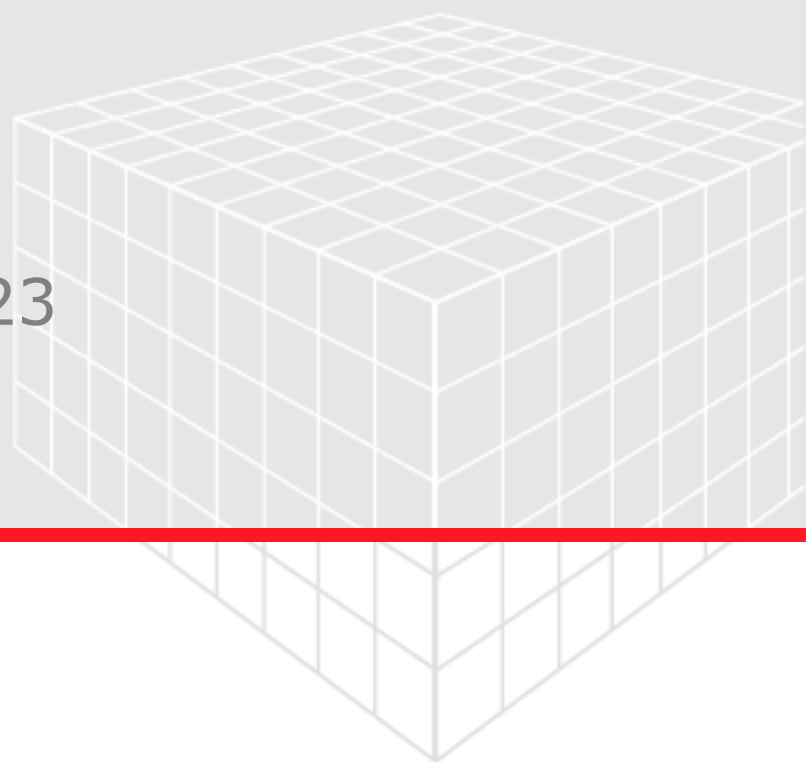


IMPORTGEO-BASE

User Guide

GeoDict release 2023

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GEO DICT

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IMPORTGEO SUBMODULES

The three **ImportGeo** submodules can import most 2D and 3D image file formats into **GeoDict**.

- **ImportGeo-Base** loads structure files with a **GeoDict** file format.
- **ImportGeo-Vol** is used to import most image file formats for 3D visualization, 3D image processing and segmentation. On imported gray value images, **ImportGeo-Vol** can perform 3D processing with a variety of filtering techniques. Subsequent segmentation converts gray values to material index values typically stored in the **GeoDict** Binary file format. For more information, check the [ImportGeo-Vol](#) handbook of this User Guide.
- **ImportGeo-CAD** imports surface triangulation files that describe only the surface geometry of a three-dimensional object. During import, these files can be converted to 3D material models. For more information, check the [ImportGeo-CAD](#) handbook of this User Guide.

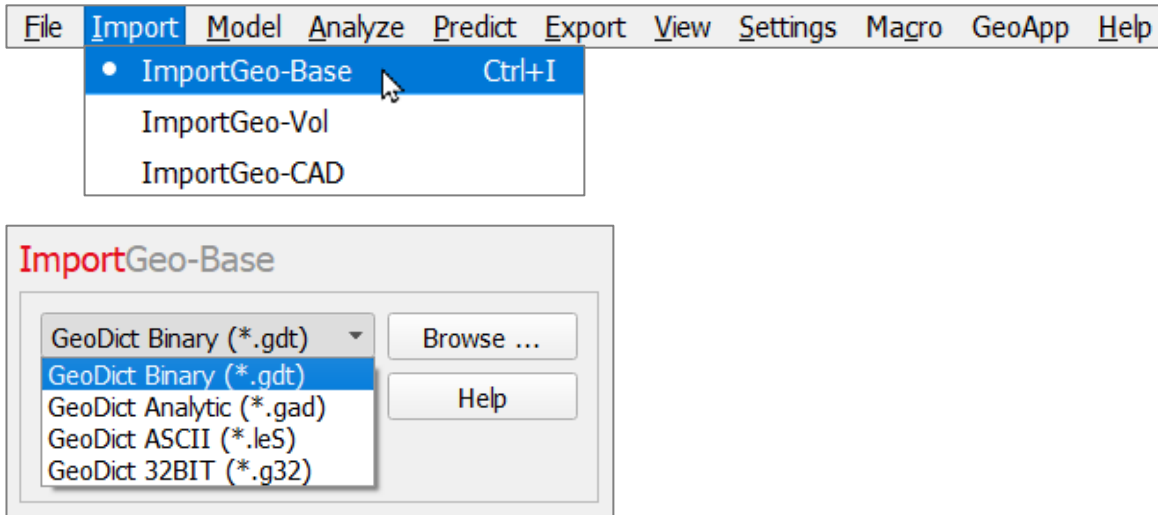
The three **ImportGeo** submodules import the following file formats:

ImportGeo submodule	File formats			
ImportGeo-Base	GeoDict Binary (*.gdt)	GeoDict Analytic (*.gad)	GeoDict ASCII (*.leS)	GeoDict 32BIT (*.g32)
ImportGeo-Vol	1, 2 or 4 Byte Integer (*.raw)	4 Byte Float (*.vol)	GeoDict Raw File (*.grw)	GeoDict Binary (*.gdt)
	GeoDict ASCII (*.leS)	GeoDict 32BIT (*.g32)	Rek File (*.rek)	Zeiss 3D Image (*.txm)
	Avizo Binary File (*.am)	WiseTex Vox File (*.vox)	IASS File (*.iass)	TIF Image File (*.tif) (*.tiff)
	BMP Image File (*.bmp)	CUR Image File (*.cur)	GIF Image File (*.gif)	ICO Image File (*.ico)
	JPEG Image File (*.jpeg)	JPG Image File (*.jpg)	PBM Image File (*.pbm)	PGM Image File (*.pgm)
	PNG Image File (*.png)	PPM Image File (*.ppm)	SVG Image File (*.svg)	SVGZ Image File (*.svgz)
	XBM Image File (*.xpm)	XPM Image File (*.xpm)		
ImportGeo-CAD	STL File (*.stl)	OBJ File (*.obj)		

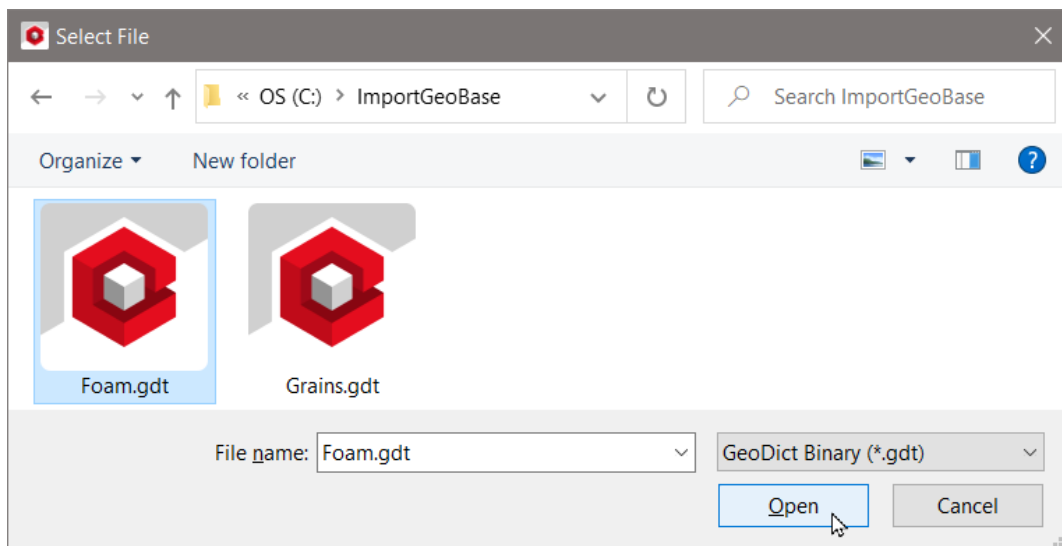
For complete information on **GeoDict** file formats and file formats supported by **GeoDict**, see **File Management** in the [Base Reference](#) handbook of the **GeoDict** User Guide.

IMPORTGEO-BASE

To import structure data in GeoDict formats, select **Import** → **ImportGeo-Base** in the menu bar. The **ImportGeo-Base** section opens in the module section at the left of the GeoDict GUI.



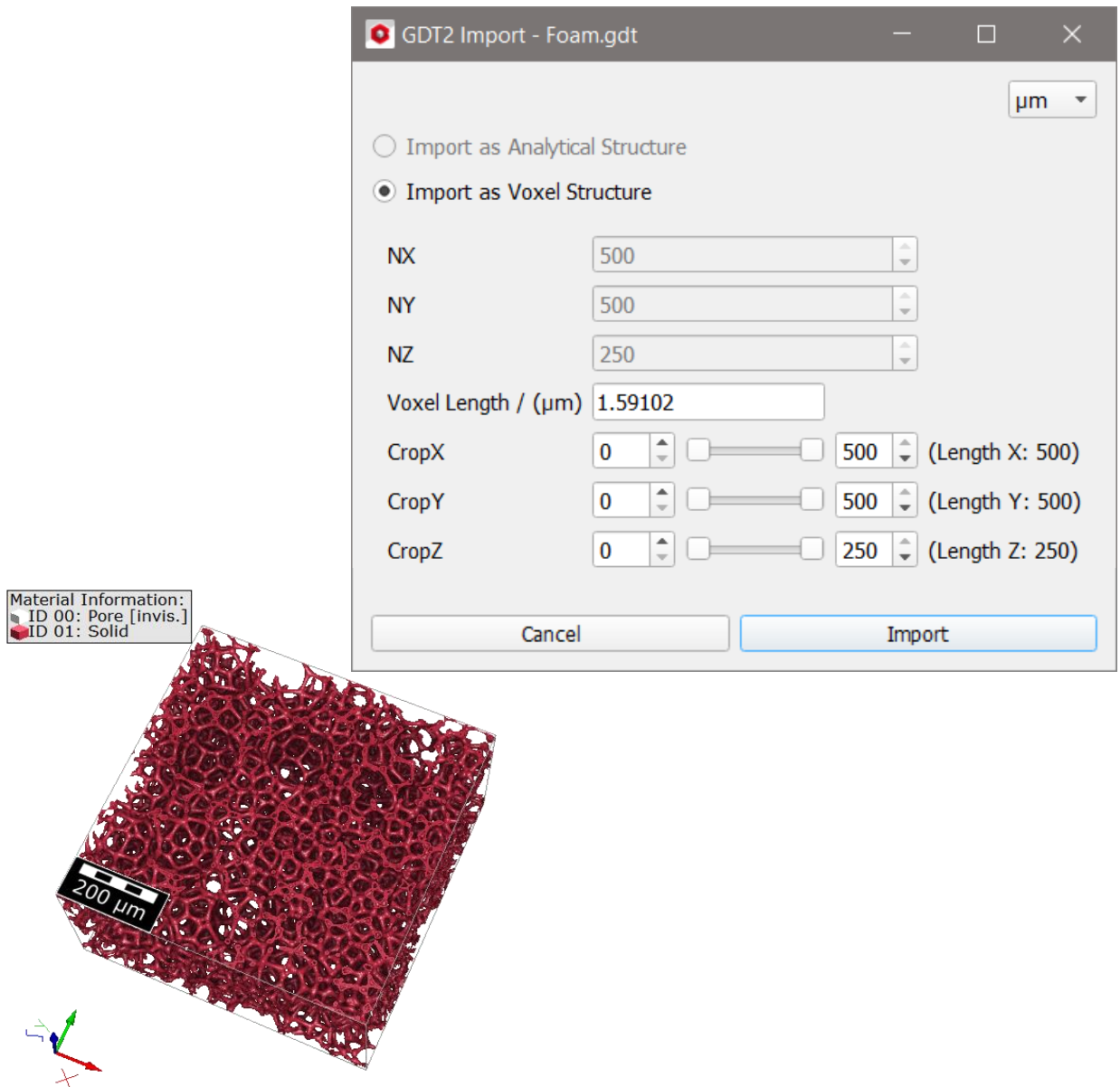
The data format to be imported is selected from the pull-down menu in the **ImportGeo-Base** section. After selecting the format (here *.gdt), clicking **Browse** opens a **Select File** dialog box to locate a file of that format in the chosen project folder. Select the file name and click **Open**.



The size of the microstructure contained in the file is automatically entered.

Since GeoDict 2019, the *.gdt format can also contain analytical information. Thus, there are two import options for this file format: **Import as Voxel Structure** or **Import as Analytical Structure**. The second option is enabled only if the *.gdt file contains analytical information. Geometry modeling with GeoDict is based on geometric objects like spheres, ellipsoids, and fibers. In GeoDict, these analytic objects are called gad-objects, where gad stands for GeoDict analytic data. Learn more about the GeoDict analytical data in the [GadGeo](#) handbook of the GeoDict User Guide.

Click **Import** to import the microstructure into **GeoDict**. Now, the structure is shown in the Visualization area.



FILE FORMATS FOR IMPORTGEO-BASE

With **ImportGeo-Base** it is possible to directly load the main **GeoDict** formats: *.gdt, *.gad, *.leS and *g32 formats.

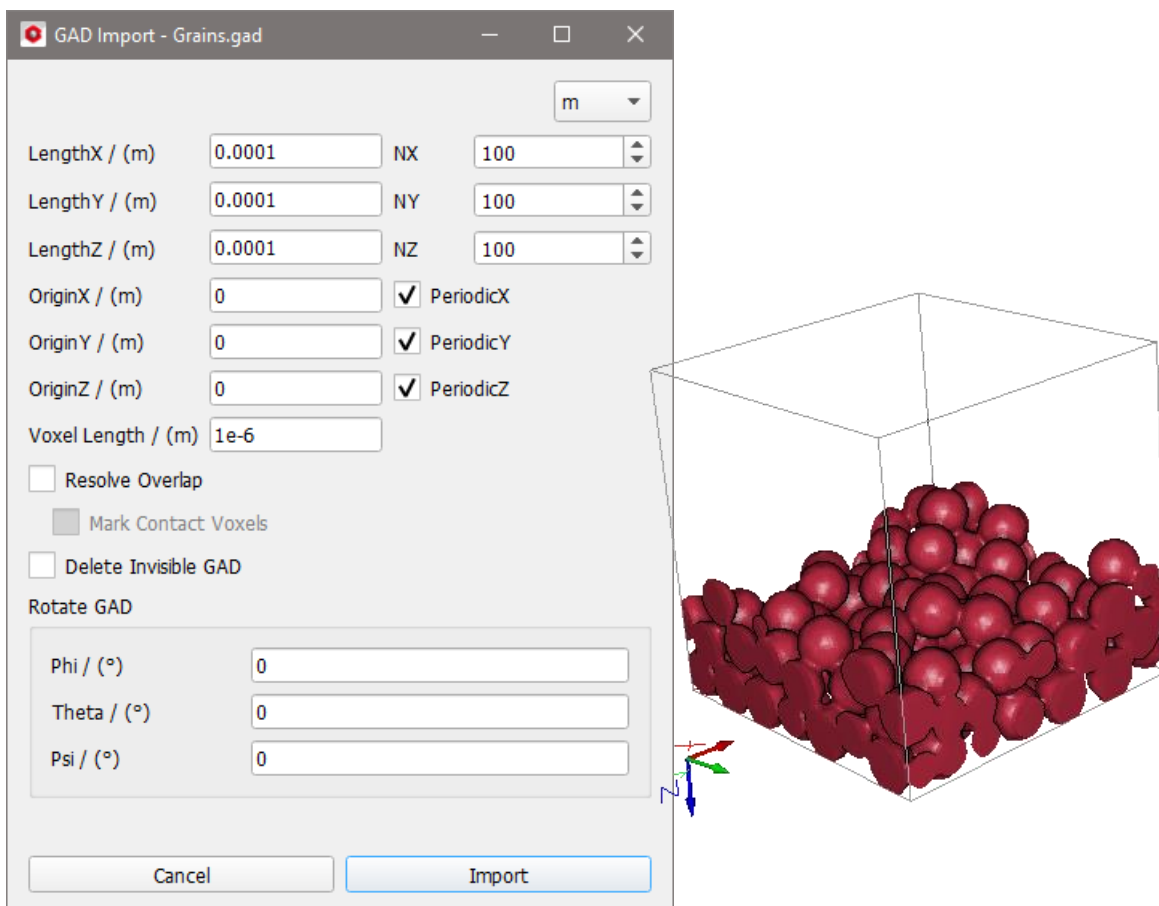
Loading files via **ImportGeo-Base** instead of simply opening them by selecting **File** → **Open Structure (*.gdt, *.gad) ...** or **File** → **Load Volume Field...** in the menu bar allows changing the voxel size and cropping the structure. Additionally, structures with GAD data can be rotated during import.

GEO_DICT BINARY (*.GDT) AND ANALYTIC DATA (*.GAD)

Select **GeoDict Binary (*.gdt)** or **GeoDict Analytic Data (*.gad)** from the pull-down menu and click **Browse** to choose and open the file of interest.

The available units (**m**, **mm**, **µm**, **nm** and **Inch**) are selectable from the pull-down menu at the top right of the **Import** dialog.

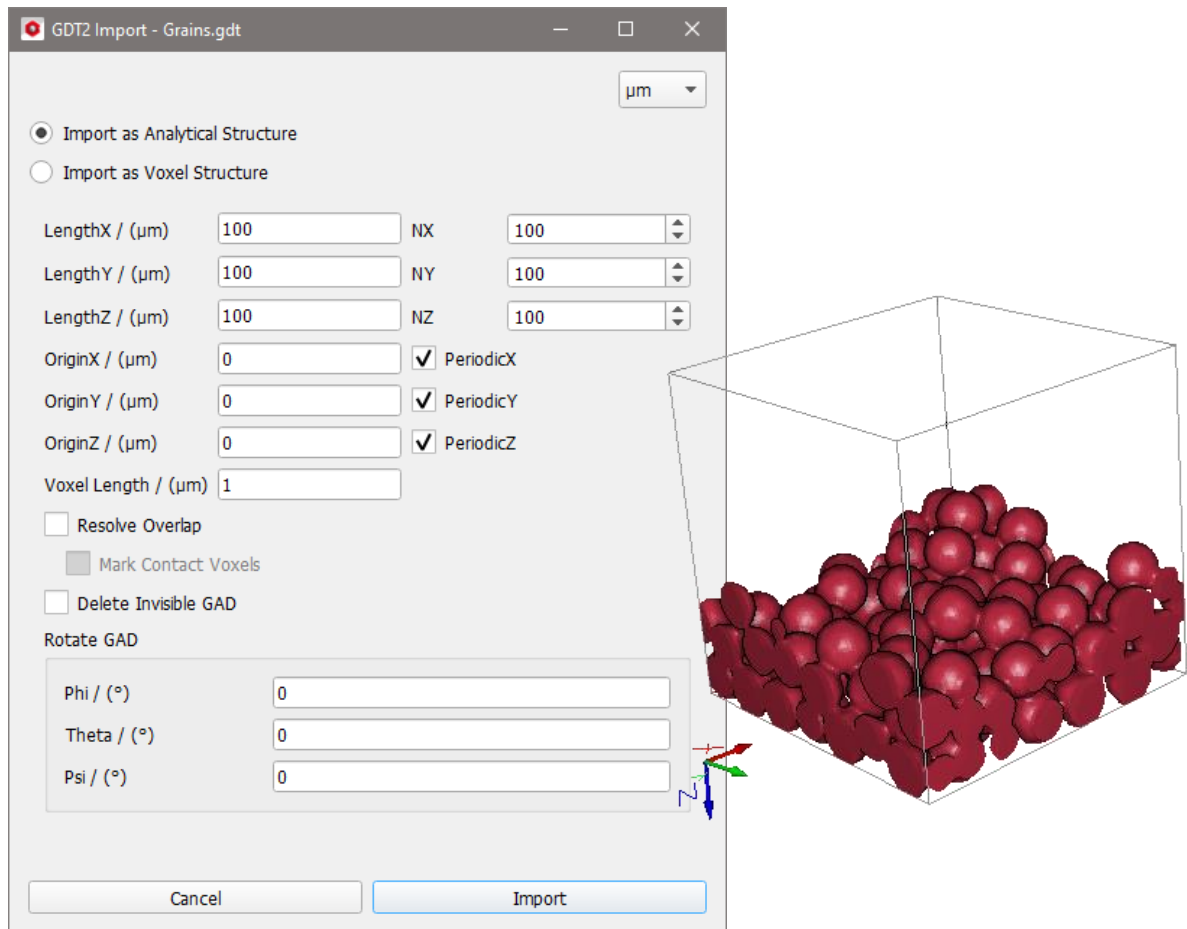
For both types of files, the **Voxel Length** and the dimensional values of **NX**, **NY**, **NZ** are automatically filled in.



For **GeoDict Binary (*.gdt)** containing analytical information, the options to **Import as Voxel Structure** or **Import as Analytical Structure** are shown.

The options for **Import as Analytical Structure** are the same as for **GeoDict Analytic Data (*.gad)**.

Click **Import** to load the selected file in **GeoDict** or abort the import by clicking **Cancel**.



IMPORT AS ANALYTICAL STRUCTURE

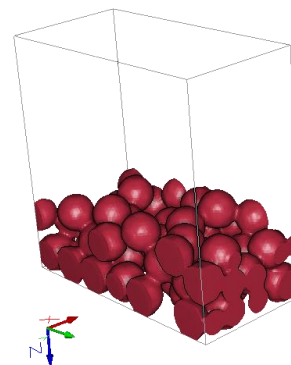
Domain Parameters

For a file which contains analytical information of the microstructure, the size can be adjusted by changing the voxel counts **NX**, **NY**, **NZ**, changing the **Voxel Length**, or changing the **Length**.

Changing the values for **LengthX**, **LengthY** and **LengthZ** crops or embeds the structure. This also changes the values for **NX**, **NY** and **NZ**. If a smaller value is entered for length, it is recommended to disable the periodicity in the corresponding direction to prevent overlap.

In the example below, the **LengthX** was changed from 100 to 50 and **PeriodicX** was unchecked. Thus, the structure is cropped in X-direction.

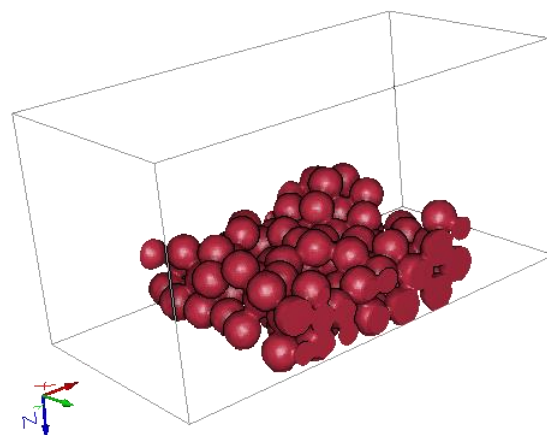
LengthX / (μm)	50	NX	50
LengthY / (μm)	100	NY	100
LengthZ / (μm)	100	NZ	100
OriginX / (μm)	0	<input type="checkbox"/> PeriodicX	
OriginY / (μm)	0	<input checked="" type="checkbox"/> PeriodicY	
OriginZ / (μm)	0	<input checked="" type="checkbox"/> PeriodicZ	
Voxel Length / (μm)	1		



The parameters **OriginX**, **OriginY** and **OriginZ** control the position of the structure in the domain. This is very useful if the values for **Length** are changed.

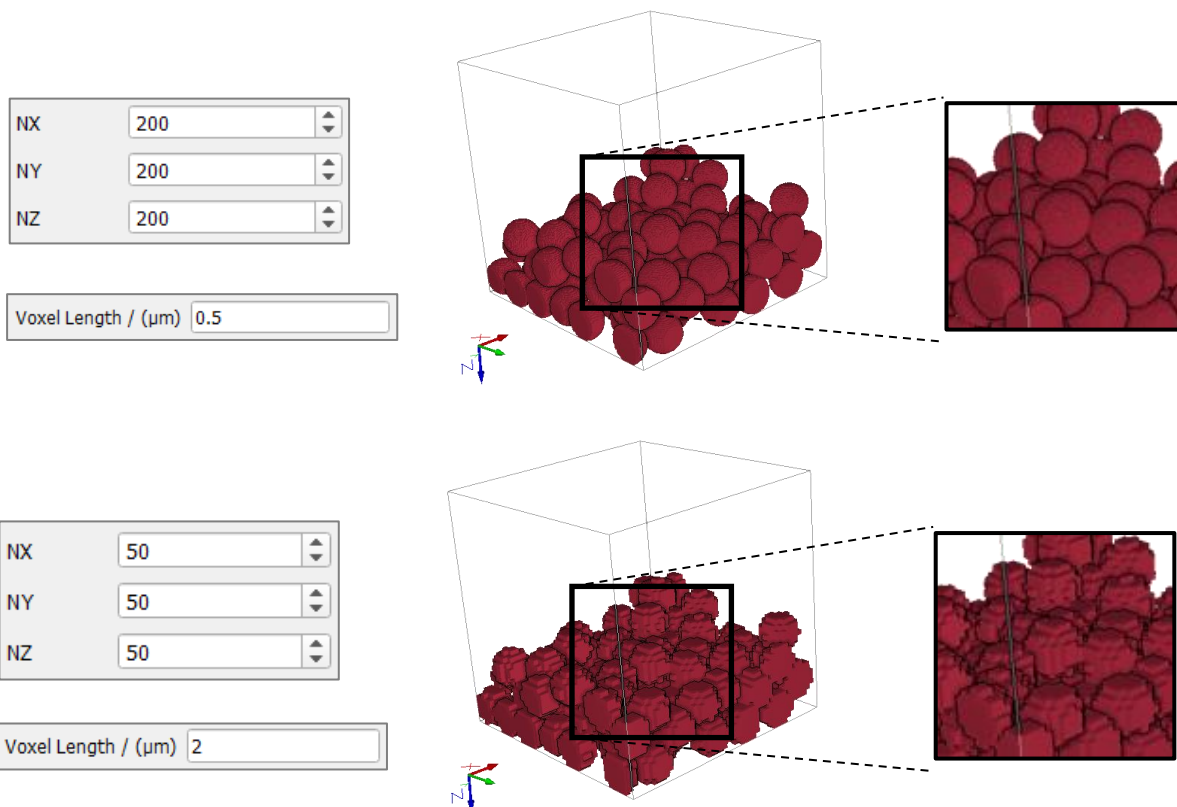
In the following example, the **LengthX** was set from 100 μm to 200 μm and the **OriginX** was set to -50 μm. For this structure, this leads to a position in the center of the bigger domain. Observe, that the grains are no longer cut in X-direction, as the analytical data for the complete grains is stored in the structure file.

LengthX / (μm)	200	NX	200
LengthY / (μm)	100	NY	100
LengthZ / (μm)	100	NZ	100
OriginX / (μm)	-50	<input checked="" type="checkbox"/> PeriodicX	
OriginY / (μm)	0	<input checked="" type="checkbox"/> PeriodicY	
OriginZ / (μm)	0	<input checked="" type="checkbox"/> PeriodicZ	
Voxel Length / (μm)	1		



Changing the **Voxel Length** also changes the values for **NX**, **NY** and **NZ** and controls the size of the loaded structure. The values for **NX**, **NY** and **NZ** can also be changed manually, which changes the **Voxel Length** accordingly.

Observe how the resolution changes according to the selected size.



Checking the **PeriodicX**, **PeriodicY**, and **PeriodicZ** boxes allows the import of structures which are periodic in one or several directions. Periodicity has the effect that objects ending on one side of the volume reappear on the opposite side.

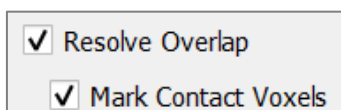
Control Object Overlap

Analytic objects might overlap in **GeoDict** structures and the overlap locations may display other properties than the original materials. Thus, by default the overlap is assigned to a new material ID, unless **Resolve Overlap** is checked.

If instead, **Resolve Overlap** is checked, the watershed algorithm is used to decide which of the overlap voxels belongs to which object. Thus, each overlap voxel is assigned to one specific object. This option needs more memory and a longer runtime.

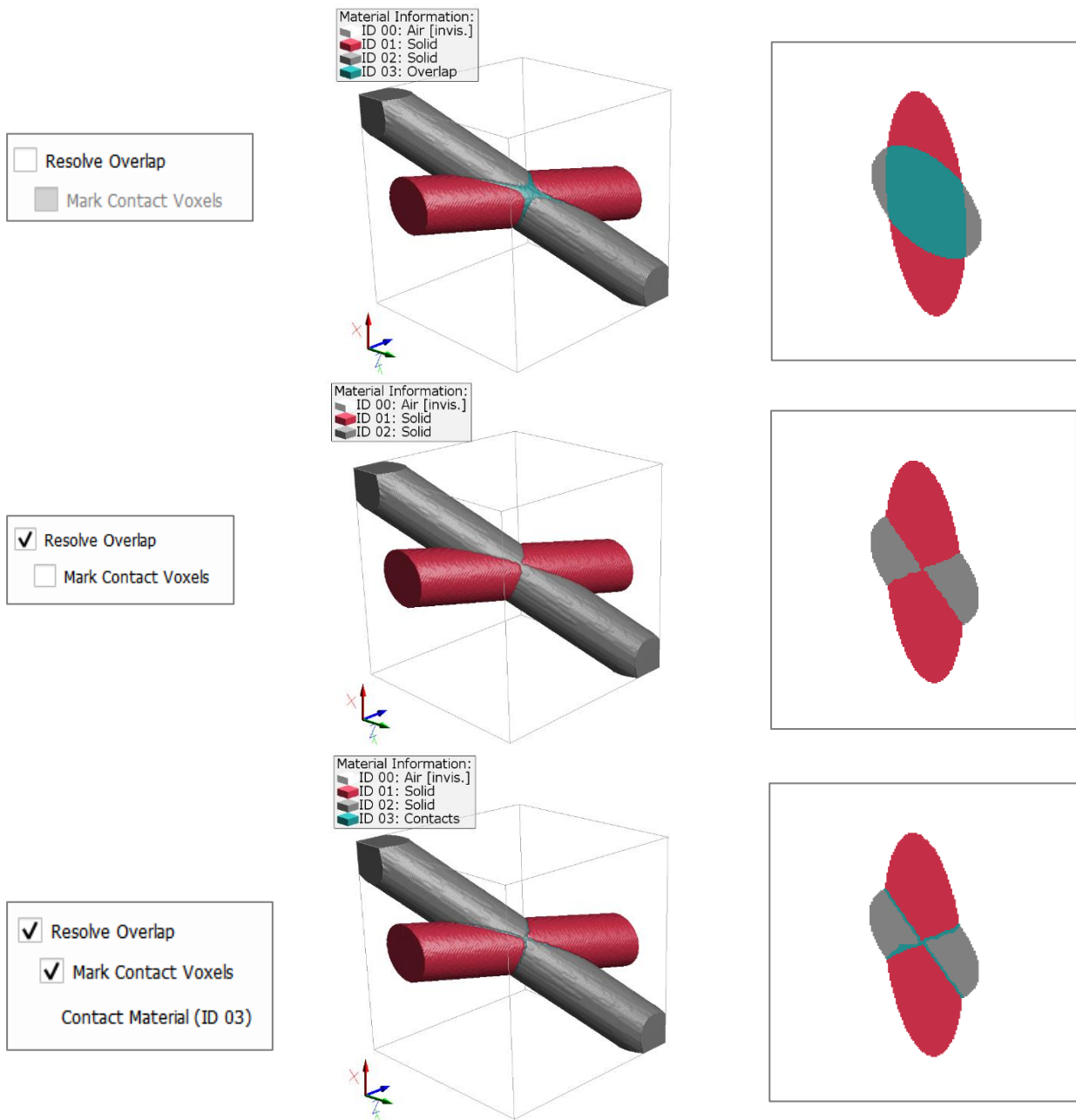
In detail, the **Resolve Overlap** algorithm starts with computing a distance map for the overlap voxels, i.e. computes the distance to the next object for each overlap voxel. On the distance map, the watershed algorithm is run using the object IDs as seeds. So, the overlap area is filled with the object IDs according to the distance map.

To mark the contact voxels between the objects with a separate material ID, select **Mark Contact Voxels**. The voxels, where two or more object IDs meet, are marked as contact voxels, by reassigning them with a new material ID. Thus, the layer of contact voxels always has two voxels thickness.



ImportGeo submodules – ImportGeo-Base

In the following, observe the resulting Material IDs for the overlap for not resolved, resolved, and resolved overlap with marked contact voxels, while all other settings are kept the same.



Delete Invisible GAD

Check **Delete Invisible GAD** to not import GAD objects which lie completely outside of the domain.

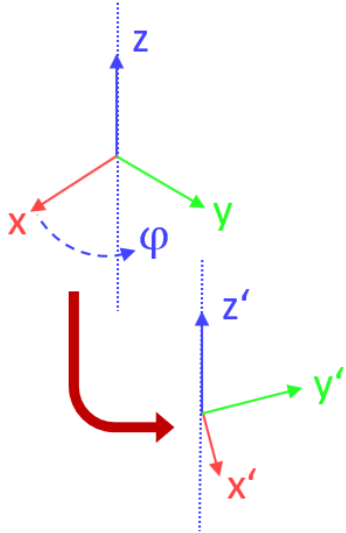
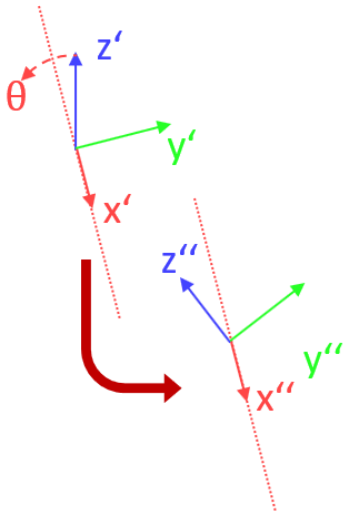
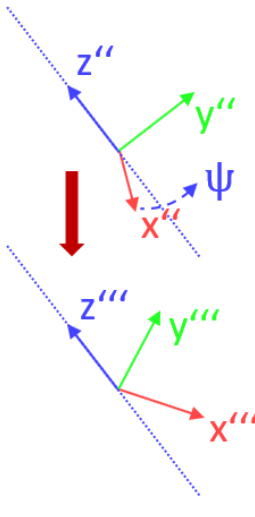
Rotate GAD

The imported GAD file can also be rotated by defining the [Euler Angles](#) **Phi**, **Theta**, and **Psi** in the **Rotate GAD** panel for the different axes.

Rotate GAD

Phi / (°)	<input style="width: 80%;" type="text" value="0"/>
Theta / (°)	<input style="width: 80%;" type="text" value="0"/>
Psi / (°)	<input style="width: 80%;" type="text" value="0"/>

The Euler rotation angles are applied to the objects during the generation following the order Phi → Theta → Psi

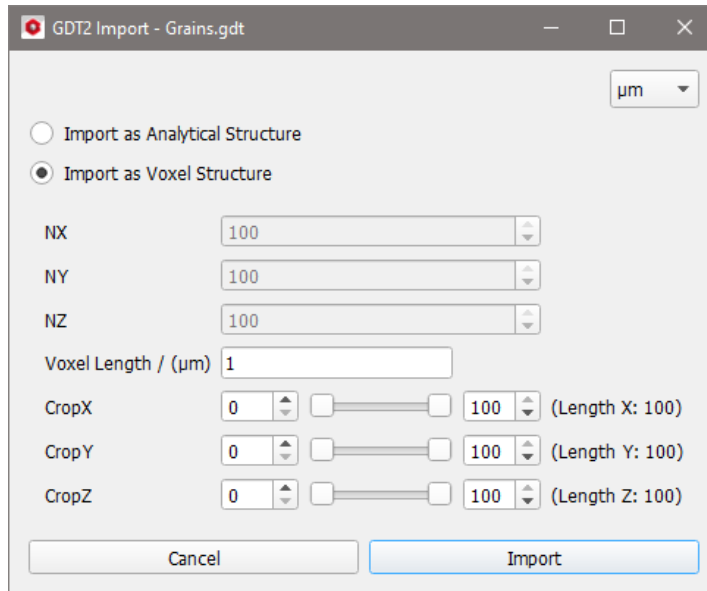
Z-axis fixed	new X-axis fixed	new Z-axis fixed
Phi applies rotation around existing Z-axis	Theta applies rotation around the new X-axis	Psi applies rotation around the new Z-axis
		

IMPORT AS VOXEL STRUCTURE

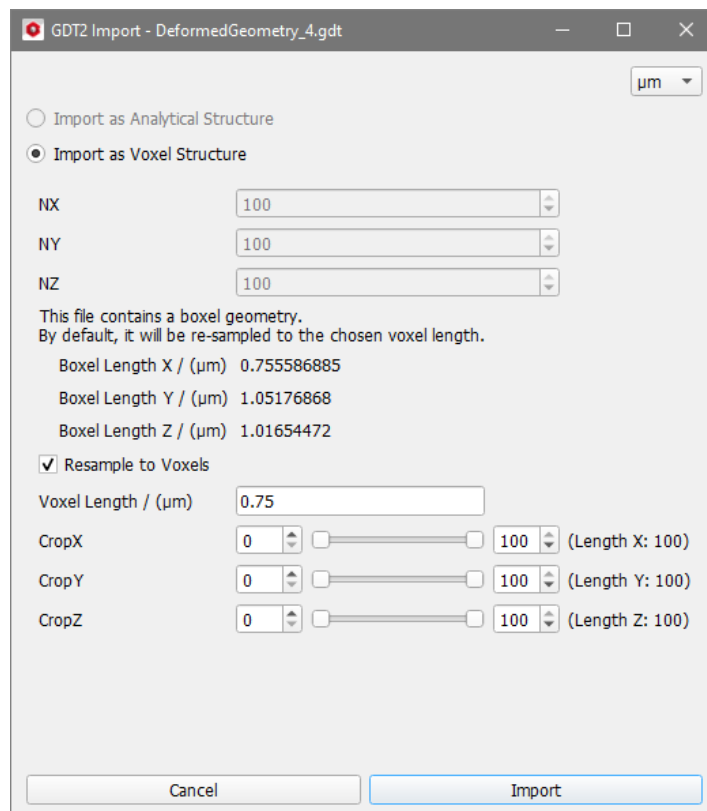
If **Import as Voxel Structure** is checked, the dimensional values of **NX**, **NY**, **NZ** cannot be changed.

The **Voxel Length** can be changed and has no impact on the number of voxels.

A sub-region to load can be set by adjusting the sliders for **CropX**, **CropY** and **CropZ** or entering the exact voxel number in the corresponding boxes. The resulting **Length** is shown on the right in the unit selected from the pull-down menu in the upper right corner of the dialog.



If a **GeoDict** Binary file contains boxels, the option to **Resample to Voxels** appears in the dialog. This is the case for deformed structures obtained with the FeelMath solver in **ElastoDict**. While voxels have the same side length in all three dimensions, boxels can have different lengths in the three axial directions.



Usually when loading a deformed geometry from an **ElastoDict** result file or by selecting **File** → **Open Structure (*.gdt, *.gad)** from the menu bar, the boxels are resampled to voxels. For this, the new voxel length is set to the shortest **Boxel Length**.

In **ImportGeo-Base** the **Voxel Length** can be set manually to a desired value. In the example below, the grain structure already shown above on page 4 is deformed in X-direction, using **ElastoDict Deformations**. For more information about deformations refer to the [ElastoDict User Guide](#).

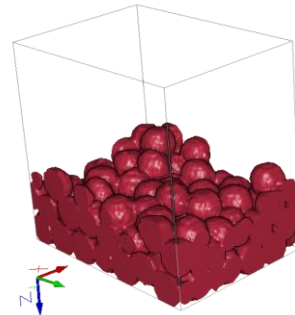
This file contains a boxel geometry.
By default, it will be re-sampled to the chosen voxel length.

Boxel Length X / (μm) 0.755586885
Boxel Length Y / (μm) 1.05176868
Boxel Length Z / (μm) 1.01654472

Resample to Voxels

Voxel Length / (μm)

● Structure (101x140x136, 750 nm)



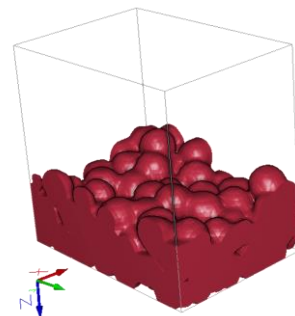
This file contains a boxel geometry.
By default, it will be re-sampled to the chosen voxel length.

Boxel Length X / (μm) 0.755586885
Boxel Length Y / (μm) 1.05176868
Boxel Length Z / (μm) 1.01654472

Resample to Voxels

Voxel Length / (μm)

● Structure (38x53x51, 2 μm)



When unchecking **Resample to Voxels**, the boxels are considered as voxels, ignoring the different boxel lengths.

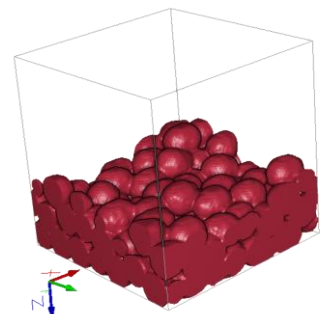
This file contains a boxel geometry.
By default, it will be re-sampled to the chosen voxel length.

Boxel Length X / (μm) 0.755586885
Boxel Length Y / (μm) 1.05176868
Boxel Length Z / (μm) 1.01654472

Resample to Voxels

Voxel Length / (μm)

● Structure (100x100x100, 750 nm)

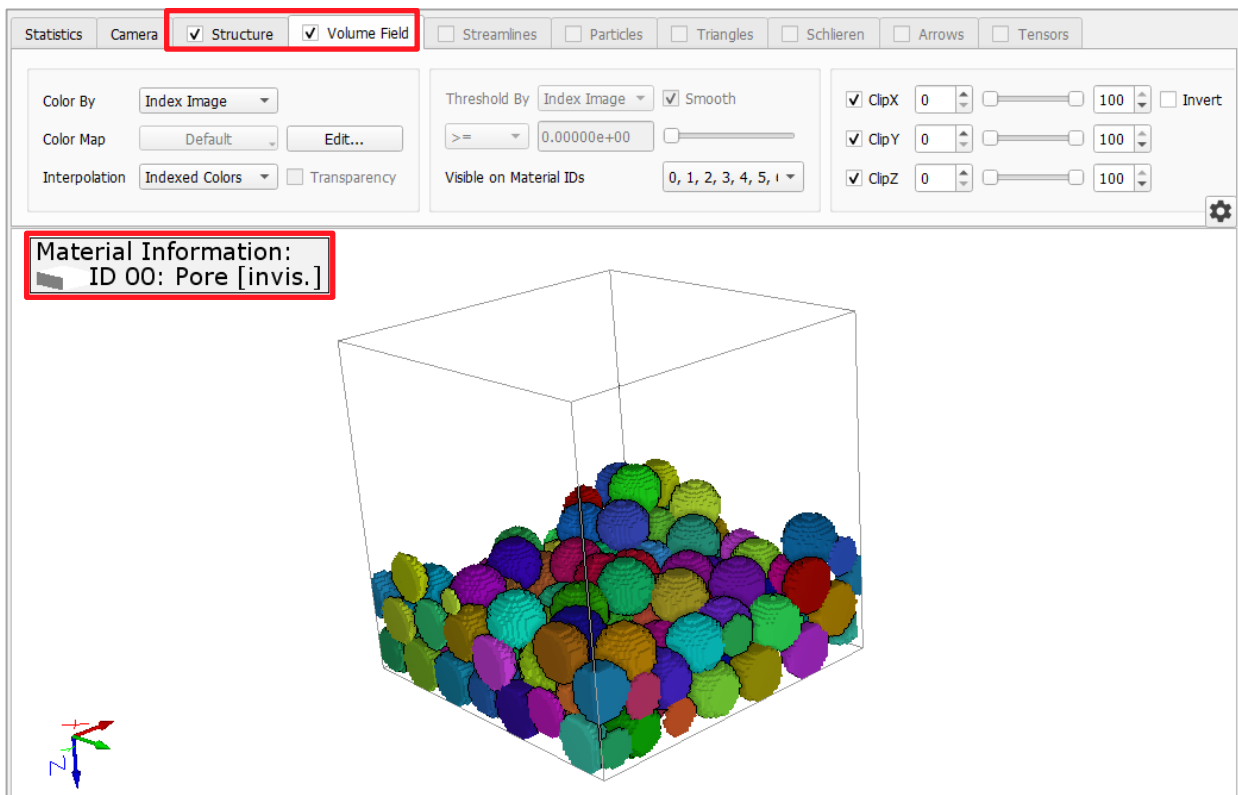


GEO_DICT ASCII (*.LES) AND GEO_DICT 32BIT (*.G32)

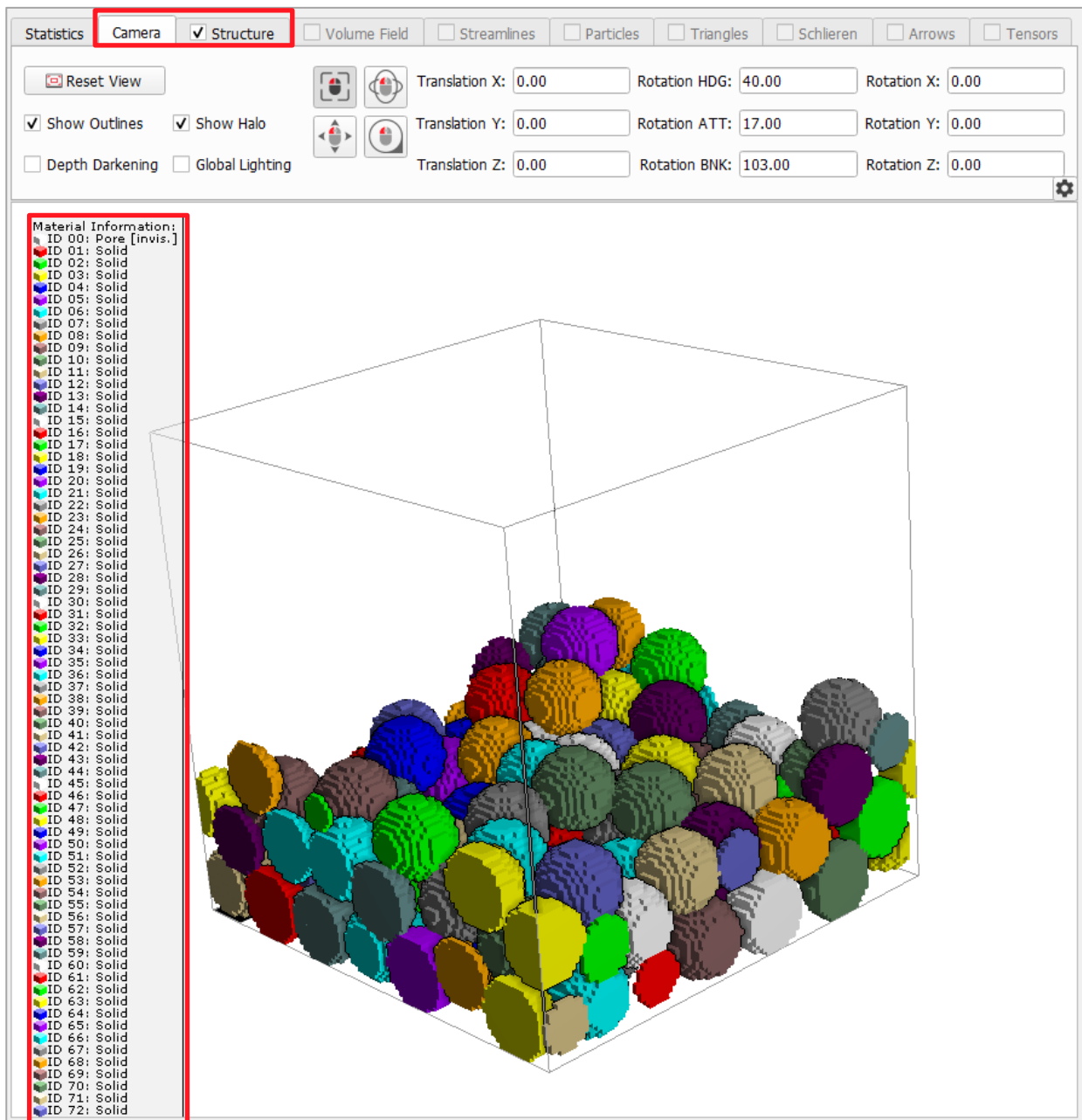
Loading a *.leS or *.g32 file with **File** → **Load Volume Field** loads it as an index image. Using **ImportGeo-Base** instead imports the file as a structure in **GeoDict**, assigning the indices to the 256 material IDs. First, the index 0 is assigned to ID00. Then, the other indices are assigned to the other 255 IDs equally. That means, index 01 gets ID 01, index 02 gets ID 2 and so on till index 255 gets ID 255. If more than 256 indices are contained in the *.g32, then the IDs are assigned again starting with id 1 for index 256.

In the following example a *.g32 file first is loaded with **File** → **Load Volume Field** and then again using **ImportGeo-Base**.

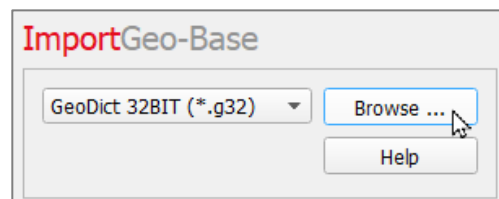
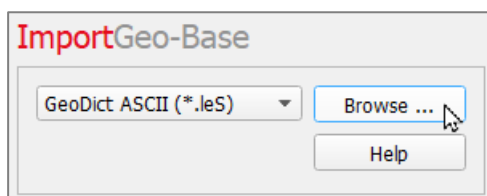
For the volume field each grain has a different index.



If the same file is loaded with **ImportGeo-Base**, the objects are assigned to the 256 material IDs. The **Volume Field** tab is not available, as no volume field is loaded.



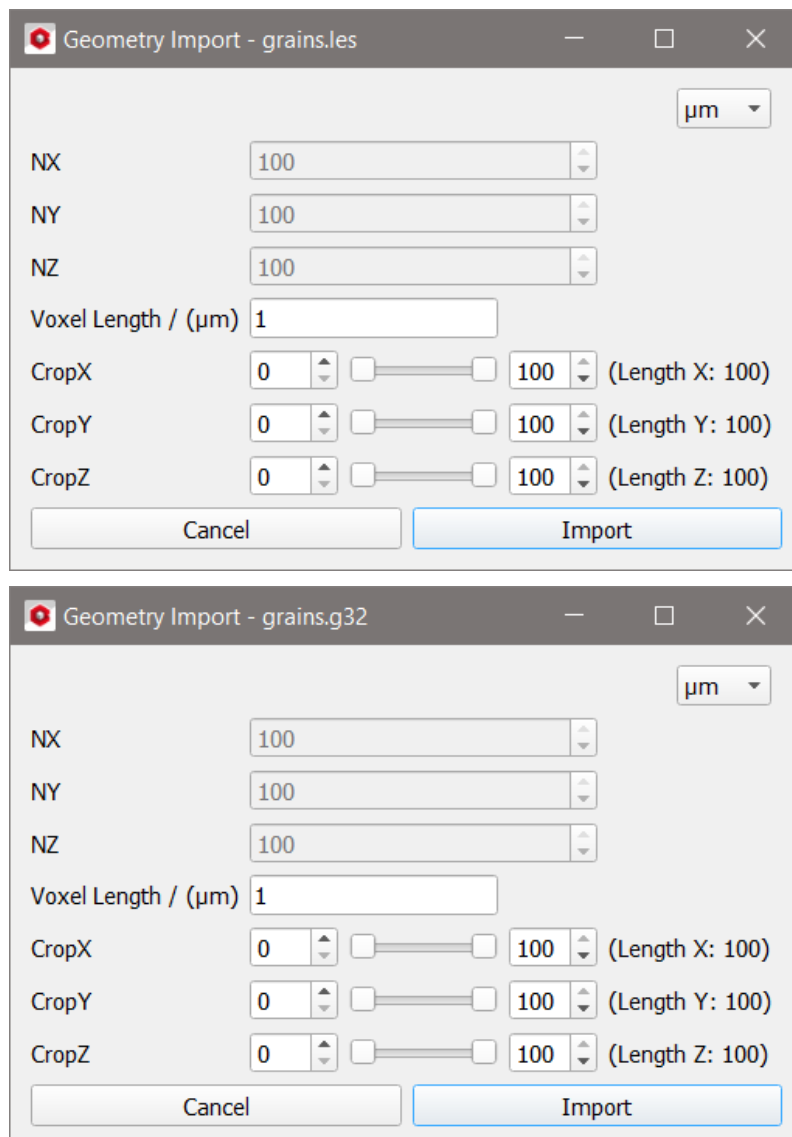
Select **GeoDict ASCII (*.leS)** or **GeoDict 32BIT (*.g32)** from the pull-down menu and click **Browse** to choose and open the file of interest.



Click **Import** to load the selected file in **GeoDict** or abort the import by clicking **Cancel**.

The available units (**m**, **mm**, **µm**, **nm** and **Inch**) are selectable from the pull-down menu at the top right of the **Import** dialog.

The **GeoDict** ASCII file type *.les contains structure information in ASCII format. The file type *.g32 contains **GeoDict** structures with object index information. Both files store the number of voxels in each of directions (**NX**, **NY** and **NZ**) and the **Voxel Length**.

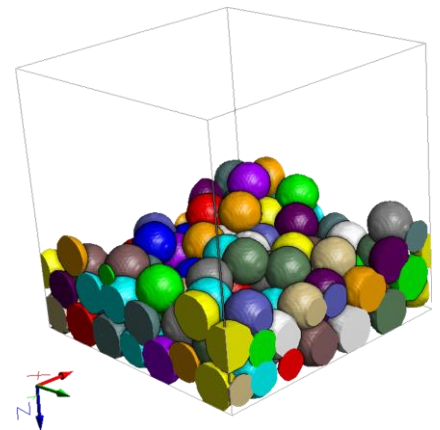


The **Voxel Length** can be changed and has no impact on the number of voxels.

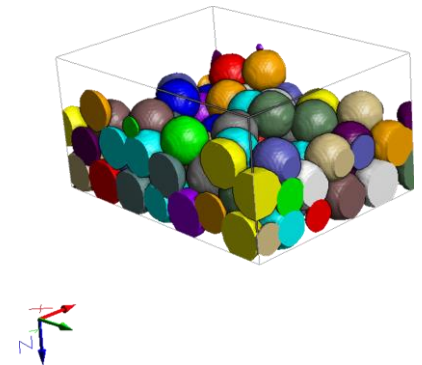
A sub-region to load can be set by adjusting the sliders for **CropX**, **CropY** and **CropZ** or entering the exact voxel number in the corresponding boxes. The corresponding **Length** is given on the right in the unit selected from the pull-down menu in the upper right corner of the dialog.

In the following example a *.g32 file is loaded once without changing the parameters and once cropped in X and Z.

NX	100	
NY	100	
NZ	100	
Voxel Length / (μm)	1	
CropX	0	100 (Length X: 100)
CropY	0	100 (Length Y: 100)
CropZ	0	100 (Length Z: 100)



NX	100	
NY	100	
NZ	100	
Voxel Length / (μm)	1	
CropX	25	75 (Length X: 50)
CropY	0	100 (Length Y: 100)
CropZ	50	100 (Length Z: 50)



Since **ElastoDict Deformations** not only writes deformed geometries as *.gdt, but also as *.g32 (if the option **Enable Object Tracking** is activated), in **ImportGeo-Base** the voxel length can be defined or the structure can be imported ignoring the boxel lengths as described on page [10](#) for *.gdt files.

Geometry Import - DeformedObjectIndices_4.g32

μm

NX	100
NY	100
NZ	100

This file contains a boxel geometry.
By default, it will be re-sampled to the chosen voxel length.

Boxel Length X / (μm) 0.755586885
 Boxel Length Y / (μm) 1.05176868
 Boxel Length Z / (μm) 1.01654472

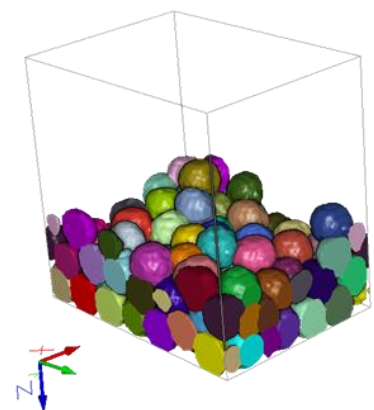
Resample to Voxels

Voxel Length / (μm) 0.75

CropX	0	100 (Length X: 100)
CropY	0	100 (Length Y: 100)
CropZ	0	100 (Length Z: 100)

Cancel Import

● Structure (101x140x136, 750 nm)



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