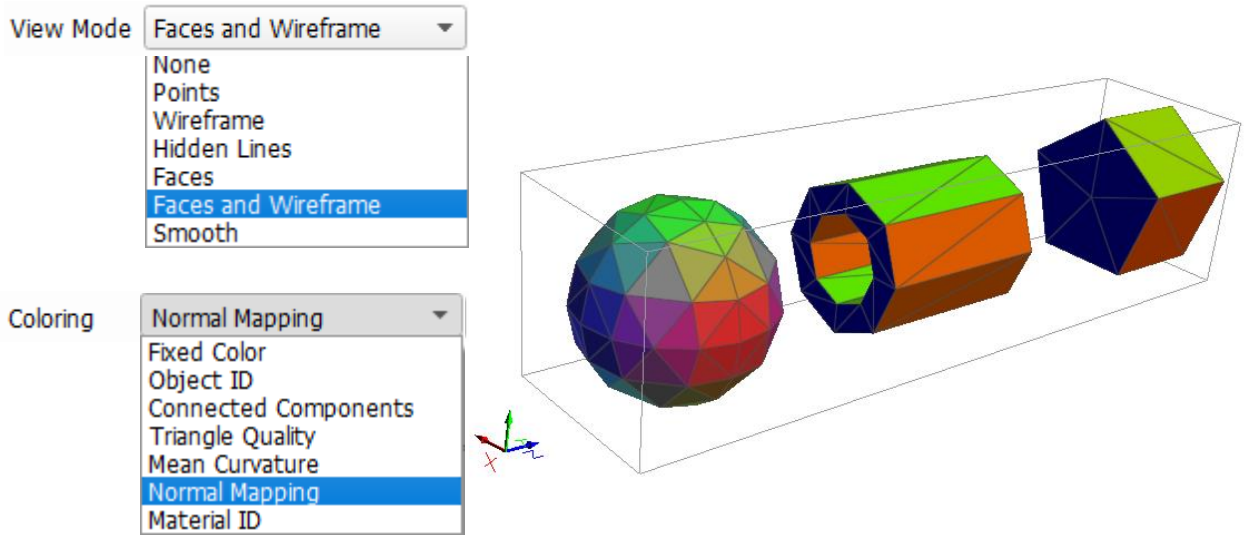
VISUALIZATION OF SURFACE MESHES

When a surface triangulation is loaded, the structure appears in the Visualization area of the GUI and, above in the Visualization panel, the **Triangles** tab becomes activated. Modifying the parameters allows to visualize the triangles in different ways.

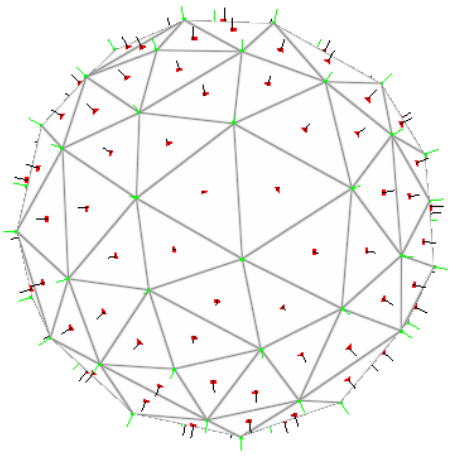
When visualizing triangulated surfaces, and to observe the difference between the **View Mode** and **Coloring** choices, the visualization of the voxelized structure must be switched off by unchecking the **Structure** tab.



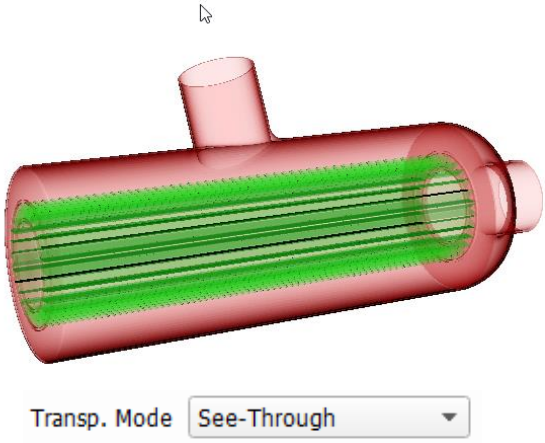
The user can choose between different **View Modes** and **Coloring** schemes:

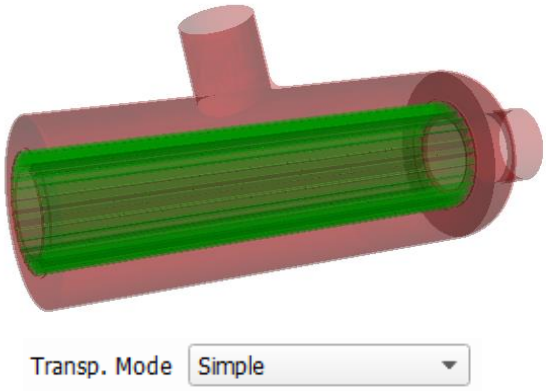


The **Features** pull-down menu allows to visualize vertices, midpoints, face, and vertex normals.

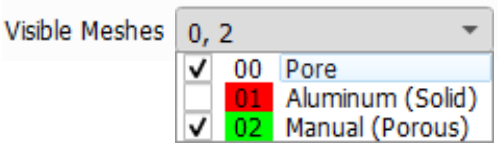


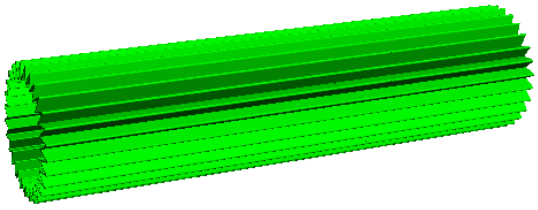
Two different **Transparency Modes** are available, which allow to visualize the inner parts of the structure:





With the **Visible Meshes** pull-down menu, the visualization of every imported mesh can individually be switched on and off.





With the help of the **Clip** sliders, the region to be shown can be adjusted.

https://doi.org/10.30423/userguide.geodict

Technical documentation:

Jürgen Becker

Andreas Grießer

Barbara Planas

MATH 2 MARKET

Math2Market GmbH

Richard-Wagner-Str. 1, 67655 Kaiserslautern, Germany
www.geodict.com