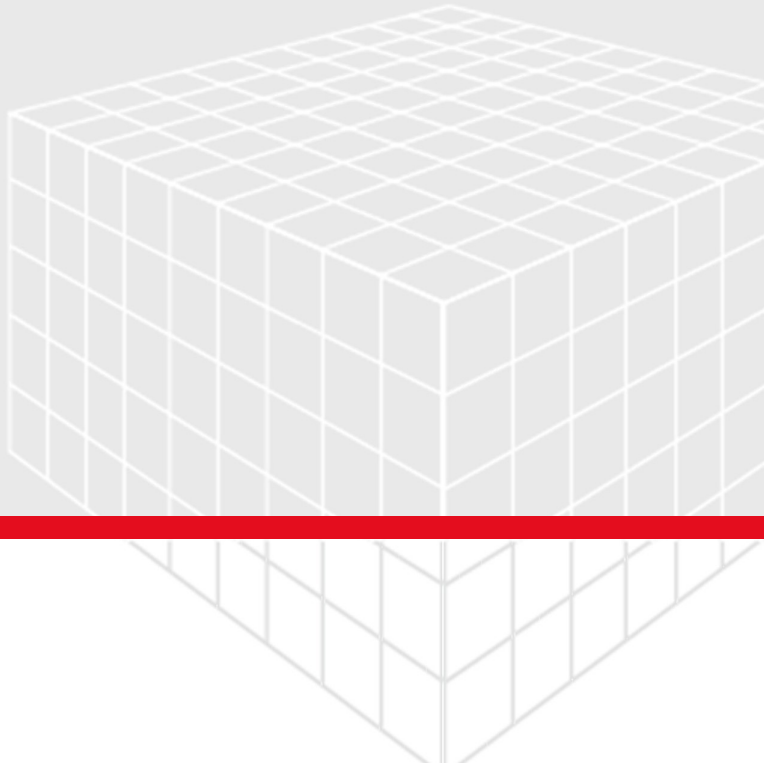
ImportGeo-CAD

User Guide



GEODICT Release 2026

Published: June 2026

GeoDict

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

ImportGeo-CAD

1 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.

How ImportGeo-CAD works

- Import STL and OBJ Files 5
  Browse for the surface triangulation file(s), select domain size and material parameters, and import the structure either as surface triangulation or convert it into a voxel mesh.
- Visualization of Surface Meshes 14
  Learn how to visualize triangulations in GeoDict.

Join the conversation

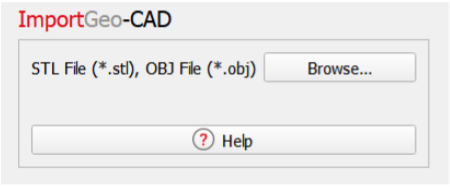
Visit the Community on GeoDict Forum to be inspired and get answers to top questions.
Find illustrative application examples on the website.
Our tutorials and seminar videos give you a first hands-on experience. They are

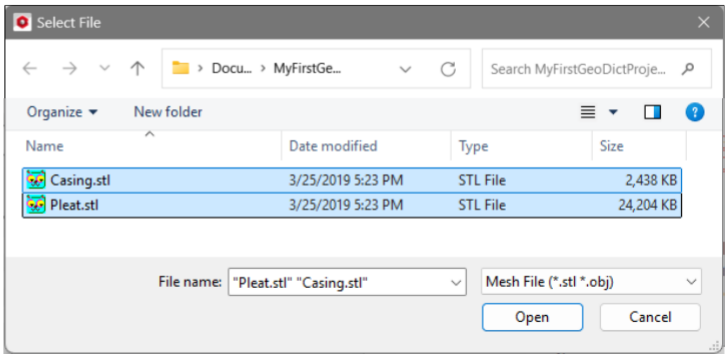
collected in the Learning Center.
Send your Support Request to our technical Support.

1.1 Import STL and OBJ Files

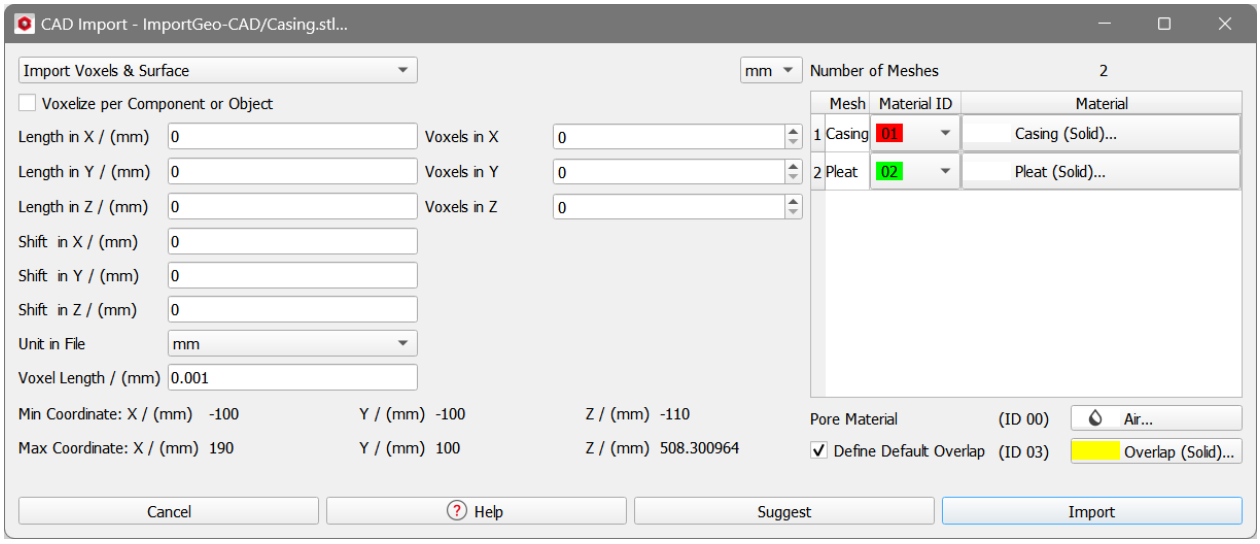
To import CAD models in GeoDict formats, select **Import** → **ImportGeo-CAD** in the menu bar. The **ImportGeo-CAD** section opens at the left of the GeoDict GUI.

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.





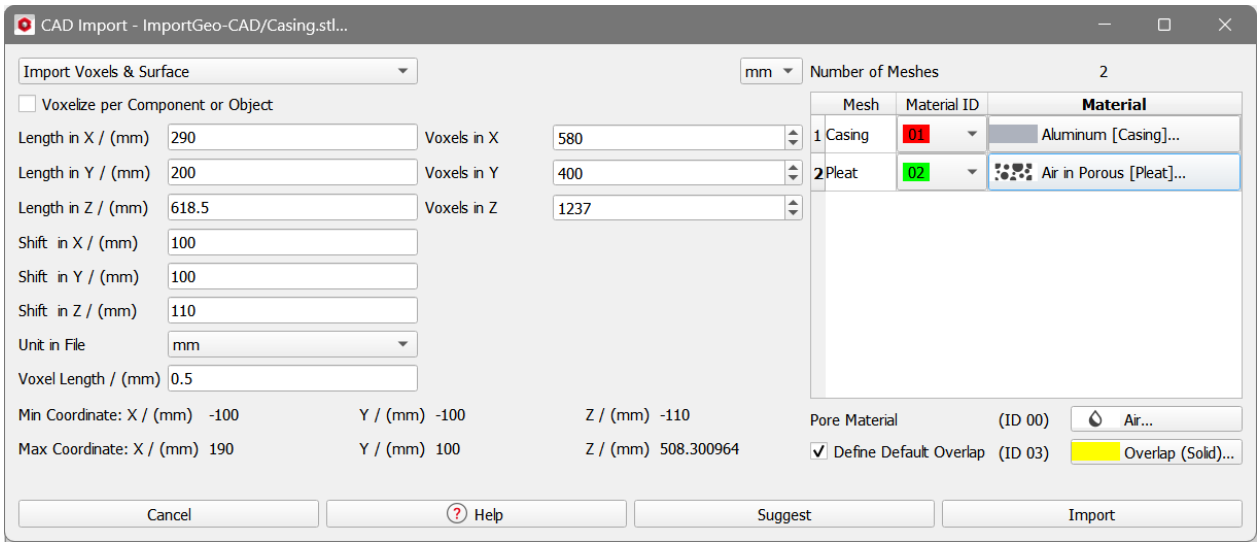
When all files to import have been selected, click **Open**. The CAD Import dialog that opens already shows how many meshes are contained in the selected files.



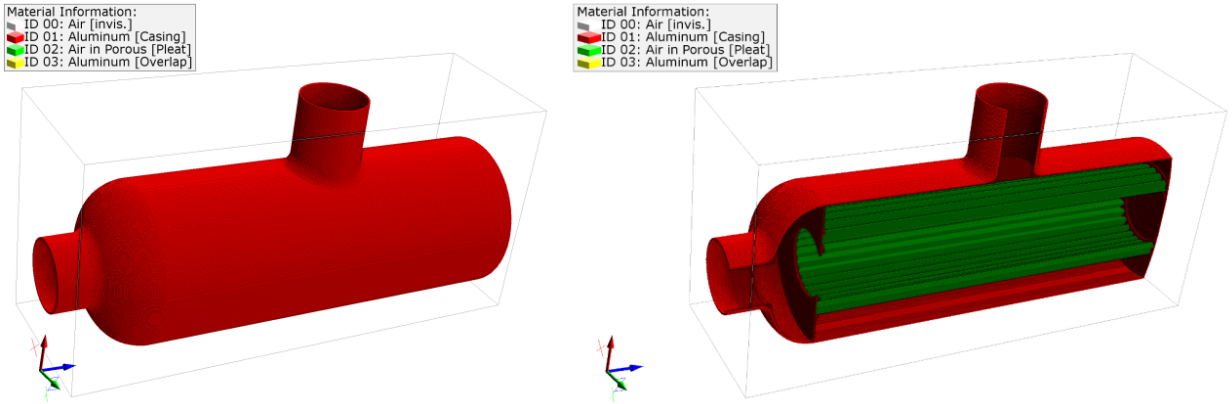
The input parameters shown in the dialog are divided into three categories:

- Import Voxels and/or Import Surface 7
  Select whether to import surface date for visualization or to create a 3D voxel mesh.
- Domain Size and Voxel Length 11
  Determine the domain size and voxel length of the imported structure.
- Material and Material ID Selection 12
  Assign material IDs to each of the meshes and define pore and overlap materials.

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

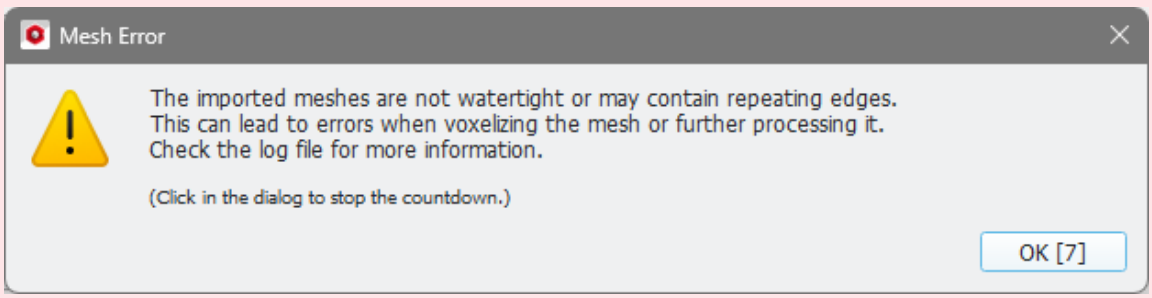


If **Import Voxels** was selected, the structure is available as a voxel grid afterwards for further computations with other GeoDict modules. It can be visualized as any other generated or imported voxel mesh. See the Visualization chapter of this User Guide for more details.



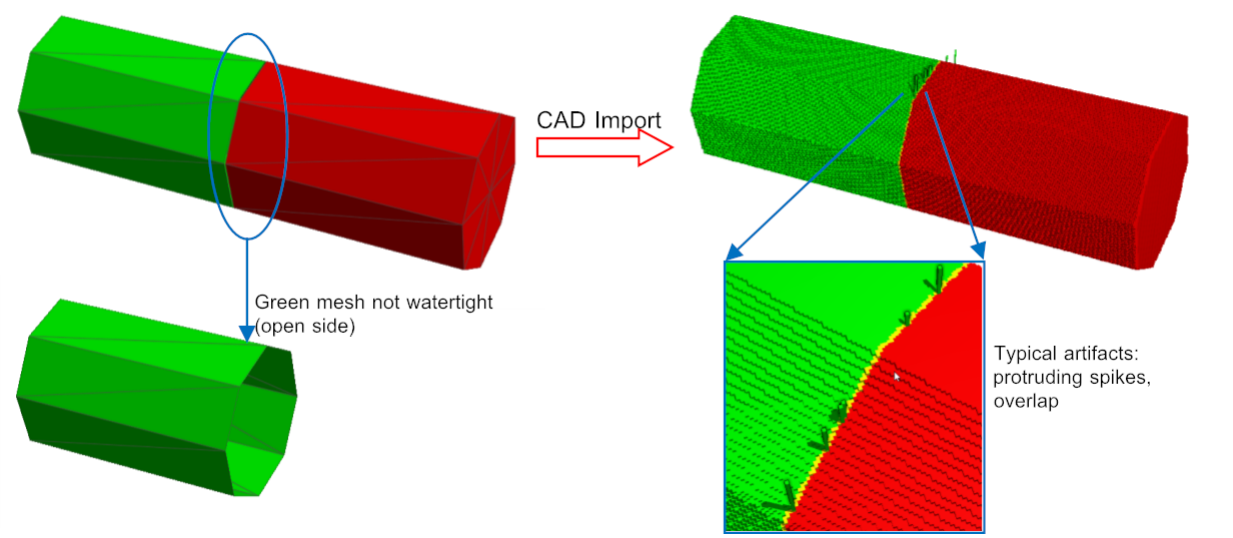
If **Import Surface** was selected, the original surface triangulation is loaded and can be visualized as described in Visualization of surface meshes 14.

Important! Please note that only watertight meshes can be imported, otherwise an error message pops-up and the imported structure may contain artifacts.



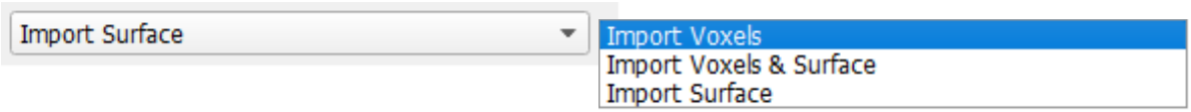
If you want to import multiple meshes (or if the file to import contains multiple meshes), each mesh must be watertight by itself. If a mesh is not watertight, inside and outside is not clearly defined in some places and this may lead to unwanted artifacts. In the example below, only

the red part is watertight, the green part is not closed (the side where the green part touches the red part is missing).



1.1.1 Import Voxels and/or Import Surface

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



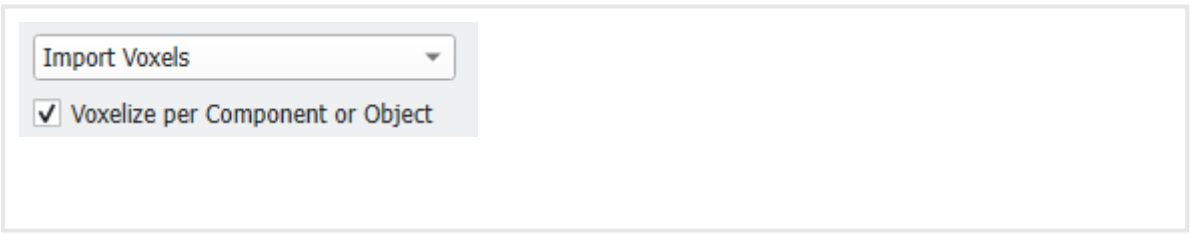
Import Voxels generates a voxel mesh, that can be utilized across all GeoDict modules for simulations and analysis. To turn the surface mesh into a volumetric voxel mesh, each voxel is assigned a material based on the location of the voxel center. If the center lies *inside* the triangulated surface, 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.

When you select **Import Voxels** or **Import Voxels & Surface**, the option **Voxelize per Component or Object** becomes available.

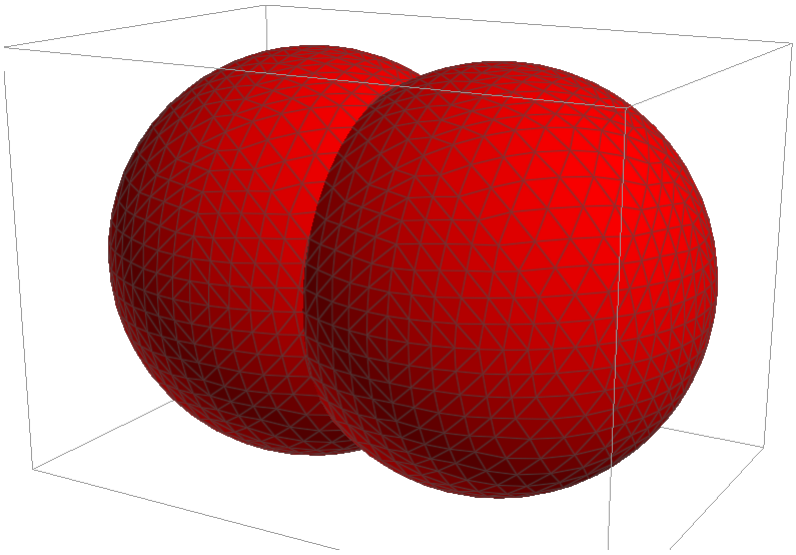
Voxelize per Component or Object



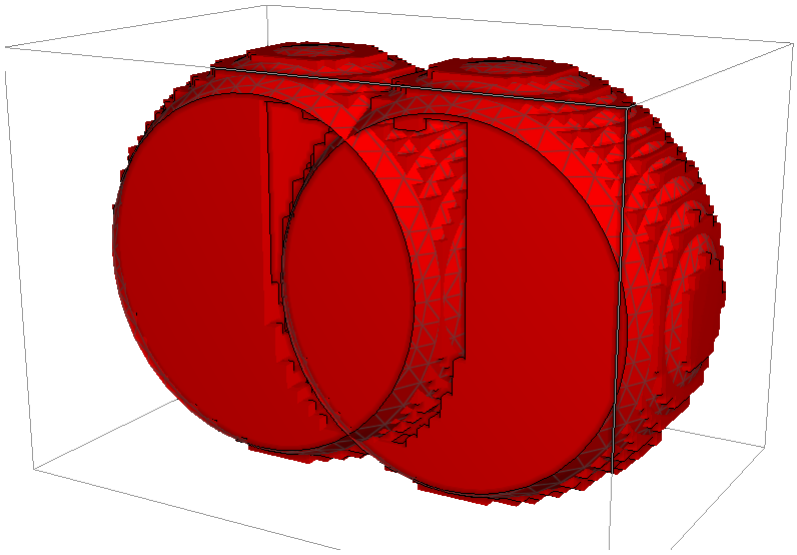
When selected, each triangle mesh is first divided into connected components, which are then imported and voxelized separately. An additional effect of this option is that a label image is created that stores the ID of the components to allow later modification of individual components. When object IDs are present in a STL file these are used as component indices. Be aware that choosing this option might increase the runtime of importing the mesh.

Important!

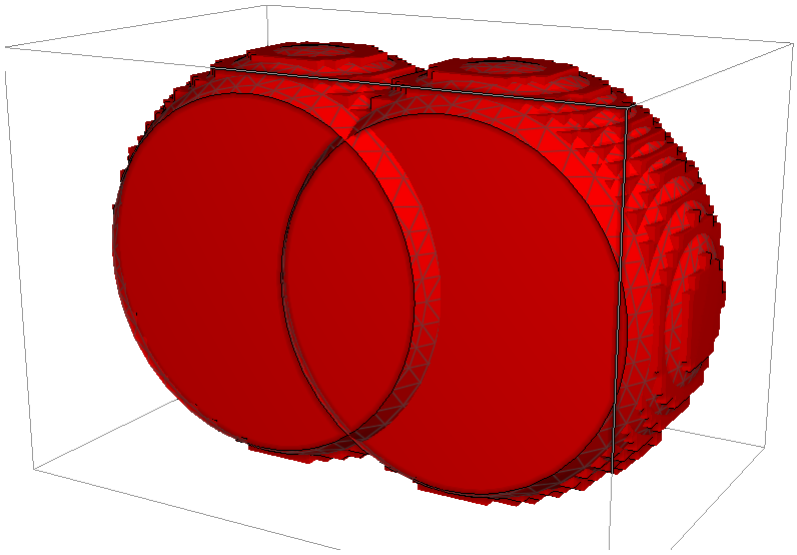
- When there are no overlapping objects in the imported mesh, this option does not influence the voxelization.
- It takes effect only when a mesh contains connected components with the same material ID or no material ID at all.



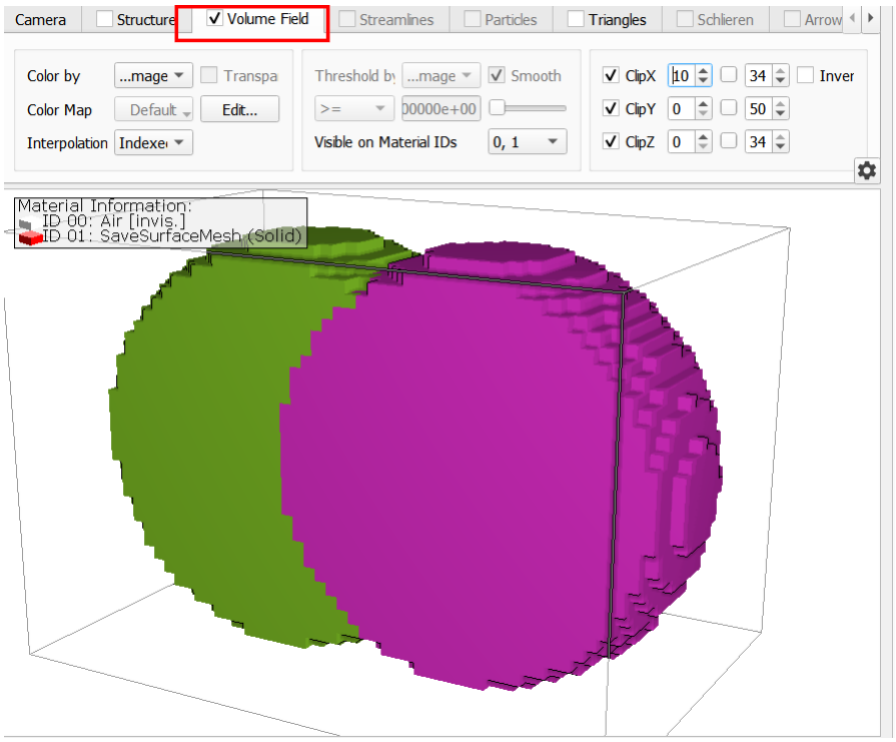
Without **Voxelize per Component or Object,** a mesh containing two overlapping spheres is voxelized in a single step, and the decision if a voxel is inside or outside of the structure is made based on the nearest surface. Therefore, in the overlap region, the resulting voxel structure may contain holes or other artifacts.



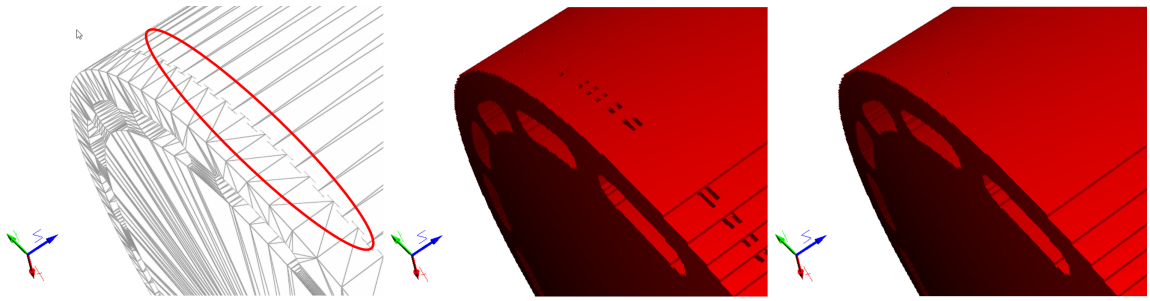
When **Voxelize per Component or Object** is checked, the space taken by the objects is voxelized correctly to solid.



The **Index Image** volume field is created when the option is used. One of the object indices is assigned to the overlap region.



Such overlapping or intersection can occur fairly often in CAD-generated STL files, especially in complex designs. For example, a filter housing and base might cross one another, but by correctly using the option here, the errors in CAD modeling can be repaired.



STL mesh with overlapped objects

Voxelization without
Voxelize per Component or Objects

Voxelization with
Voxelize per Component or Objects

When you select **Import Surface**, the **Surface Mode** drop-down menu appears.

Surface Mode

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.

1.1.2 Domain Size and Voxel Length

The domain size should be determined based on the original physical dimension of an STL file. 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 190 mm in X-direction, from -100 mm to 100 mm in Y-direction, and from -110 mm to 508.3 mm in Z-direction.

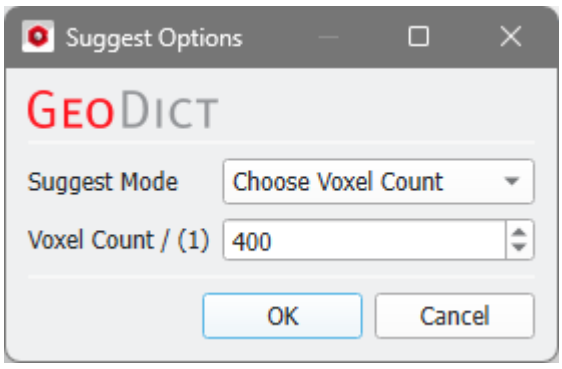
Next, define the bounding box (domain size) of the voxel structure. It is possible to enter the values manually or to find a box that completely contains the structures to import automatically by clicking **Suggest**.

Important! You must set the correct **Unit in File** before using **Suggest.**

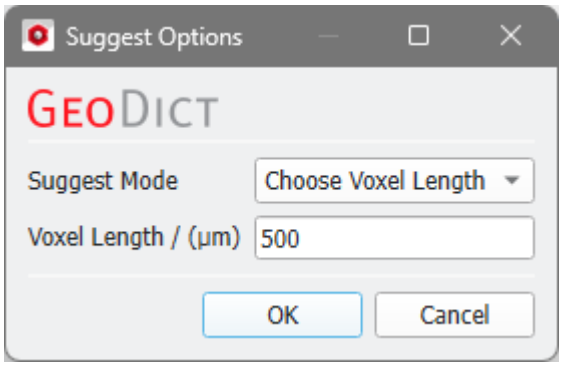
Suggest

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.

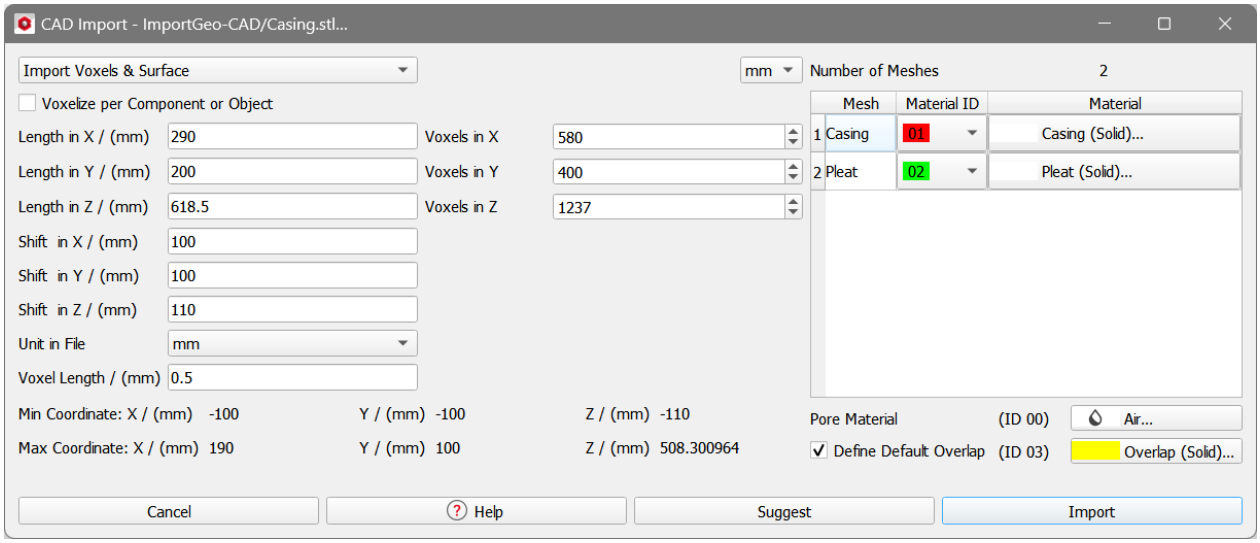


With **Choose Voxel Length**, the resolution is fixed to the given **Voxel Length**.



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

With **Suggest**, the domain size and shift values are automatically entered into the dialog 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.

1.1.3 Material and Material ID Selection

Use the right-hand side of the dialog to define material ID and constituent material for each of the STL meshes, the pore space, and the overlap.

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.

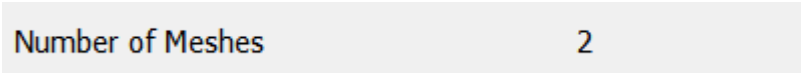
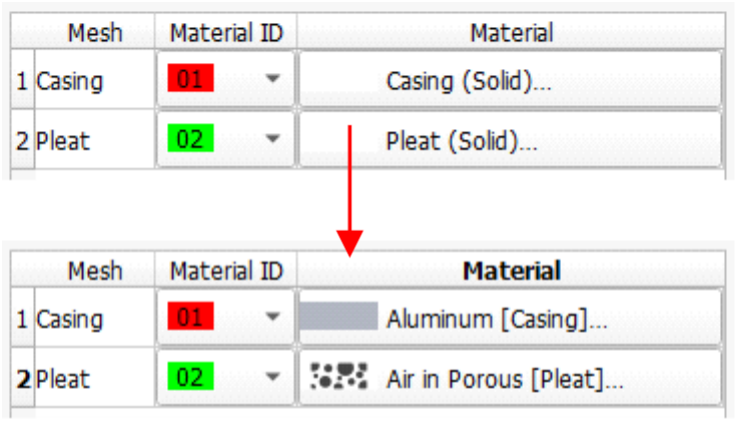


Table of Meshes and Materials

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 has the ID 00.

Define Default Overlap

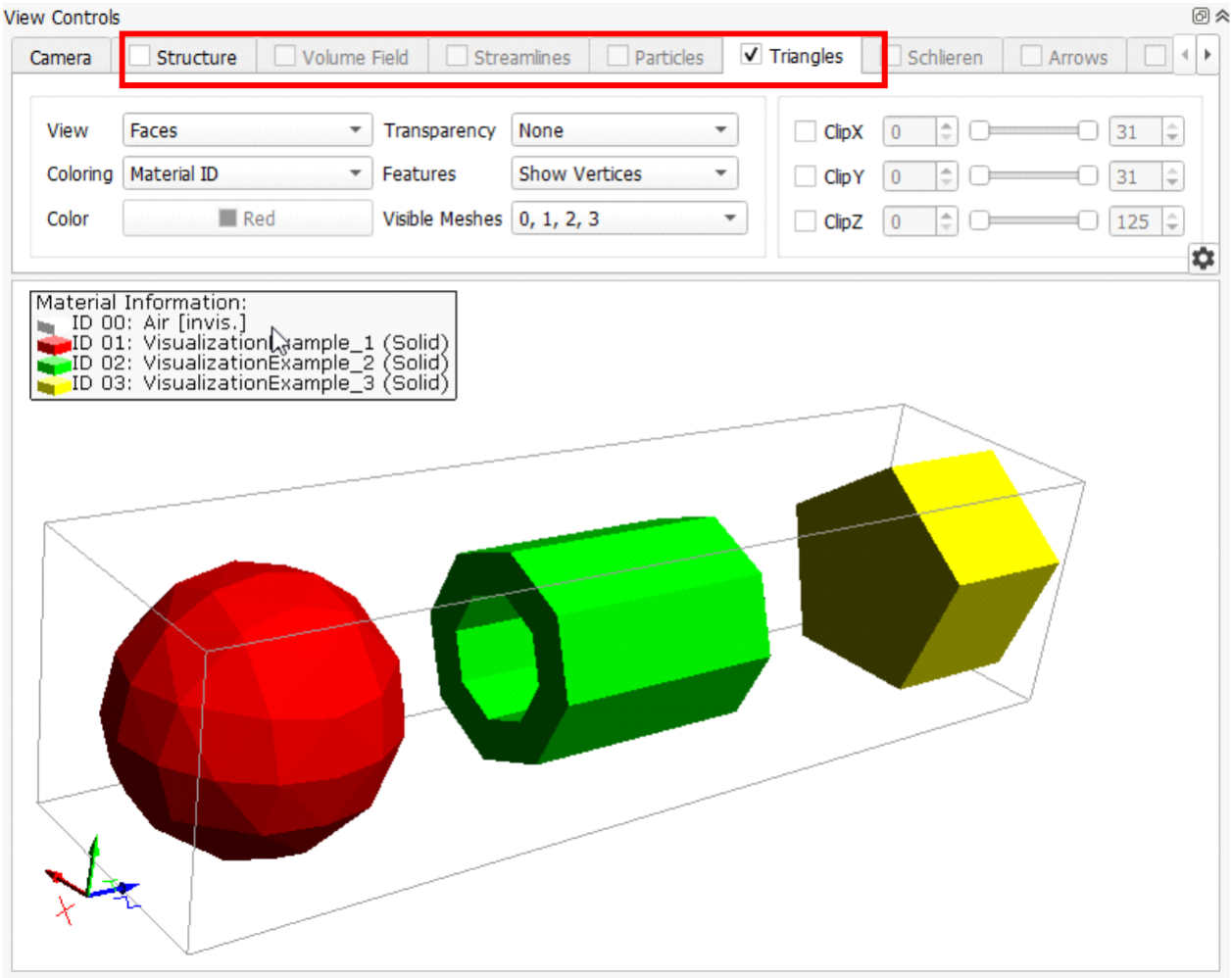
Meshes might overlap if several files for meshes are imported, so that some voxels possibly belong to several materials.

Use this option to 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.

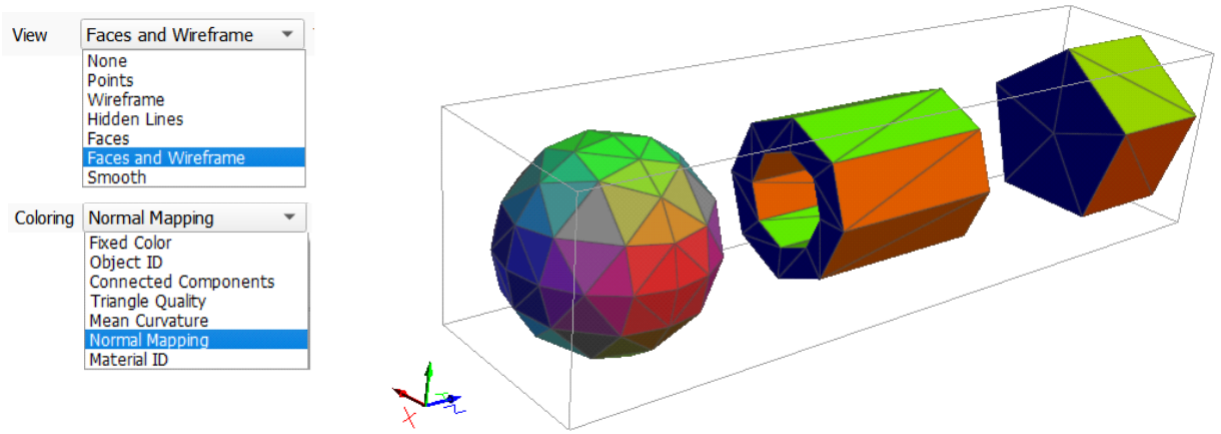
1.2 Visualization of Surface Meshes

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.

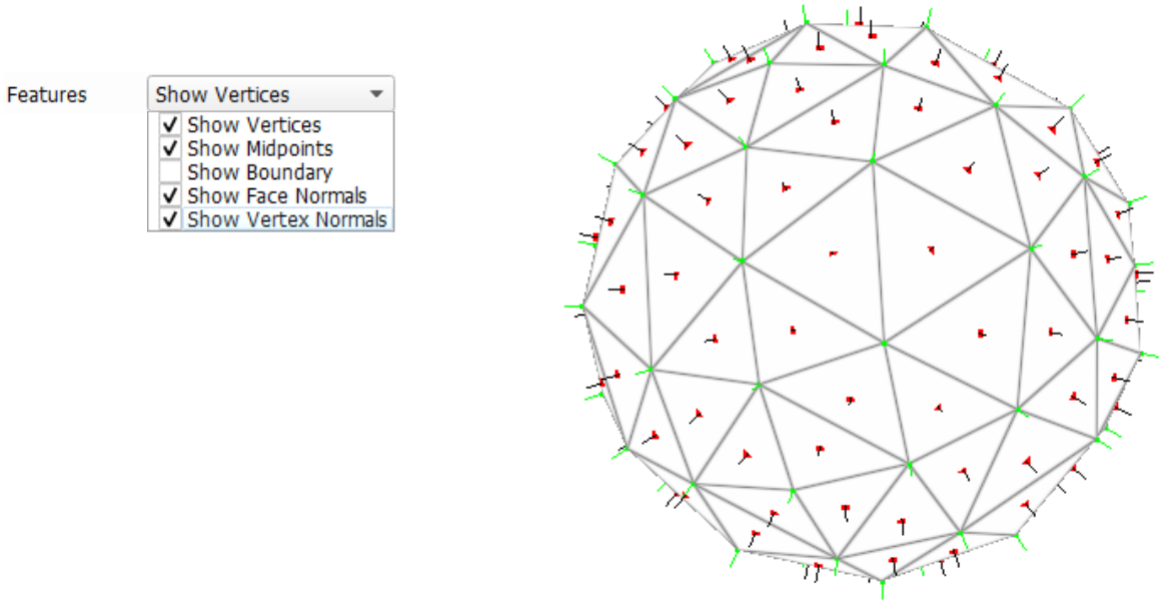
When visualizing triangulated surfaces, and to observe the difference between the **View Mode** and **Coloring** choices, the visualization of the voxelized structure must be switched off by unchecking the **Structure** tab.



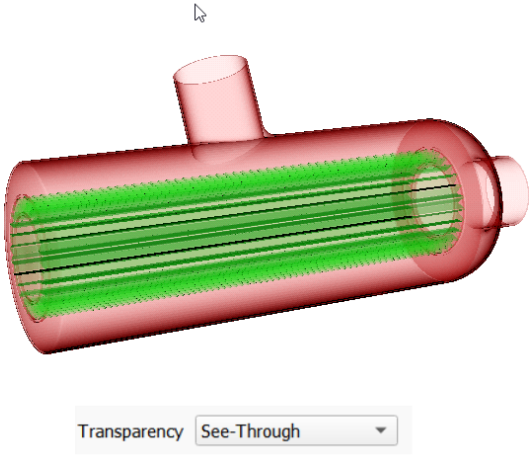
Select between different **View Modes** and **Coloring** schemes:

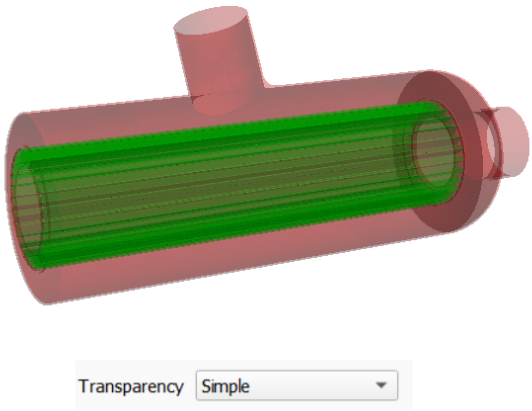


The **Features** pull-down menu allows to visualize vertices, midpoints, and face and vertex normals.

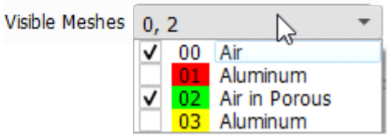


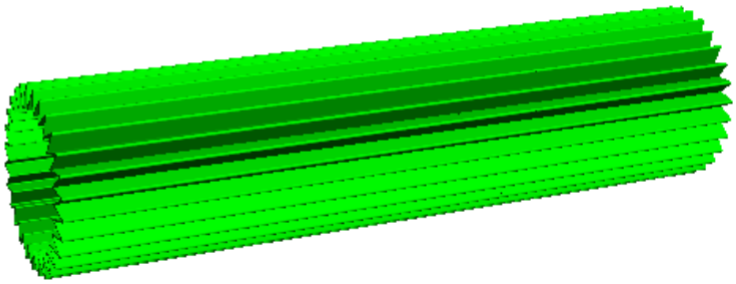
Two different **Transparency Modes** are available, which allow to visualize the inner parts of the structure:



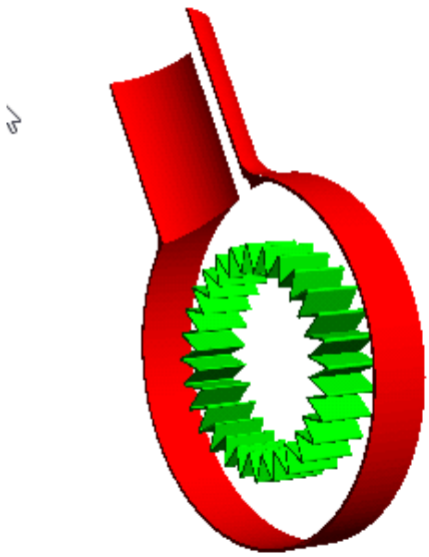


With the **Visible Meshes** pull-down menu, the visualization of every imported mesh can individually be switched on and off.





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



Citation: Math2Market GmbH, 2026: GeoDict 2026 User Guide, ImportGeo-CAD, Math2Market GmbH, Germany, doi.org/10.30423/userguide.geodict

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