POLYGONALmeister®

Ver.7.0.0

Operation Manual

UEL Corporation

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CONTENTS

1 Introduction 4

2 Terms 5

2.1 Terms Expressing Shapes 5

2.2 Terms Used for Operation 10

2.3 Color Terms 12

3 Explanations of Screen 15

4 Explanation of Operation 19

4.1 Activating and Exiting POLYGONALmeister 19

4.2 Operation for Screen Display 20

4.2.1 Viewing Operation 20

4.2.2 Clip 20

4.2.3 Displaying Figures 21

4.2.4 Initial Display and View in Parallel with Coordinate Axes 22

4.2.5 Mesh Comparison 23

4.2.6 Information 24

4.2.7 Temporary Figure 24

4.2.8 Color Display 25

4.2.9 Parallel Projection and Perspective Projection 25

4.2.10 Grid 25

4.2.11 Background 25

4.3 Operation for Screen Display 26

4.3.1 Selection of Command 26

4.3.2 Command Dialogue 26

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4.3.3 Inputting Parameters in a Command Dialogue 27
4.3.4 UNDO/REDO 28
4.3.5 Interim Progress Display and Process Suspension 29
4.3.6 Result List 30
4.3.7 Shell List 32
4.3.8 QAT Registration and Shortcut Key 34
4.4 Operation of Figures 37
4.4.1 Specification of Figures 37
4.4.2 Specification of Areas 37
4.4.3 Drawing Auxiliary Lines 40
4.4.4 Handle 41
4.5 Operating Procedure 43
5 Command Overview 45
5.1 File tab 46
5.2 Home 47
5.3 Edit 51
5.4 Evaluation tab 56
5.5 Colors 58
5.6 3D Print 60
5.7 Geography 61
5.9 Beta Version 63
5.10 Help 64
6 Precautions for operation 65
7 Settings 66
7.1 System Requirements 66

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7.2 PC Settings Capable of Handling Polygons in Quantity 66

8 Limitations 69

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1 Introduction

The name ‘POLYGONALmeister’ includes ‘polygon’ that means a shape which has multiple angles. Data that expresses shapes based on collected polygons is referred to as ‘polygon data’. Polygon data communicated via STL and other types of file formats are triangle data in most cases.

POLYGONALmeister is a software product that enables triangle polygon data to be edited and evaluated.

This common operation manual to the POLYGONALmeister series describes functions that may not be depending on the license that has been granted through contract.

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2 Terms

This section explains the terms used in POLYGONALmeister.

2.1 Terms Expressing Shapes

POLYGONALmeister expresses surface of an object by covering it by triangles. Adjacent triangles are arranged to meet the sides and both the vertices thereof. This status where sides and vertices are met is referred to as ‘connection’.

- Mesh

A mesh represents a collection of triangles that express shapes.

- Shell

A shell represents a collection of triangles (faces) that are mutually connected in a mesh. Connected triangles (faces) belong to the same shell. For example, a mesh that has a hollow part (closed cavity) inside consists of a Shell that is recognized externally and a shell that represents the surface of the internal hollow. These two shells are not connected to each other. Shells include closed shells such as solids and open shells such as surfaces. Furthermore, a shell has two sides, an obverse side and a reverse side.

- Shell Boundaries

Shell boundaries represent circumferences of open shells such as external peripheries and hole peripheries.

- Faces

A mesh is comprised of shells. Individual shells are comprised of triangle data, faces. A face has sides, an obverse side and a reverse side.

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■ Edges

An edge represents a side of a triangle (face).

■ Vertices

Vertices represent triangle apexes that are positioned by coordinate values. POLYGONALmeister does not use units such as mm to indicate coordinate values.

See below a simple example.

The mesh right consists of

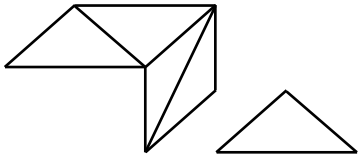
2 shells,

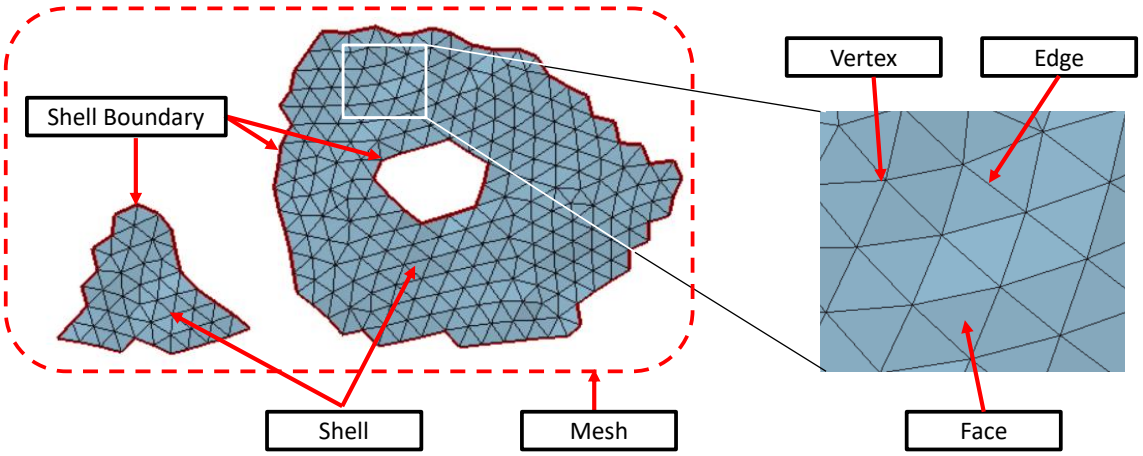
2 shell boundaries,

5 faces,

12 edges, and

9 vertices.





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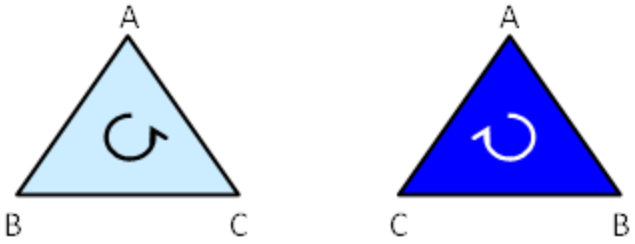
■ Obverse Side and Reverse Side of Face

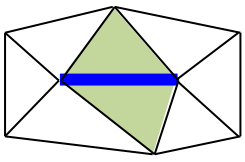
Faces (triangles) have two distinct sides, obverse and reverse. The obverse side represents the side where vertices appear to be positioned counterclockwise. The example face figures below show that triangle (face) vertex data are expressed in the order of A, B, and C in external files such as STL. The left figure shows the obverse surface of the triangle (face) and the right figure shows the reverse surface.

Triangles (faces) should be identical, obverse to obverse and reverse to reverse if faces are mutually connected. The obverse and reverse surfaces of individual triangles (faces) comprise the obverse surface and reverse surface of a shell.

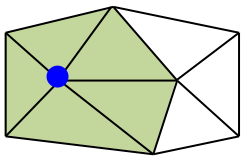


■ Regular Connection and Irregular Connection

The normal shell connection is indicated in the left figure below where two faces are connected to each other with an edge in between. It is also indicated in the right figure below where faces are connected to each other around a vertex.



Regular Connection
Two faces are connected
with an edge in-between



Regular Connection
Faces are connected
around the vertex

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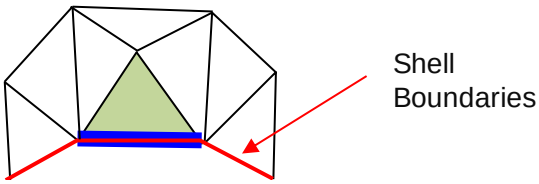
An edge that resides on a shell boundary belongs to a single face.

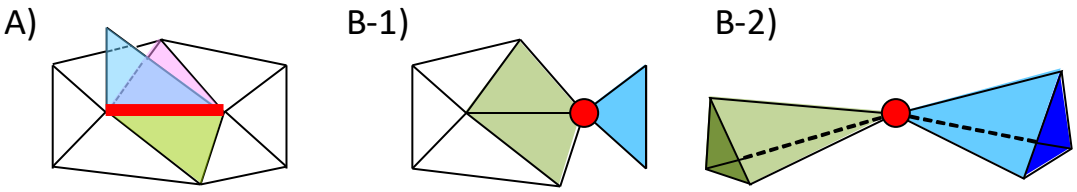


Regular Connection of Shell Boundaries
An edge belongs to a single face.

The figures below show irregular connections.

A) 3 or more faces are connected to one edge.

B) Multiple groups of mutually connected faces are connected to one vertex.



Edge where three or more faces meet

Vertices where multiple mutually-connected faces meet

Any irregular connections in a mesh may prevent normal command operations.

This shape can be detected and corrected through the use of 'Irregular Connection' test item of the "Cleaning" command.

The fact that two faces are connected to each other means that two faces share an edge including the vertices at the both ends of the edge.

If the individual vertices of two edges do not meet mutually, the two edges are not connected with each other and have an extremely tiny gap in-between. In other words, the red line comprised of the two edges in the below figure has a hole.

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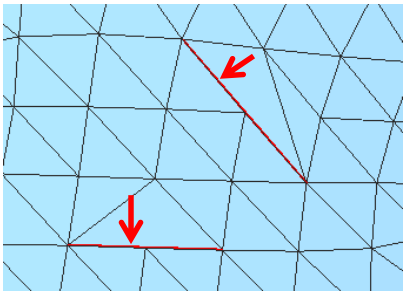
Such shapes can be detected and corrected by executing the ‘Gap’ test item, the ‘Hole’ test item of the “Cleaning” command, or the “Fill Holes” command.



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2.2 Terms Used for Operation

- Commands

A command is a unit that a user executes functions.

- Command Dialogue

A Command Dialogue is a dialogue box that appears on the display upon activating a command. It is used to input parameters that are necessary for command execution and expressing execution results.

- Detailed Parameters

Detailed Parameters represent parameters that are used in order to explicate processing conditions among parameters that are input in the Command Dialogues. The field for Parameter Details is not displayed by default. Click an arrow icon [⌄] to open the input field. Note that the arrow icon direction is changed depending upon the open status or the closed status.

- Temporary Figures

Temporary Figures are displayed only temporarily by the System in order to help user's command inputs and display calculation results. Basically, they are green when users confirm their input directions, and they are red when they display the System calculation results.

- Clip

The "Clip" function hides figures that are positioned in the foreground of a plane. The plane specified is referred to as clipping plane, and can be transferred to arbitrary directions and positions. This function helps easy understandings of complicated structures by displaying internal side of solids.

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■ External Files

There are several types of file formats such as STL, VRML, PLY, OBJ, OFF, NAS, BDF, and BLK. They are used in order to send and receive mesh data with other systems.

■ Result List

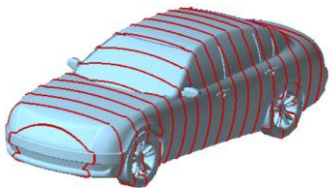
Temporary Figures disappear when a command ends, but it is possible to save them using the Results List function until the System ends. Then, it is possible to switch display / non-display of saved Temporary Figures and automatically move the viewing state to the position where a Temporary Figure is present.

■ Shell List

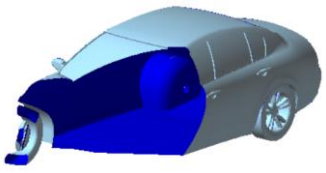
This is a list of shells displayed in Command Dialogues.

■ Box

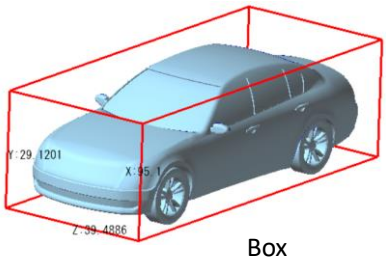
Box is a minimum-size cuboid containing a mesh with edges parallel to the coordinate axes.



Temporary Figures



Crip



Box

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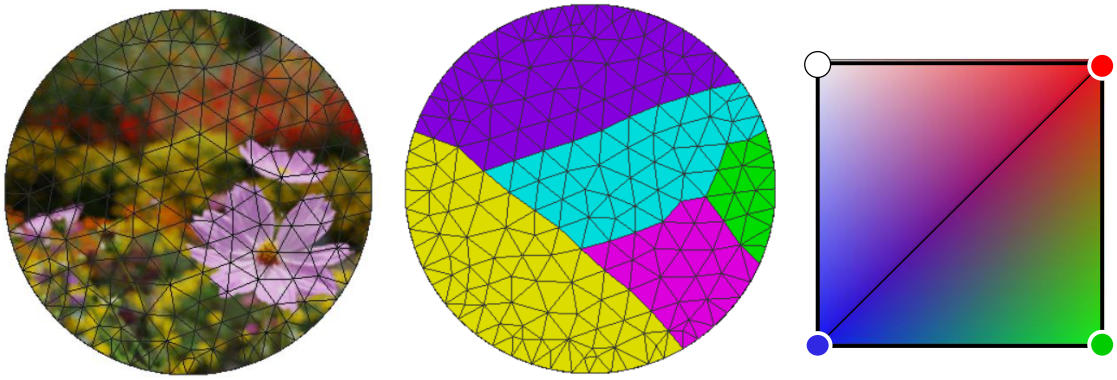
2.3 Color Terms

Faces can have color data. Faces can have color data in the four ways below.



Texture Coloring　　Face Coloring　　Vertex Coloring

■ Texture Coloring

Triangular pieces of 'Texture Image' are assigned to faces.

'Texture Image' has been imported into the System, where the image data is to be assigned to faces.

■ Face Coloring

A face is painted in a single color. This color is referred to as 'Face Color'.

■ Vertex Coloring

Each vertex can have its 'Vertex Color'.

Blend colors of the three vertices of a face. Paint the face in the resulting blended color. Give gradation to the color composed of the three colors so that each of the member colors becomes intensified as it is closer to the corresponding vertex.

■ No Colors

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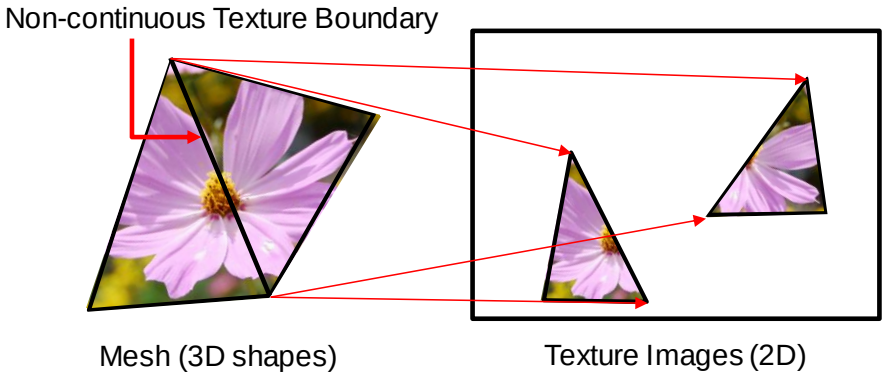
No color data is assigned.

The face to which the texture is attached has information on the texture image to be pasted and the corresponding position (2D coordinates in the vertical direction and the horizontal direction) of a texture image for each vertex. Therefore, it is possible to paste areas of different texture images on adjacent faces. In addition, it is also possible to paste distant areas of the same texture image. As shown in the figure below, even though it seems that a pattern continuous to two adjacent faces is pasted, the area of the texture image to be referenced may be far away.

A texture in which texture images are not continuous on both sides of an edge is called a 'Noncontiguous Texture', and the non-continuous edge is called 'Non-continuous Texture Boundary'. For non-continuous texture boundaries, restrictions are imposed on functions that change edges, such as simplification and remeshing, to keep the texture pattern.



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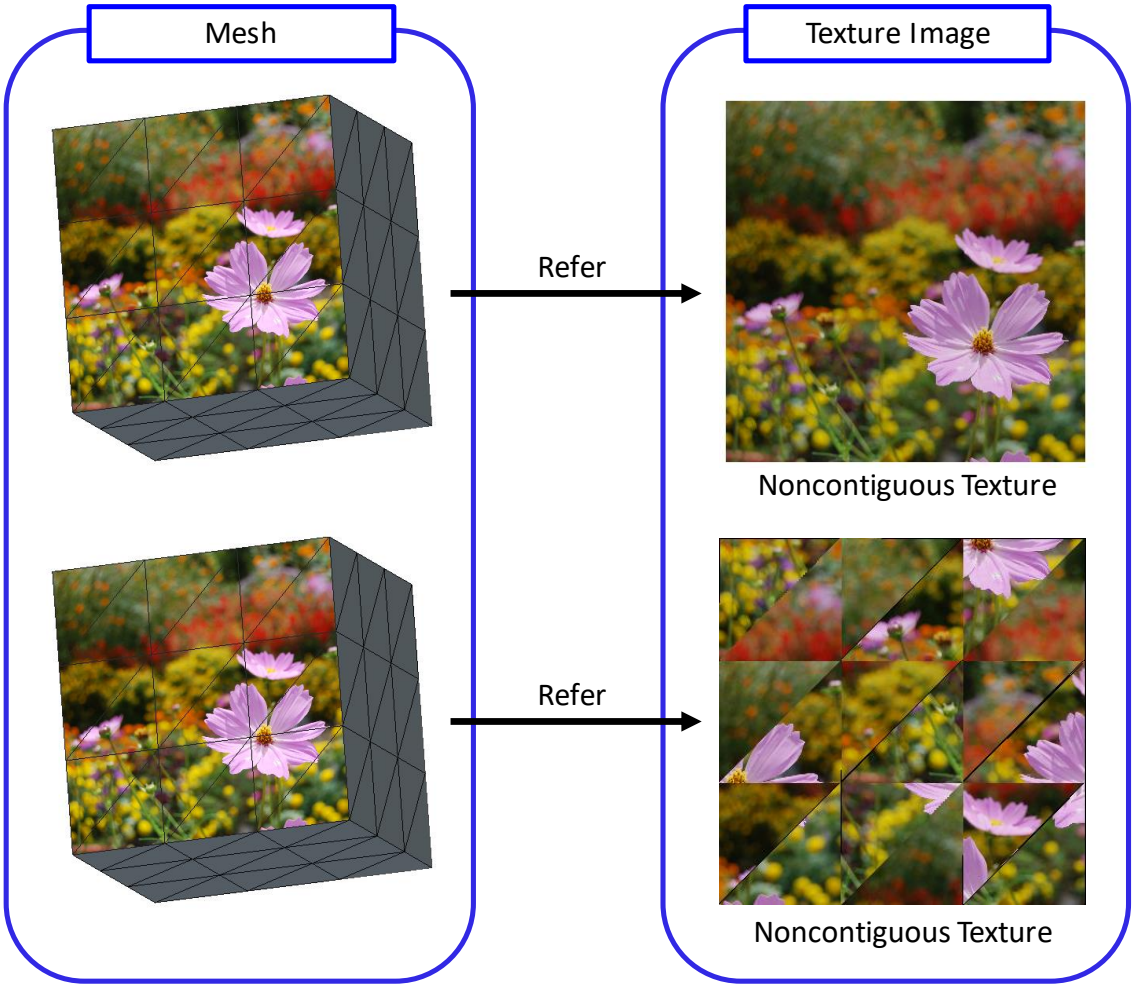

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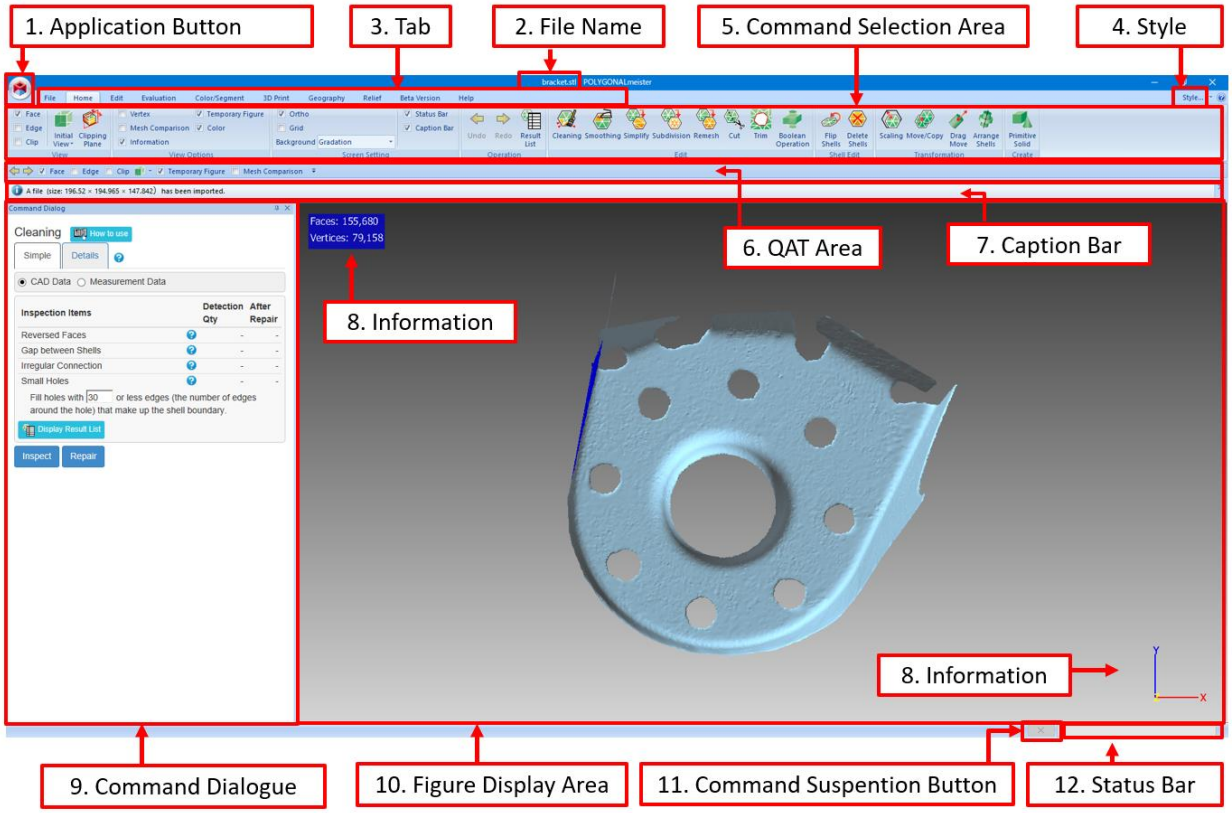
3 Explanations of Screen

This section explains the structure of screen and roles of individual portions.



1. Application Button

Click this button in order to display the window below where external files can be imported and exported.

External files can be imported and exported by executing a relevant command in the 'File' tab. Application Button enables their import and export without changing tabs.

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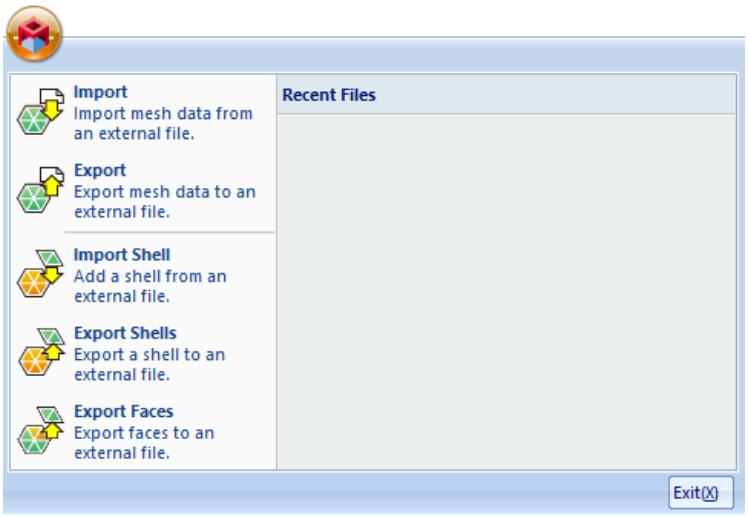

2. File Name: A name of file that has been imported is indicated.

   A file name may be illegible or positioned differently depending on the Style settings. (See '4. Style' of this chapter.)

3. Tab: Click a tab in order to change contents of Command Selection Area.

   Chapter 5 of this manual provides an overview of the command functions for each tab.

4. Style: Command to change display styles such as window color schemes

5. Command Selection Area

   Area where command-representing buttons are available for selection.

   If '▼' appears under the name of button, click the inverted triangle in order to unfold and display folded commands.

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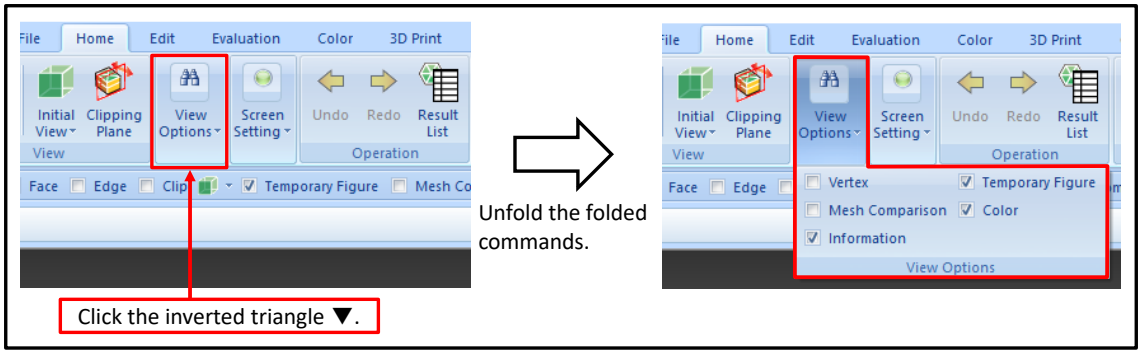
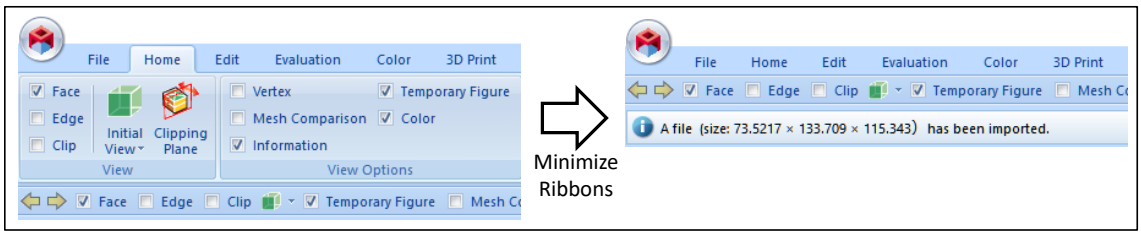


Right-click on this area, or click the sign of the 'QAT' area (See '6. QAT Area' of this chapter.) in order to tick the 'Minimize Ribbons' option. Then, the Figure Display Area can be used widely by hiding the Command Selection Area. Left-click on the tab where the Command Selection Area is hidden, the Command Selection Area will be temporarily displayed. Follow the same operation as those followed in order to minimize the ribbons and untick the 'Minimize Ribbons' optional capability in order to resume the original display status.



6. QAT (Quick Access Tool Bar) Area:

This is an area where commands can be registered at the discretion of users. Register commands of frequent use in this area. Then, users will be able to select the commands from there without changing tabs. (See 4.3.8 'QAT Registration and Shortcut Keys')

7. Caption Bar:

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Area where messages (error messages, etc.)　from the System to users are displayed

8. Information

Information shows face quantity and vertex quantity of a mesh, and the directions of coordinate axes in the Figure Display Area. Coordinate values become larger the further away they are from the converging position of these three lines into the respective end of lines.

Untick the 'Information' of 'Details' of the 'Home' tab in order to non-display them.

9. Command Dialogue

Area where necessary parameters for command execution are input, and execution results are indicated

10. Figure Display Area

Area where a 3D mesh shape is displayed

11. Command Suspension Button

Click the button in order to forcibly suspend a command execution. (See '4.3.5. Interim Progress Display and Process Suspension'.)

12. Status Bar:

This bar indicates a progress status of an executed command.

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4 Explanation of Operation

4.1 Activating and Exiting POLYGONALmeister

■ Activating POLYGONALmeister

Double-click the icon of POLYGONALmeister on the desktop.

POLYGONALmeister can also be activated by choosing Start | All Programs | POLYGONALmeister Folder | POLYGONALmeister.

■ Exiting POLYGONALmeister

Click the [X] button in the upper right corner of the screen in order to exit the software. Also, click the button

of the Application Button at the upper left corner of the screen.

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4.2 Operation for Screen Display

4.2.1 Viewing Operation

The mouse operations below can scale up/down and move meshes in the Figure Display Area.

- Scale up/down by rotating the mouse wheel, or Page Up/Down.
- Translate by dragging the mouse with the wheel pressed,

  or by dragging the mouse with the left side pressed.
- Perform a rotational transfer by dragging the mouse with the right side pressed.

Right-click any point of a mesh. Then, the point becomes a new center for scaling up/down or performing a rotational transfer. A point in a mesh where the mouse begins to be dragged with the right side pressed becomes a center of rotational transfer.

4.2.2 Clip

This command disables figures if they are positioned in the foreground of a clipping plane.

A clipping plane is a plane. Use this command in order to view parts that are difficult to see from outside such as the internal sides of solid figures.

Select ‘Display’ of the ‘Home’ tab and tick the [Clip] check box. If a change is made in the viewing status partly due to a rotational transfer, the mesh and the clipping plane are moved together.

Rotate the mouse wheel (or ‘PageUP/Down’ keys pressed) with the ‘Ctrl’ key pressed in order to move a clipping plane back and forth (in the direction perpendicular to the clipping plane).

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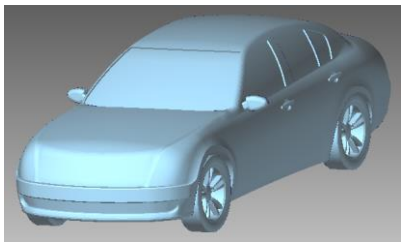
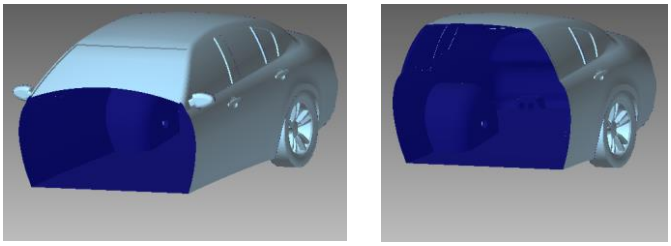


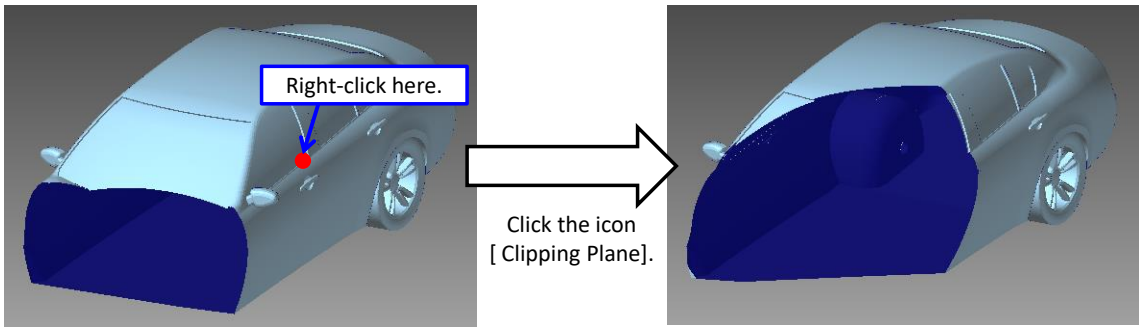
The [Clip] checkbox is unticked



The [Clip] checkbox is ticked. And, rotate the mouse wheel with the 'Ctrl' key

Click the icon [Clipping Plane] in order to change the direction of a clipping plane.

The plane that is perpendicular to the present direction of gazing at the screen is set as the clipping plane. The clipping plane is deep in the direction towards a center of rotational transfer. Thus, right-click on the mesh before clicking the icon [Set Clipping Plane] in order to set a clipping surface that passes through the right-clicked position.



4.2.3 Displaying Figures

Meshes in the Figure Display Area can be displayed through the use of the [Face] button, [Wire] button or [Point] button.

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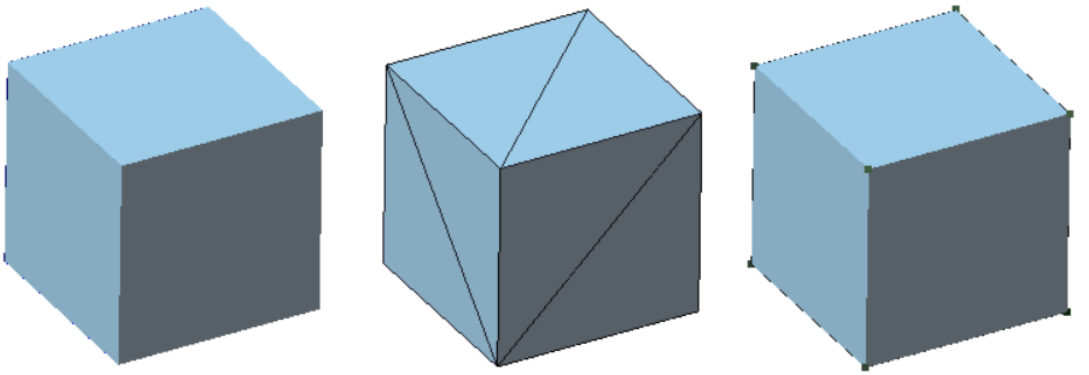
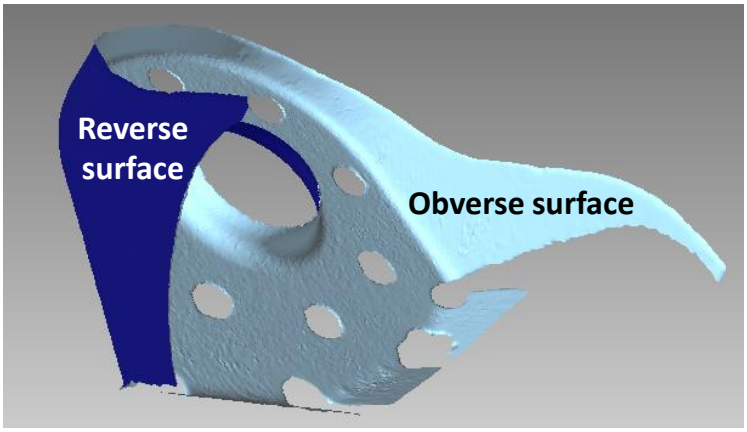


Faces have the observe surface and the reverse surface. The obverse surface is expressed in pale blue, and the reverse surface is expressed in dark blue.



4.2.4 Initial Display and View in Parallel with Coordinate Axes

Click the icon [Initial Display] in order to display a view of an imported mesh.

Click the icon [Initial Display] in order to display a pulldown menu below.

The view of a mesh displayed by clicking the icon [Initial Display] is the same view seen by selecting the option 'Front (+X+Y)', which is the view seen from the positive direction of Z axis.

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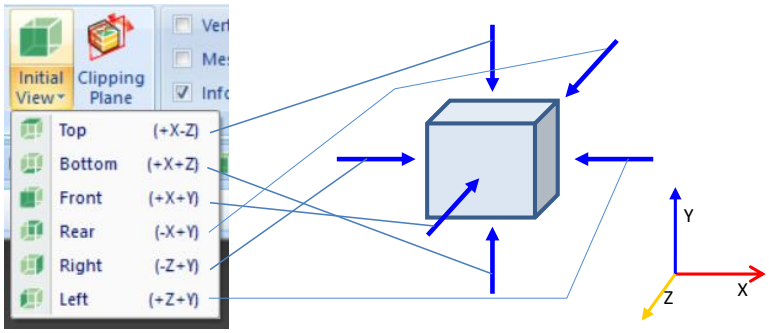
This view has two positive directions, the positive, horizontal X axis and the positive, vertical Y axis. A mesh cube comes to the center of the screen. ‘Up’ means viewing a mesh of the initial display status from the screen top (or the positive Y axis). The message ‘(-Z+X)’ next to ‘Up’ means that the view has the negative, horizontal Z axis’ and the positive, vertical X axis’.



4.2.5 Mesh Comparison

This function divides the Figure Display Area into two parts and displays the figure to be compared on the left and the current mesh on the right.

When the [Mesh Comparison] check box is ticked, the command dialog for mesh comparison is displayed.

If the ‘Before/After’ is selected, the mesh before processing (the state of ‘Undo’) will be displayed on the left.

If the ‘External File’ is selected and the external file name is specified. The mesh of the external file is displayed on the left.

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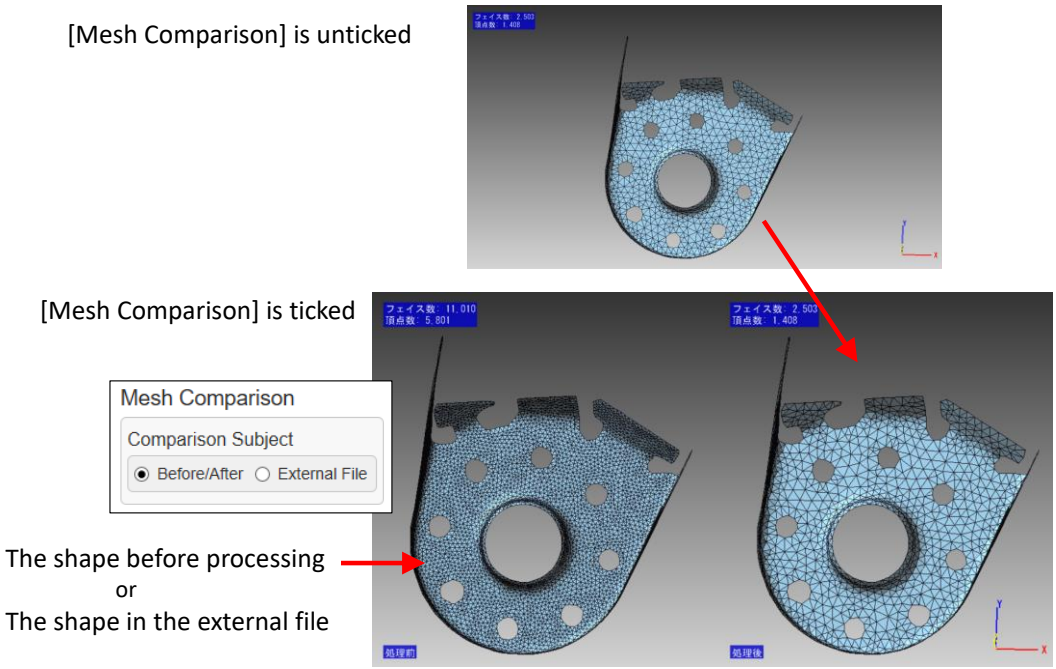

4.2.6 Information

Tick the [Information] check box in order to display face quantity, vertex quantity and coordinate axes in the Figure Display Area. If the [Before/After] check box is ticked as well, face quantity, vertex quantity, and coordinate axes before operation and those after operation are displayed.

4.2.7 Temporary Figure

Tick or untick the [Temporary Figure] check box in order to enable display/non-display status of temporary figures such as for command operation results. Temporary figures are active only for a subject command. They will disappear if another command is selected. Use the “Result List” capability (See ‘4.3.6 Result List’) in order to save them.

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4.2.8 Color Display

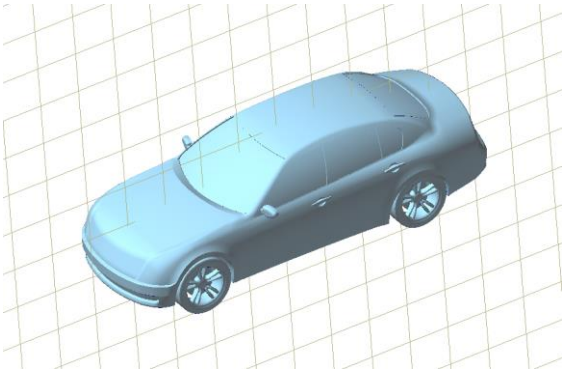
Tick/untick the [Color] check box in order to enable display/non-display status of color assigned to faces.

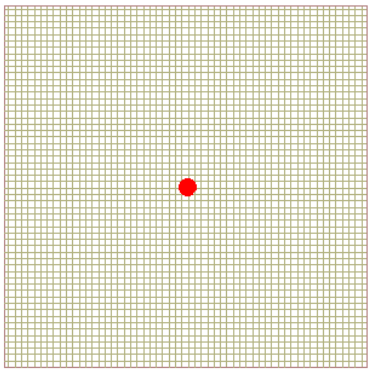
4.2.9 Parallel Projection and Perspective Projection

Tick or untick the [Parallel Projection] check box in order to select either of the figure display modes, parallel projection or one-point perspective projection. (Tick in order to select the mode of parallel projection. Untick in order to select the mode of perspective projection.)

4.2.10 Grid

When the [Grid] check box is checked, lines parallel to the X axis and lines parallel to the Y axis are displayed on the XY plane, and a red sphere indicating the position of the origin is displayed.





4.2.11 Background

The background (background color) can be changed by selecting Gradation, Black, White or Gray from 'Background Color' of 'View Options'.

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4.3 Operation for Screen Display

4.3.1 Selection of Command

Click a command icon in the Command Selection Area in order to activate it.

Upon putting a mouse pointer on it, an explanation of command function is displayed.

4.3.2 Command Dialogue

If a command is activated, a command dialogue is open. Put a mouse pointer on of a command dialogue in order to display descriptions such as input items. Click the icon 'Pin' at the upper right corner of command dialogue in order to hide a command dialogue and save a broad space for Figure Display Area. (Note that the icon 'Pin' is displayed if a command dialogue is fixated at the edge of a window.)

Click . Then, a command dialogue will disappear. This status means that no command is selected.

A command dialogue can be transferred to a position in the Figure Display Area for an easy operation. Put a mouse pointer on the pale blue header at the top of command dialogue, and drag the mouse with the left button pressed in order to transfer the command dialogue. Drag the mouse till the command dialogue is over the icon on the display in order to fixate the command dialogue at the edge of window.

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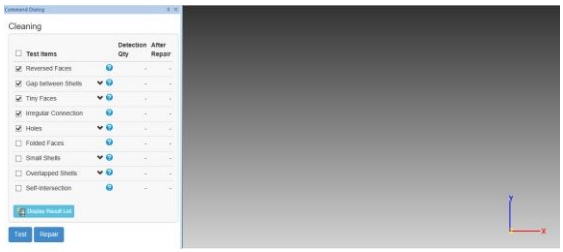
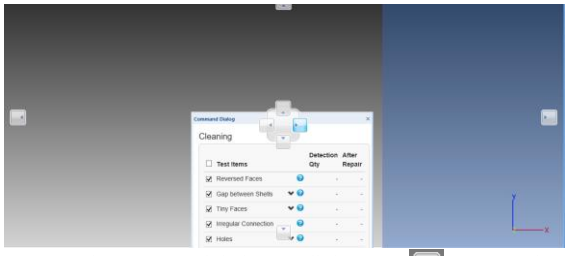
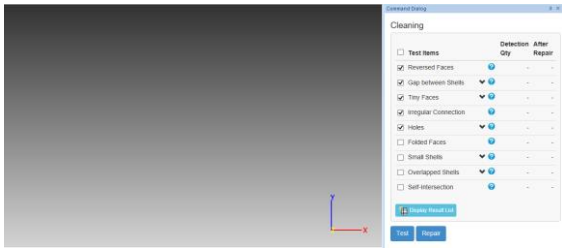


Original status

Put a cursor on the header part of a command dialogue, and drag



Drag the command dialogue till the icon is covered



The command dialogue is fixated at the edge.

Click a command dialogue and rotate a mouse wheel with the 'Ctrl' key pressed in order to scale up/down characters in a command dialogue.

4.3.3 Inputting Parameters in a Command Dialogue

Indicate parameters in a command dialogue through the use of text boxes, sliding bars, check boxes, and radio buttons as well as by operating figures in the Figure Display Area. (See '4.4 Operation of Figures'.)

This section describes about inputting parameters in a command dialogue.

Use ⌄ in the command dialogue of the "Cleaning" command in order to enable display/non-display status of an area where parameter details are input. Click ⌄ and reverse the arrow direction upside down in order to display parameter details. Click it again in order to close the area where parameter details are input.

There are parameter columns shown below that consist of a sliding bar and a text box. Users can use either a sliding bar or a text box. A value that is input in a text box is duly

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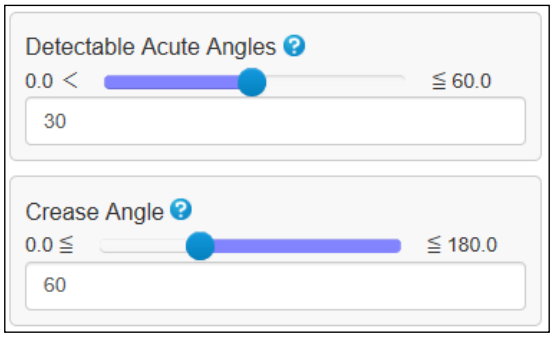
reflected in the corresponding sliding bar, and vice versa. If a degree value is input, a sliding bar becomes purple accordingly. The right bottom parameter image shows example parameters for detecting acute-angled triangles. It indicates the detection of an acute-angled triangle that has an angle of 30 degrees or less and has a crease angle of 60 degrees or more.



A command dialogue is displayed in response to a selection of the command. Default values have been set for each parameter column in the command dialogue. If a mesh figure has been imported, default values are computed on the basis of the figure shape and set by the System.

Values that are set in each parameter column will be recorded in the System once a command is executed. A recorded value is referred to as a 'Previously Input Value'. It means that the 'Previously Input Value', not the 'Default Value' will be displayed if the command is selected again. Click a text box where a value is input in order to display a 'Previously Input Value' and a 'Default Value'. (If a 'Previously Input Value' does not exist, a 'Default Value' alone is displayed.)

Click 'Default Value' in order to replace a value in the text box with the 'Default Value'. A 'Previously Input Value' will be saved till POLYGONALmeister is finished.

4.3.4 UNDO/REDO

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"Undo" reverts a mesh to the status immediately before the latest editing operation (before executing the command that changes the shape). Note that the number of recoverable steps depends on the PC environment being used.

"Redo" cancels the "Undo" action, and displays a status after the latest operation.

4.3.5 Interim Progress Display and Process Suspension

Click the button [x] at the bottom right of the screen in order to suspend a processing during a command operation. Normally, a mesh will recover its previous status to the command operation.

Note that there are some commands that prevent the button from being clicked. They are the "Import" command, the "Export" command, and other commands requiring a short processing duration.

Tick the [Interim Progress Display] check box of the command dialogue of the "Smoothing/Feature Preserving" command, the "Simplify" command, or the "Remesh" command. Then, interim processing statuses are displayed by each phase, enabling processing statuses to be confirmed on a real-time basis. Tick the check box, ensuring that the [Pre-& Post-Operation Comparison] check box has been ticked. Then, processing progress can be easily understood through retroactive comparison.

Click [x] during a command operation with the [Interim Progress Display] check box ticked, in order to record a mesh figure that is displayed when [x] is clicked as a result of command operation. Users can view a displayed mesh figure in order to confirm a sufficient processing. They can finish the command operation by clicking [x] if they thus judge.

Ticking the [Interim Progress Display] check box is useful as indicated above. However, it takes a longer operation duration than an operation without the effect. Thus, untick the check box in order to shorten an operation duration. Note that a mesh

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will recover its status previous to an operation if the operation is suspended with the [Interim Progress Display] check box being unticked.

Click [x] while the “correction” optional capability of the “Cleaning” command is being executed. Then, a mesh that reflects corrections made before the click will be created. See the description of the “Cleaning” command for details.

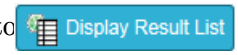
If the process is executed with the [Interim Progress Display] OFF, the processing time is shorter than ON.

If [x] is clicked during the "cleaning" correction process, a mesh with the correction that has been completed up to that point will be created.

4.3.6 Result List

If problems of a mesh figure cannot be corrected automatically by the “Cleaning” command, users can save temporary figures of the problems that have been detected, and correct them by executing other commands. Also, they can view results of detecting cutting plane lines and creases when they execute other commands.

Temporary figures disappear when other commands are selected. Use the “Result List” command in order to save temporary figures till the System is exited.

Click the [Display Result List] butto 

in a command dialogue in order to save temporary figures resulting from the command execution. Concurrently, the command dialogue [Display Result List] capable of managing saved temporary figures is displayed. Click the ‘Home’ tab | Operation | the [Display Result List] icon in order to display the command dialogue.

See below the example of a Result List. It shows that two self-intersections were not removed by executing the “Cleaning” command and have been left. Click the line ‘Self-intersection’ of the “Result List” command. The first self-intersection is zoomed in automatically in the Figure Display Area in response. Click the right arrow at the bottom of the Result List in order to zoom in the next self-intersection. Click the left arrow in order to return to the first self-intersection.

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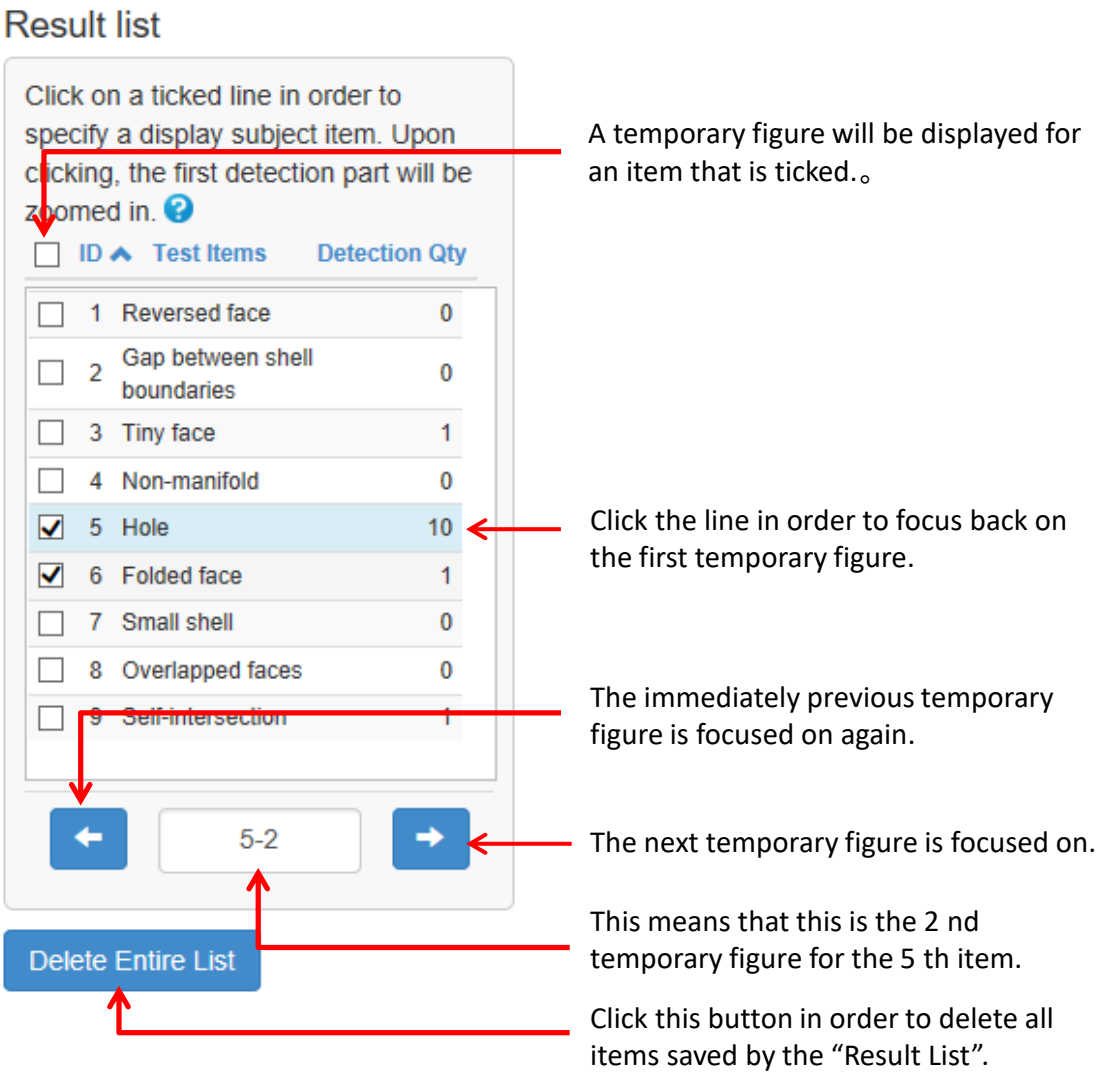
The “Result List” command is a function capable of recording only one result for each test item. If the same test is conducted again, the first result will be overwritten.

Temporary figures will be displayed if the item check box is ticked.

Click the button [Delete Entire List] in order to delete all test results in memory.



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4.3.7 Shell List

A Shell List is included in a command dialogue of commands that operate shells, the “Flip Shells” command, the “Delete Shells” command, and the “Export Shells” command. See the example below.

Statuses of checkbox (‘□’), at the left end of each column, show whether selection or deselection has been made.

Face quantity, surface area, and volume of each shell are indicated.

If a negative volume value is indicated, the shell is reversed (which means, for example, that it is hollow inside).

Note that 0 is indicated for an open shell volume.

Click ‘Face Quantity’, ‘Surface’ or ‘Volume’ of the header in order to sort data with the clicked row as the key.

Click again in order to replace an ascending order with a descending order, or vice versa.

Click at the right side of the command dialogue in order to position a selected shell at the center of the screen.

Click a column or a ‘ □ ‘ in order to tick the ‘ □ ‘. The ticked ‘ □ ‘ means that the item is selected for operation. A shell which is being selected is indicated through the use of green temporary figure in the Figure Display Area. Click a shell selected in the Figure Display Area in order to cancel the selection. Click the ‘ □ ‘ at the header in order to select all or deselect all.

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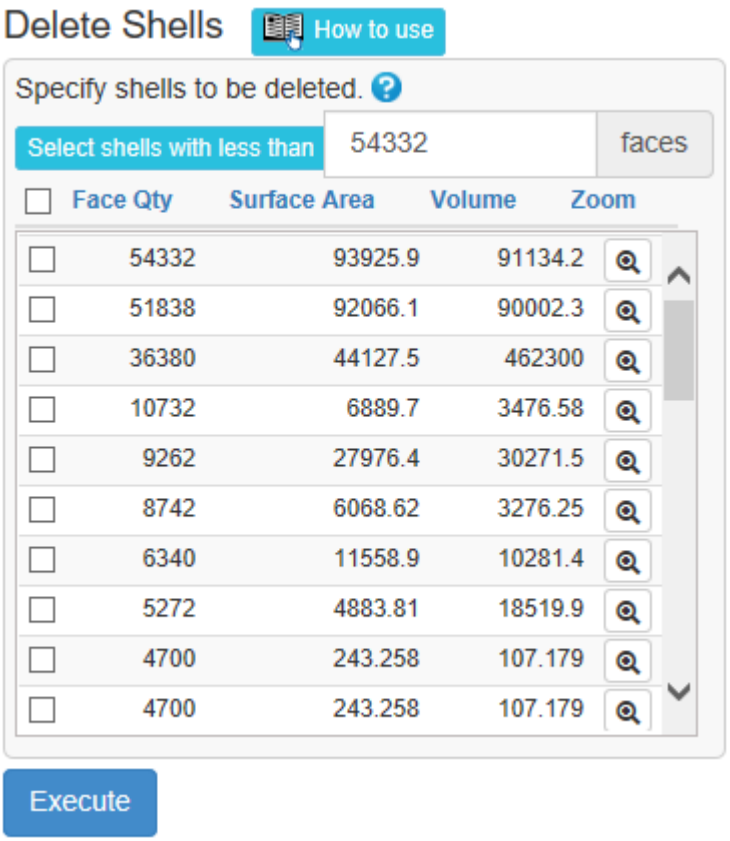

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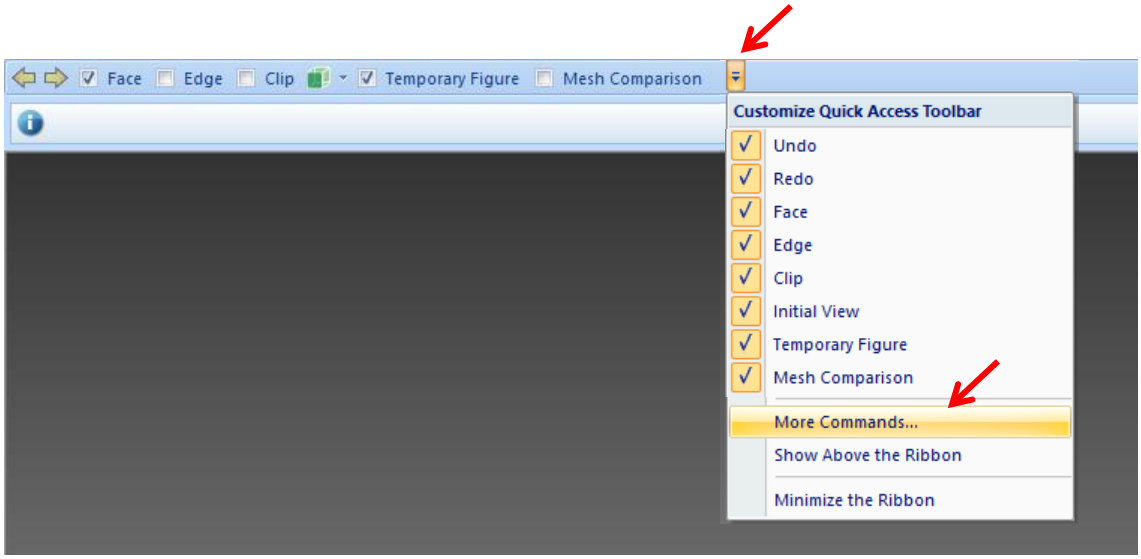
4.3.8 QAT Registration and Shortcut Key

Register commands of frequent use in QAT (Quick Access Toolbar) in order to improve operability for command selection. This section describes the method for registering commands in QAT.

Click at the right end of QAT in order to display a pulldown menu. Click 'More Commands' in the menu.



The window below will be displayed. Change a tab in the left table of the window. Click a target command that needs to be registered. Click the button [Add] at the center in order to register the command in QAT.

Click a command of QAT registration in the right table and change the order in QAT through the use of the right arrow buttons.

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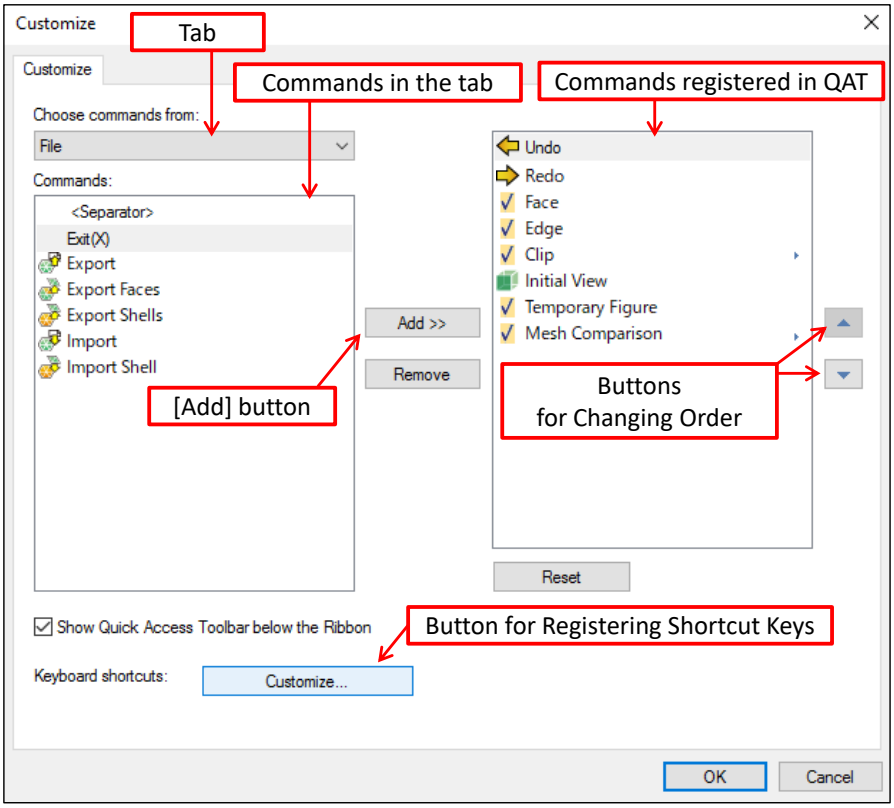

Shortcut keys can be assigned to commands.

Click the [Customize] button at the bottom of the QAT registration window above. Then, the window below appears.

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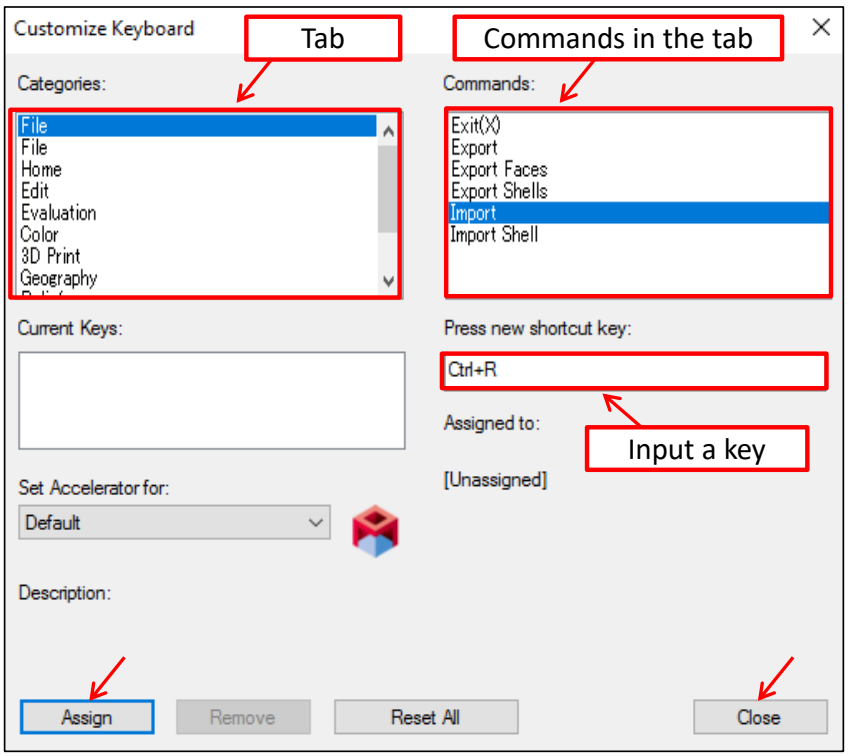

The example above shows that the shortcut key 'Ctrl+R' is assigned for the 'Import' command. Select the 'Import' command in the tab 'File'. Next, click the text box under the message 'Press the key of assignment'. Press the key 'R' with the key 'Ctrl' pressed. A message 'undefined' is displayed under the title 'Assignment Destination'. This message means that the shortcut key 'Ctrl+R' has not been used. Click the [Assign] button and then the [Close] button.

Note that the assignment of shortcut keys below has been already made by the System.

Undo = Ctrl + Z

Redo = Ctrl + Y

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4.4 Operation of Figures

4.4.1 Specification of Figures

Left-click on a target figure such as face, vertex, shell or hole in order to specify it.

4.4.2 Specification of Areas

This section describes the methods for specifying an area (where faces exist). They are the 'Rectangular' method, the 'Free-Form' method, the 'Shell' method, the 'Color' method, the '3D Sphere' method, and 'Auto' method. They are applicable depending on commands that are used.

■ Rectangular

The method 'Rectangular' indicates faces in any rectangles where all sides lie in parallel with the screen frame. (Faces that are partially included in the rectangles are selected as well.).

The method is also predicated on the specification of two diagonal points, a Drag Start Point and a Drag End Point.

If an area indicated by dragging is composed of non-continuous faces, such faces that are therein connected to the faces closest to the user will be chosen.

■ Free-Form

The method 'Free-Form' selects faces that reside within an area delineated by a dragged path boundary. (Faces that are partially included in the areas are indicated as well.)

A Drag Start Point and a Drag End Point are connected with a line segment.

If an area indicated by dragging is composed of non-continuous faces, such faces that are therein connected to the faces closest to the user will be chosen.

■ Shell

The method 'Shell' enables an indication of area by clicking or dragging. Upon clicking a face, the shell which the face belongs to will become the target. Upon dragging, all shells that are minimally included in the area indicated by dragging will become the target.

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Faces included in the target shells will be selected.

■ Color

The method ‘Color’ enables a selection of faces that are of the same color type as the clicked face.

There are three types of color types according to how to hold the face color.

- Faces that use the same Texture Image;
- Faces that use the same Face Color (Note);
- All faces where no color is assigned.

For example, click a face which a Texture Image is assigned to. As a result, all the faces that use the same Texture Image are selected.

Faces with vertex colors cannot be used for color selection.

(Note)

There are cases where monochrome faces that have the same RGB value may not assume the same Face Color. For example, faces are deemed to assume a different Face Color despite the same RGB value, if they belong to a separate shell that has been added.

■ 3D Sphere

Drag a line on a mesh. The method ‘3D Sphere’ enables a selection of faces that are entirely included in the dragged corridor along which a sphere center travels.

Put a mouse pointer on a mesh in order to display in blue, edges of faces that are included in the sphere. Begin dragging. More faces along the dragged corridor will be displayed in blue. Finish dragging in order to select an area of blue faces and display a temporary figure in green. Rotate the mouse wheel with the ‘Ctrl’ key pressed in order to change the sphere size.

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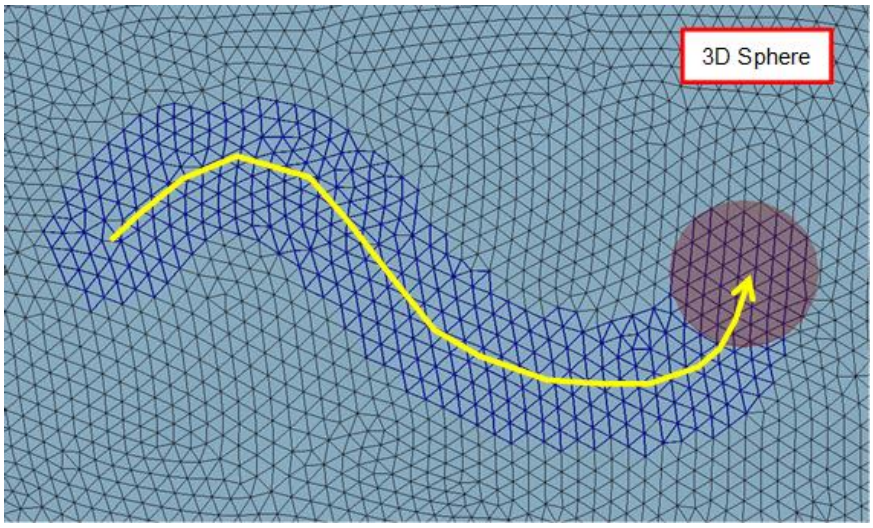

■ Auto

The method ‘Auto’ enables a selection of faces that connects smoothly with the clicked face.

Green temporary figures are displayed in order to indicate the chosen faces.
Repeat the operation of area selection in order to add areas to the selected areas.
Delete an indicated area from the selected areas by performing an area indication operation with the ‘Shift’ key pressed.
Where the method ‘Rectangular’ and the method ‘Free-Form’ are concerned, click a face that has not been selected in order to add it to the area. Conversely, click a face that resides within the selected area in order to deselect that face.

Click the [Back] button in order to cancel the previous operation of area selection, if the button is available.

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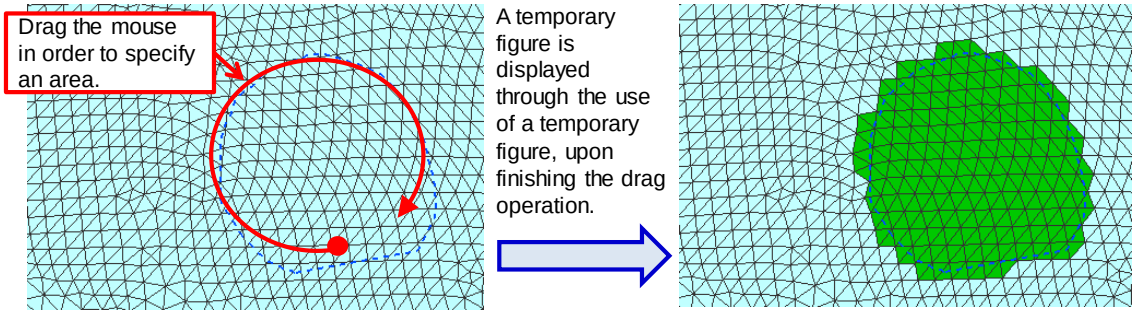

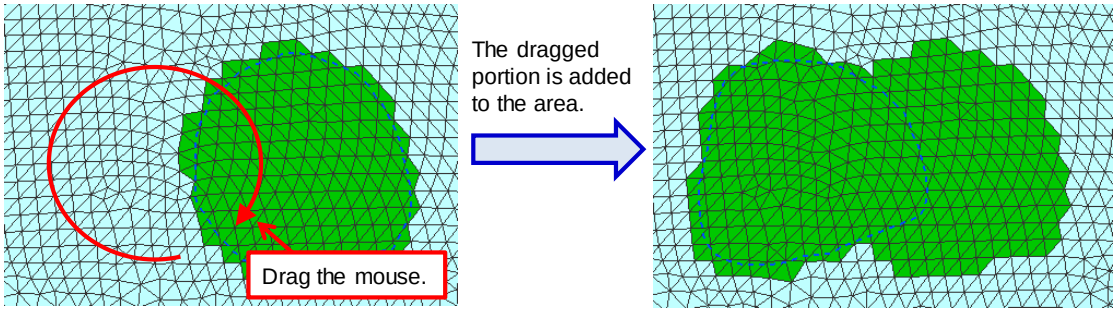

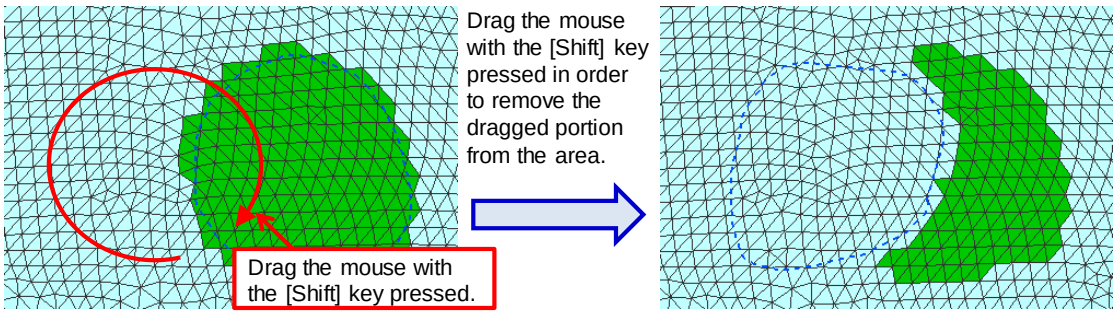

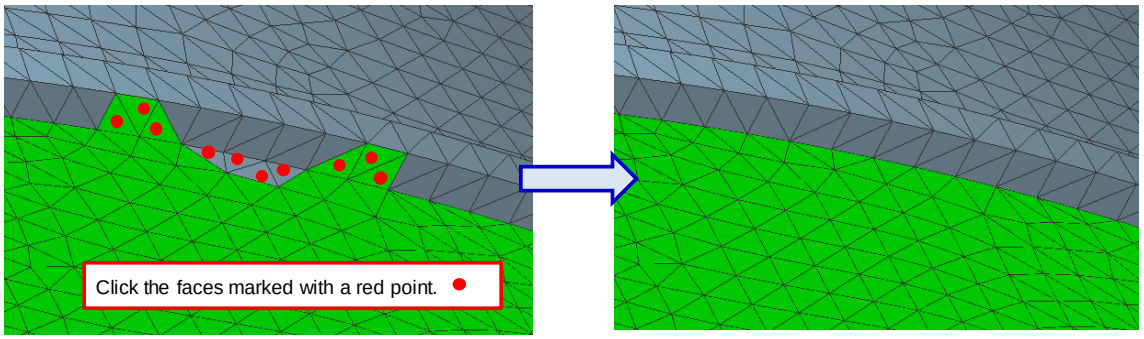

4.4.3 Drawing Auxiliary Lines

Lines drawn by dragging the mouse is used in order to execute commands such as the "Cut" command and the "Divide Faces" command.

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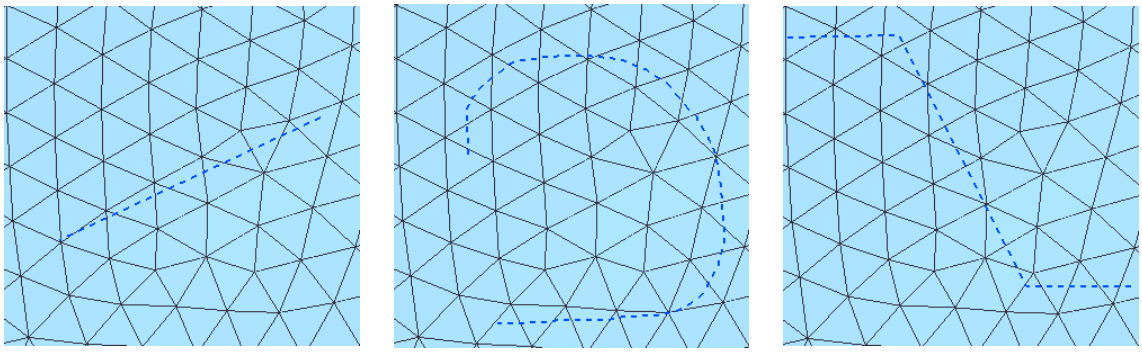
The methods of drawing lines are: ‘Line’; ‘Free-Line’; and ‘Polyline’.

The method ‘Line’ enables a straight line that starts at a Drag Start Point and ends at a Drag End Point. The method ‘Free-Line’ uses a dragged path as a line. The method ‘Polyline’ draws a polyline that connects clicked points. Double-click to end the Polyline. Drag the mouse with the ‘Shift’ key pressed in order to draw a horizontal or vertical line parallel to the screen framework when the method ‘Line’ and the method ‘Free-Line’ are used.



Line　　Free-Line　　Polyline

4.4.4 Handle

‘Handle’ is a tool capable of translating, performing rotational transfer, and scaling-up/down of image data of pictures, letters and shells.

The figure below is the handle used in the "Embed Relief" and "Stamp" command. Grab and drag the circle in order to perform a rotational transfer of characters, drawn lines or images. Grab and drag the bar in order to scale up or down a mesh in the dragging direction.

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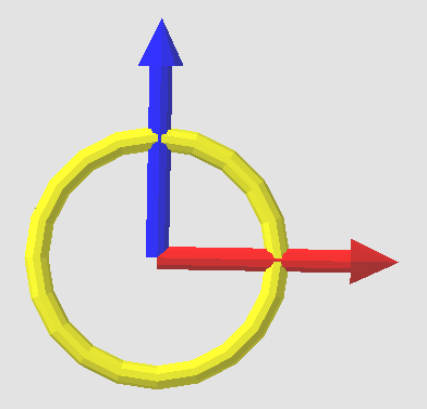
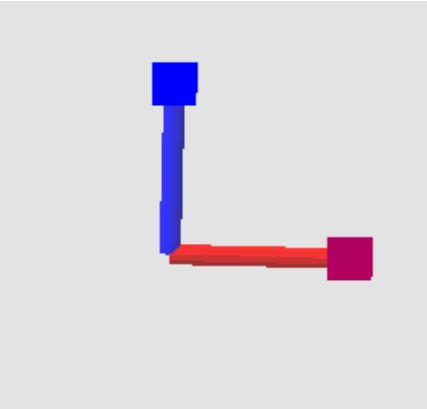
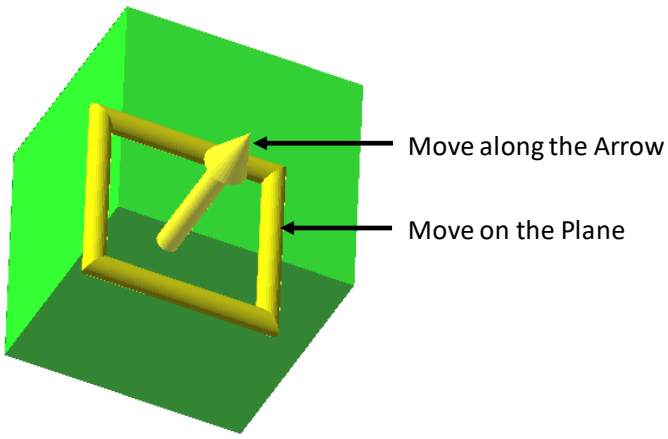


State of transferring



State of Scaling up/down

The figure below is a handle used with the "Drag Move" command. Grab the arrow and drag, the shell moves in the direction of the arrow. And grab the rectangular frame and drag, the shell moves on the plane on which the rectangular frame rides.



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4.5 Operating Procedure

Follow the editing procedure below in order to operate POLYGONALmeister.

First, execute the “Cleaning” command in order to ‘test’ data after data import. Utilize the ‘Test’ optional capability in the command dialogue of the “Cleaning” command in order to check that a normal shape has been imported. Utilize the ‘Repair’ optional capability in order to correct if necessary.

If there are problems of the shape that repel the correction by the “Cleaning” command, execute the “Defeature” command or the “Advanced Self-intersection Removal” command. Alternatively, delete faces of the issues, and fill the holes left behind the deletion.

Execute the “Smoothing” command in order to delete minute surface roughness of measurement data. By using the "Reshape CT mesh" or "Reshape Optical Mesh" commands, cleaning and smoothing can be performed at once.

Next, execute commands in order to edit mesh figures. Execute the “Cleaning” command if necessary in the midst of editing operation in order to confirm that mesh figures do not have problems if they have experienced significant changes (caused by executing the “Remesh” command, the “Cut” command, the “Wrapping” command, the “Thicken” command, or the “Offset” command).

Reducing the number of faces with the “Simplify” command speeds up the operation, but results in a coarser mesh and some deviation from the mesh before simplifying. Therefore, it is better to simplify after performing the necessary editing operations.

Finally, execute again the “Cleaning” command in order to confirm no problems with mesh shapes before exporting the data.

POLYGONALmeister works best when the 3D size (diagonal length of the box) of the mesh is between 10 and 10,000. Therefore, meshes that are too small / too large for this size should be scaled to the above size immediately after importing (before executing other commands) with the "Scaling" command. Also, scale to the original size just before exporting.

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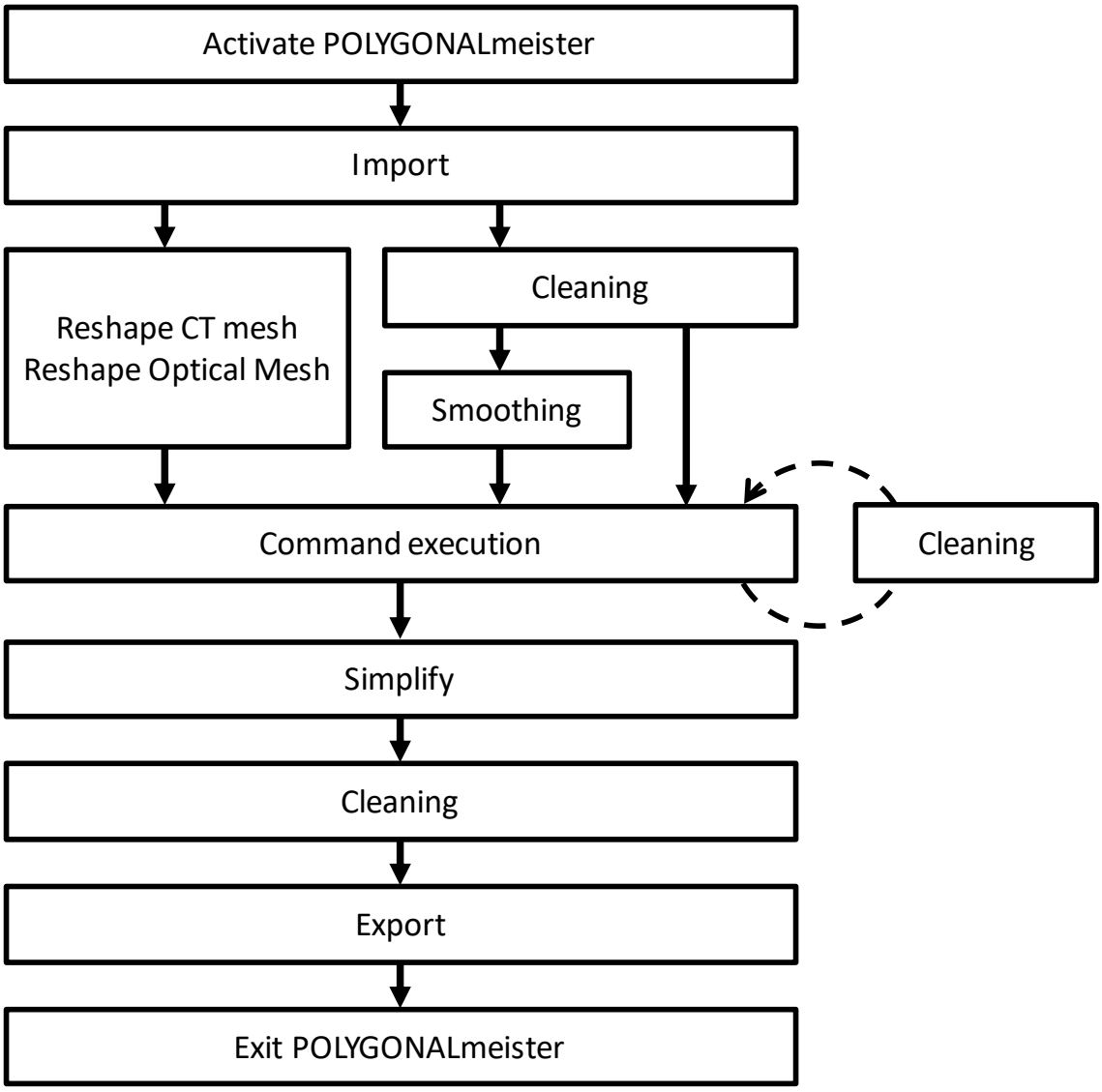
If the mesh is located far away from the origin, the calculation accuracy and display accuracy will be inferior, so it is recommended to move it to a position closer to the origin. You can easily move it by using “Move Box-center to Origin” of "Easy Layout" of the “Move / Copy” command.



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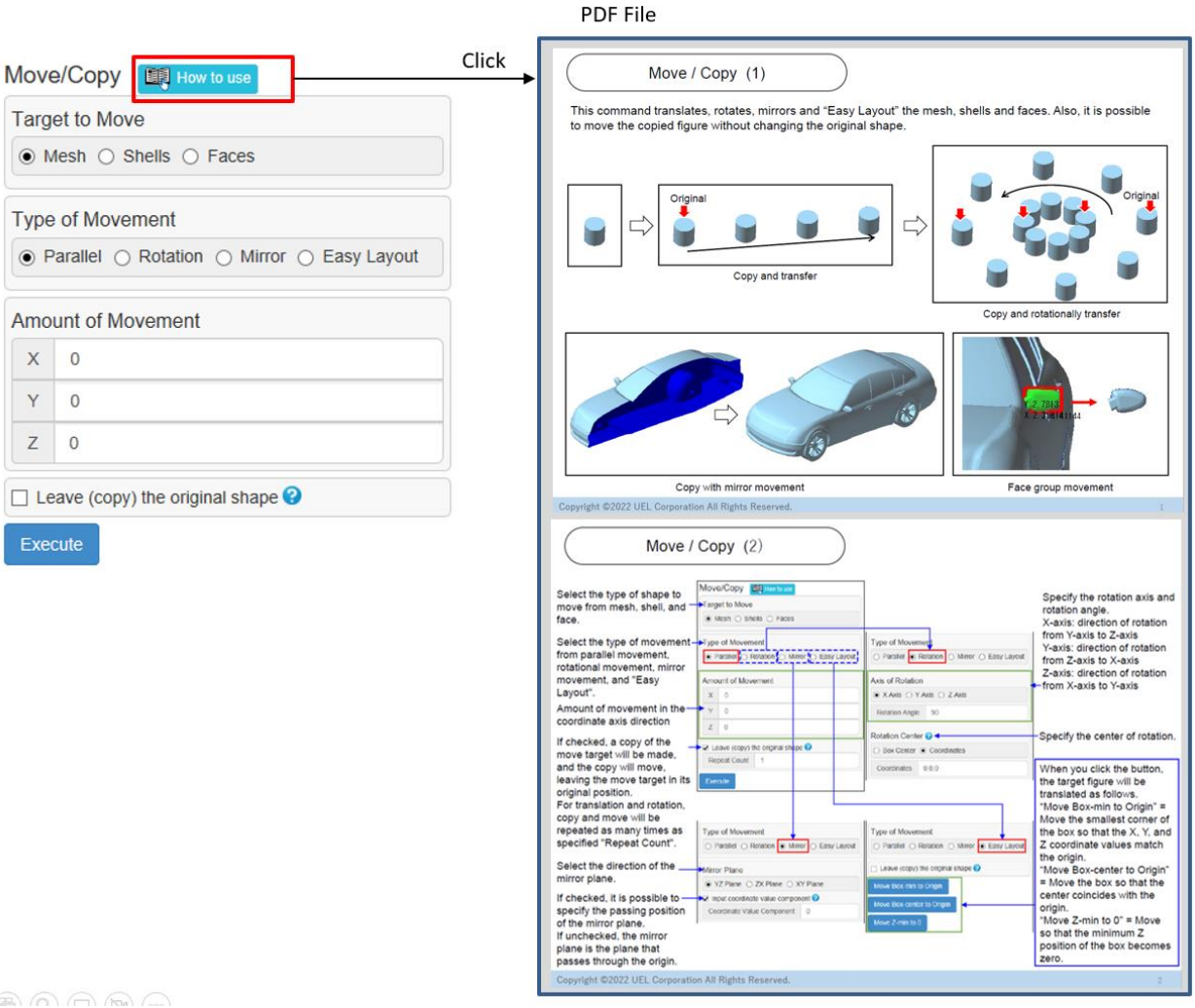
5 Command Overview

This chapter provides an overview of the functionality of the commands on each tab.

Click the "How to use" button attached to each command to display a PDF file that describes the details of the function and the operation method.



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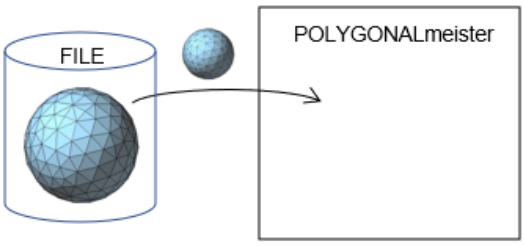
5.1 File tab

The “File” tab contains commands for inputting and outputting external files.

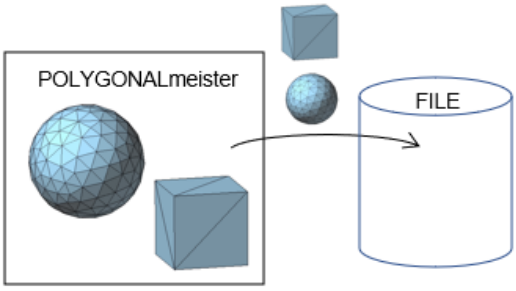
Import

Read polygon data from an external file.



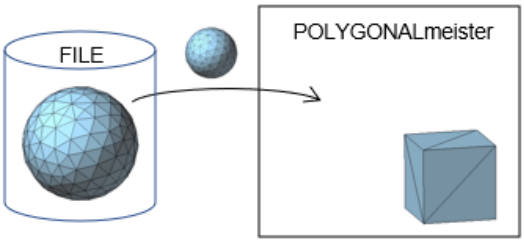
Export

Export the mesh to an external file.



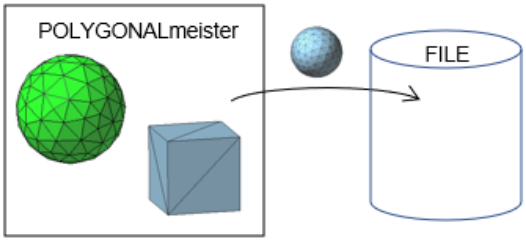
Import Shell

Add the polygon data of the external file to the mesh as shells.



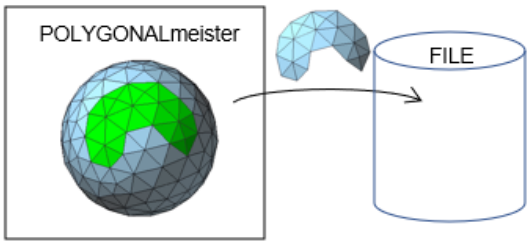
Export Shells

Write the specified shell to an external file.



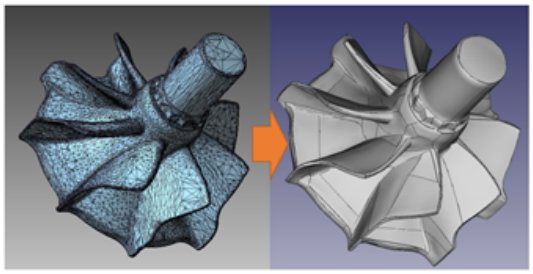
Export Faces

Write the specified faces to an external file.



CAD Surface Export

Create a CAD surfaces from the mesh and export them to an IGES file.



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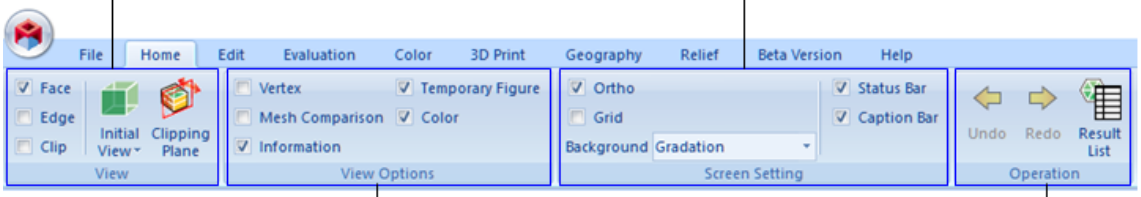
5.2 Home

The “Home” tab includes the “Edit” Panel where frequently used commands capable of editing the mesh shapes are listed; the “Edit Shell” Panel where commands capable of editing shells are listed; and the “Transformation” Panel where commands capable of scaling up/down, transferring and copying are listed. The Create panel contains commands to create shells.

[Face] Check in order to display a face.
[Edge] Check in order to display an edge.
[Clip] Check in order to hide the figure in front of the clipping plane and display the interior of a solid, and thus display the internal side of a solid.
[Initial View] Click in order to retrieve the display status when the file was imported. Click in order to enable a display in accordance with the direction of selected coordinate axis.
[Clipping plane] Click in order to set a plane perpendicular to the visual line direction as a clipped surface.

[Ortho] Display method of the figure between parallel projection (checked) and single point perspective projection (unchecked) can be switched.
[Grid] If checked, a line parallel to the X and Y axes is displayed in the XY plane, and a red sphere indicating the origin position is displayed.
[Background] You can change the background color of the figure display area. Please select from gradation/black/white/gray.
[Status bar] Hide the process stop button and the progress display area at the bottom of the screen.
[Caption bar] Hides the system message display area.



[Vertex] Check in order to display vertices.
[Mesh Comparison] Check in order to divide the figure display area into two: mesh before processing or the external file on the left; and the current mesh on the right.
[Information] Check in order to display in the figure display area face qty, vertex qty and coordinate axes.
[Temporary Figure] Check/uncheck in order to display/hide temporary figures such as command execution results.
[Color] Check/uncheck in order to enable display/non-display status of color assigned to faces.

[Undo] The mesh returns to the state before the previous operation was executed (before the command that involves changing the shape).
[Redo] Cancel "Undo" to return to the state after execution.
[Result list] Click to display the dialog for managing the saved temporary figures.

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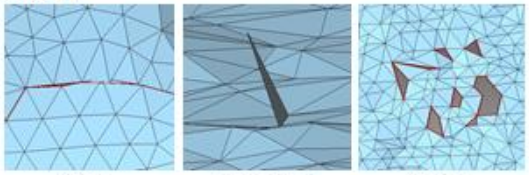
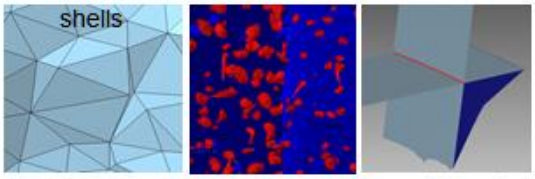
Cleaning

Inspect and repair incorrect parts of the mesh.



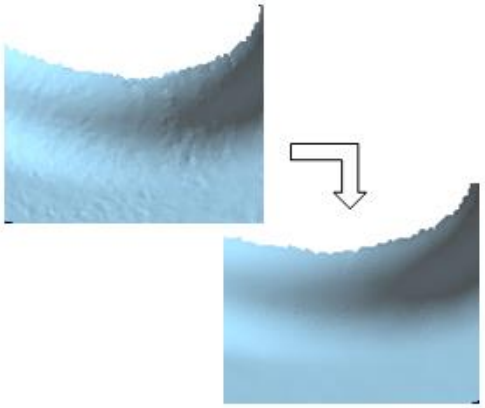
Gap between shells | Irregular Connection | Holes



Folded Faces | Small Shells | Self-intersection

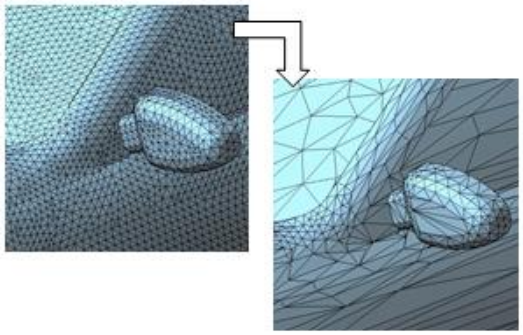
Smoothing

Make smooth by removing fine irregularities on the surface of the mesh.



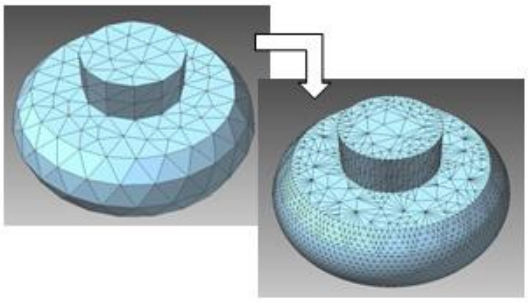
Simplify

Reduce the number of faces in the mesh (to keep the mesh from deforming as much as possible).



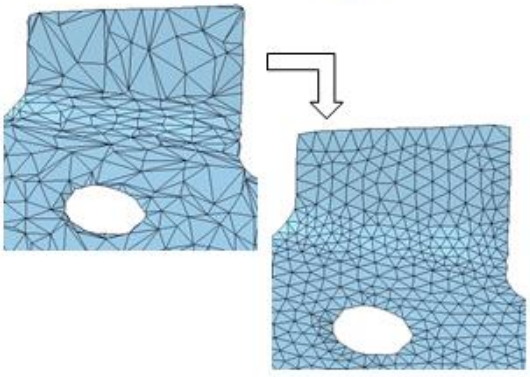
Subdivision

Approximate the mesh to a smooth curved surface and divide the face into small pieces so that it fits on the curved surface. The mesh will be smooth.



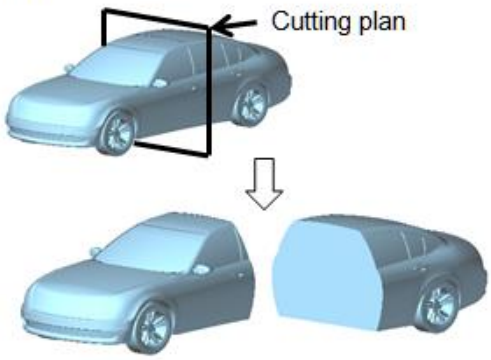
Remesh

Reconstruct the mesh so that the faces are close to equilateral triangles.



Cut

Cut the mesh with a plane. You can remove one side of the cut or leave both sides.



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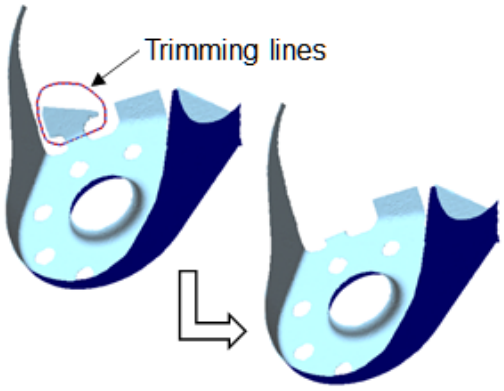
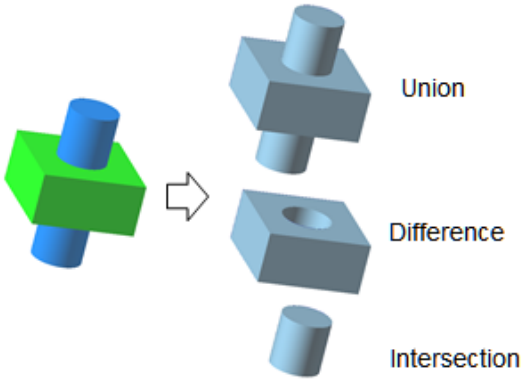
Trim

Trim the mesh with the drawn lines.



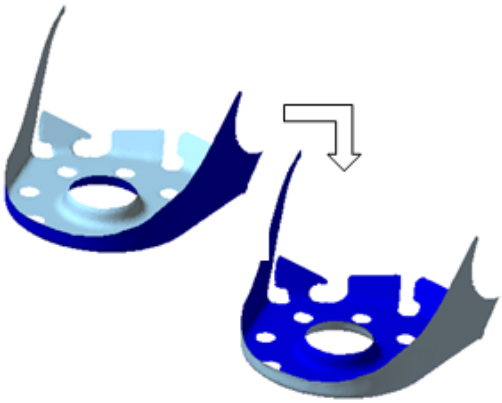
Boolean Operation

Create union / difference / intersection of two shells.



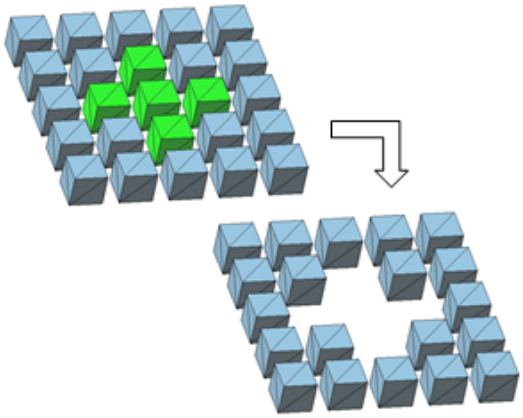
Flip Shells

Flip the front and back sides of the specified shells.



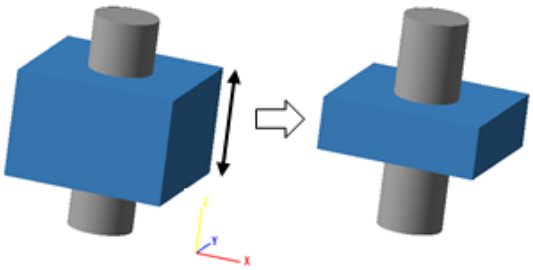
Delete Shells

Delete the specified shells.



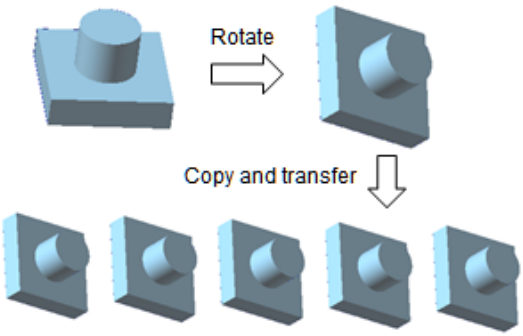
Scaling

Scales the entire mesh or individual shells. You can also change the enlargement ratio for each coordinate axis direction.



Move / Copy

Parallel, rotate, and mirror move the entire mesh, shells, and faces. You can also make copies and place them.



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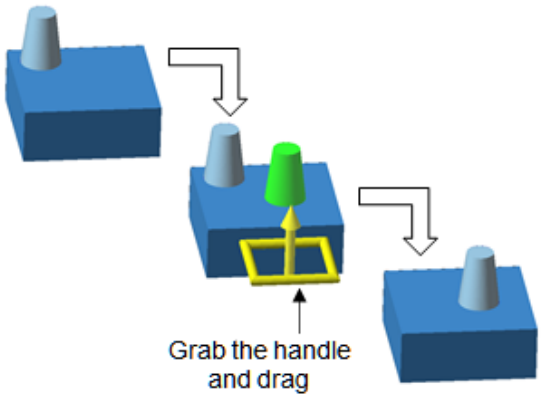
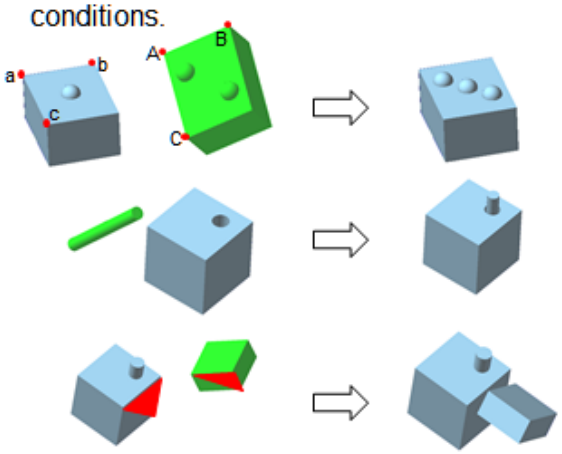
Drag Move

Shells can be moved along a straight line or on a plane by dragging.



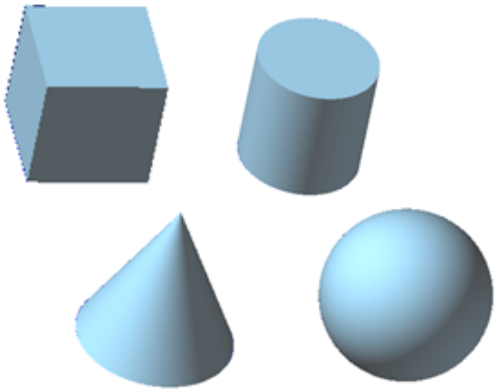
Arrange Shells

Arrange shells according to various conditions.



Primitive Solid

Create a cuboid, cylinder, cone or sphere shell.



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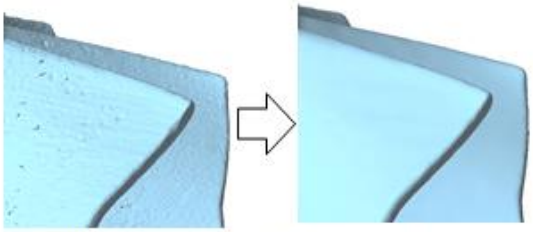
5.3 Edit

In the "Edit" tab, there are commands to edit faces, edges, vertices, partial areas and the entire mesh.

Reshape CT Mesh

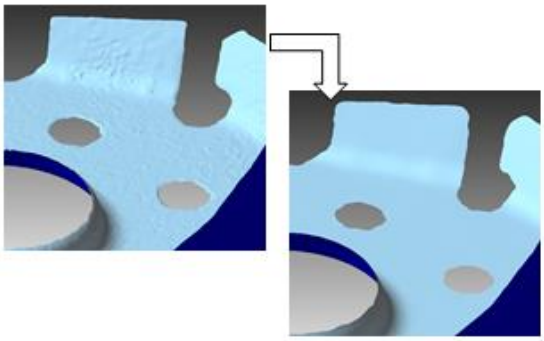
Repair the irregular part of the mesh derived from CT measurement, smooth the mesh, and remesh the faces to be close to equilateral triangles.



Irregular connection:	6,081 ⇨	0
Folded faces:	180 ⇨	0
Self-intersection:	942 ⇨	0

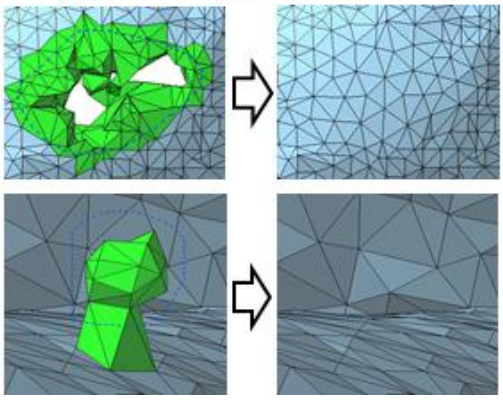
Reshape Optical Mesh

Repair the irregular part of the mesh derived from optical measurement, smooth the mesh, and remesh the faces to be close to equilateral triangles.



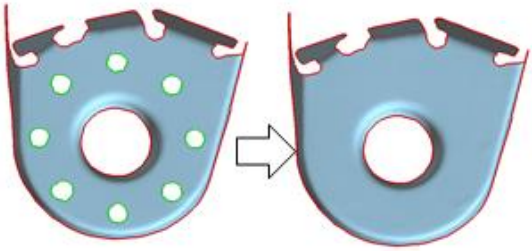
Defeature

Remove through holes, blind holes, dents, protrusions, self-intersections, etc.



Fill Holes

Fill the holes on the mesh surface. (In order to fill through holes, use the "Defeature" or " Fill Caves" command)



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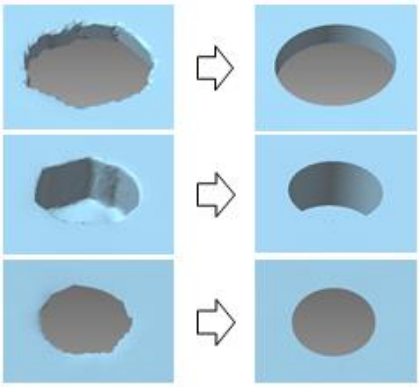
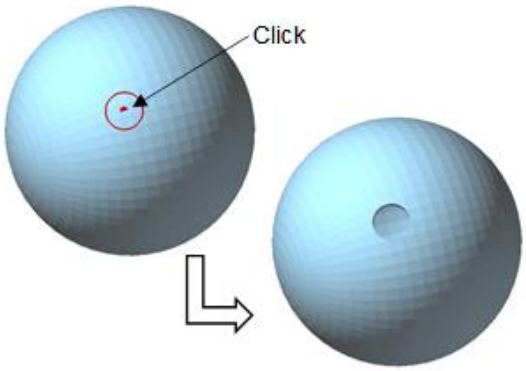
Reshape Hole

Compensate for the irregularities in a hole (through hole, blind hole, and hole in a shell) to round.



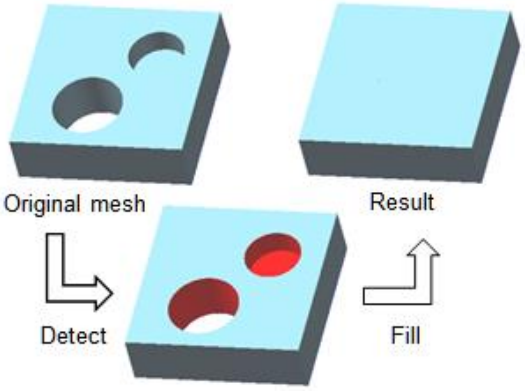
Through Hole

A circular through hole with the specified diameter is made at the clicked position.



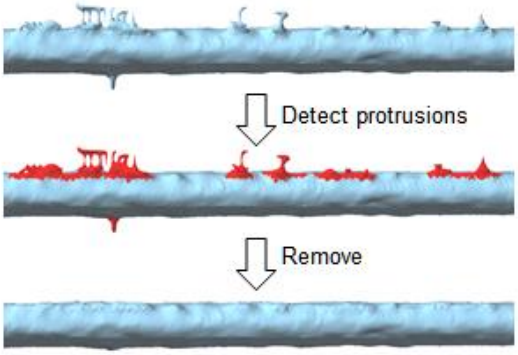
Fill Caves

Detect through holes and blind holes, and fill them.



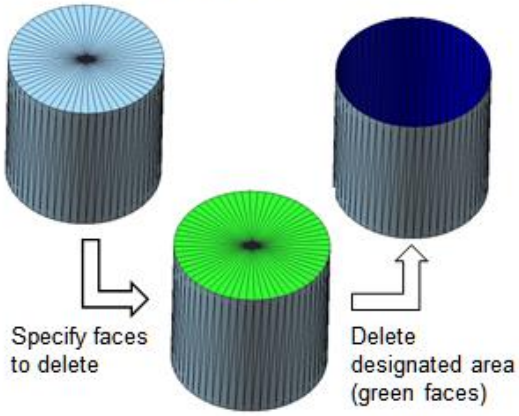
Remove Protrusion

Detect protrusions of a mesh and remove them.



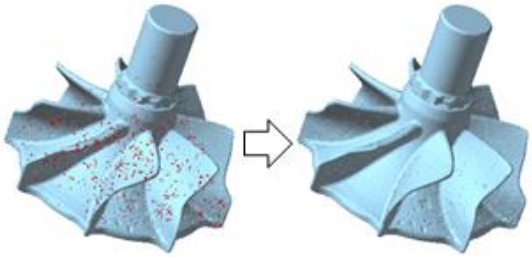
Delete Faces

Delete the specified faces.



Advanced Self-intersection Removal

Correct self-intersections that cannot be repaired with the cleaning command.



Number of self-intersections

= 942 ⇨ = 0

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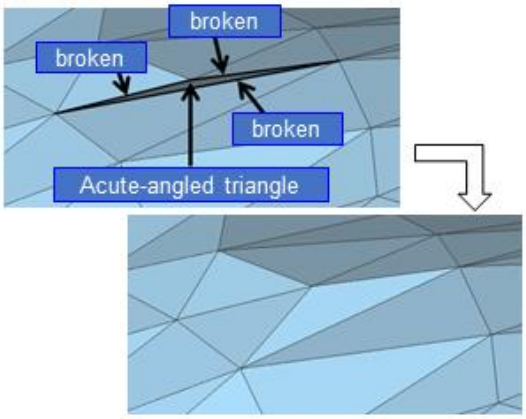
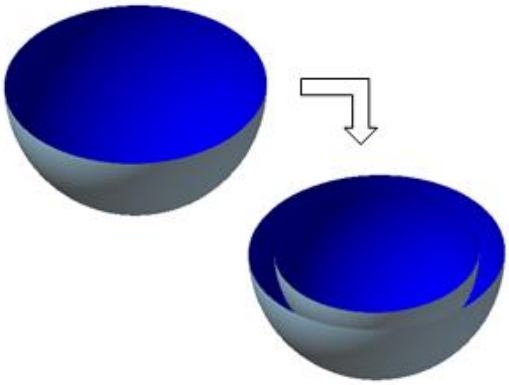
Remove Acute Triangles

Detects acute triangles and removes them.



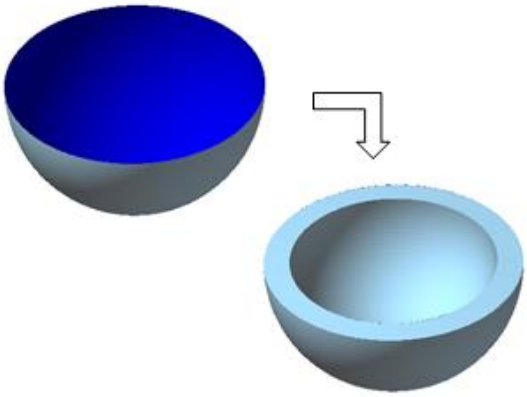
Offset

Create a mesh that is a fixed distance away from the original mesh.



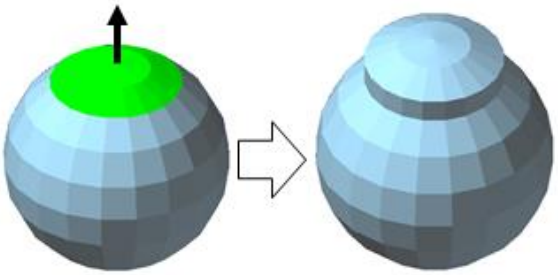
Thicken

Add thickness to the shell.



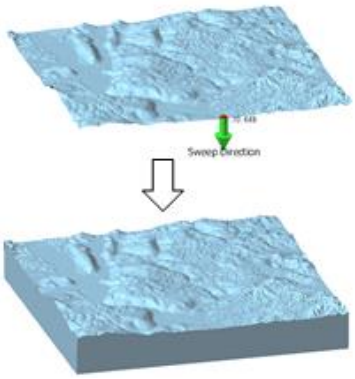
Morphing

Lift the specified area. It can also be lifted for a smooth connection to the surrounding area.



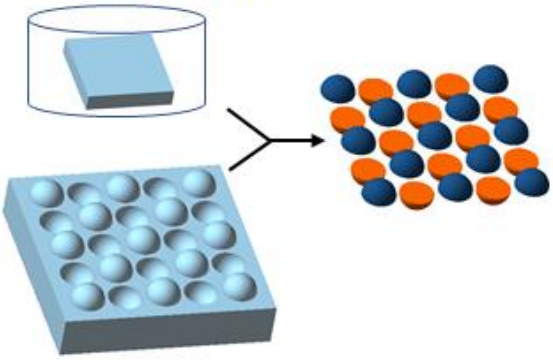
Projection Solid

Sweep the open shell to a flat surface to create a solid shell.



Difference Solid

Create the difference between the mesh and the polygon data of an external file as shells.



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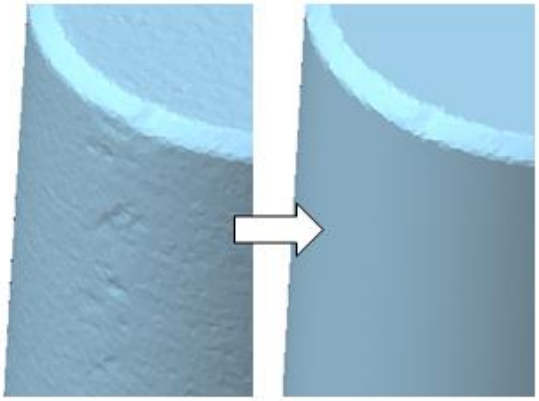
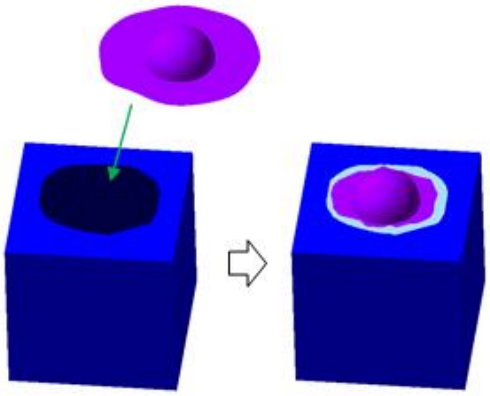
Make Flat / Cylindrical

The specified area is reshaped into a flat or cylindrical surface.



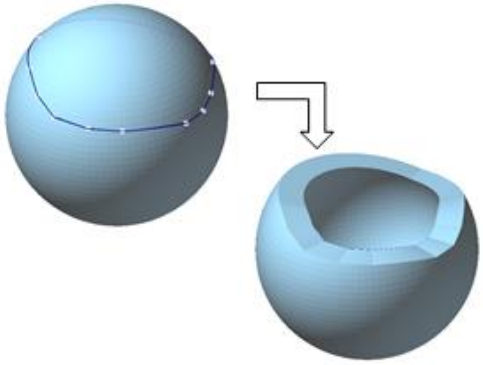
Transplant

Embed another shell in the hole.



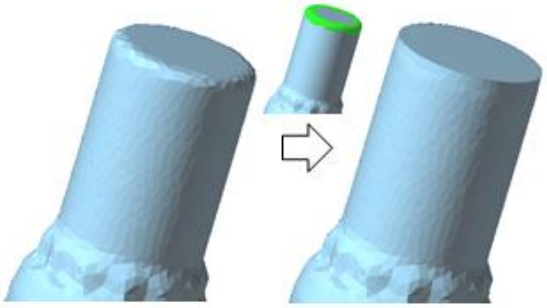
Loop Cut

Cut the mesh with the closed polyline drawn on the mesh.



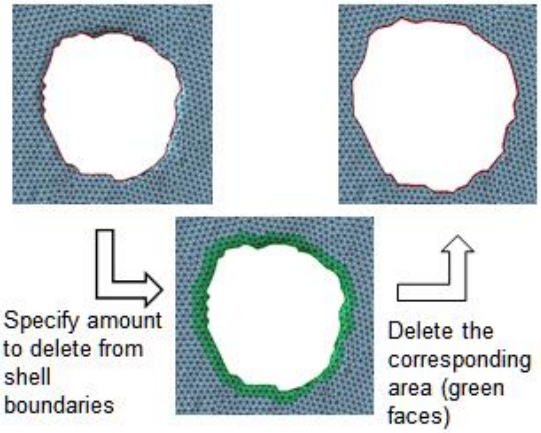
Sharpen

Makes a rounded ridge area into a sharp edge.



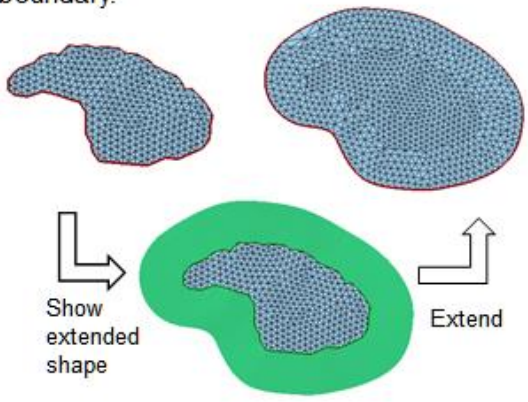
Delete Boundary Faces

Delete faces near the shell boundary.



Extension

Extend the mesh smoothly at the shell boundary.



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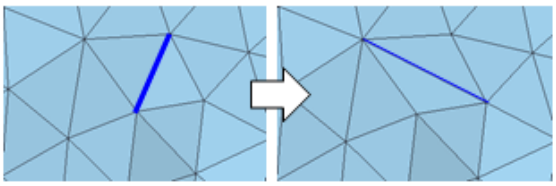
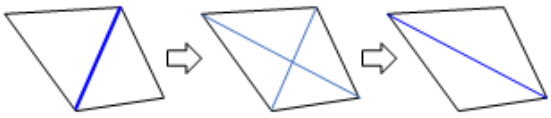
Flip Edge

Replace the edge using the quadrilateral diagonal formed by two triangles on either side of the edge.

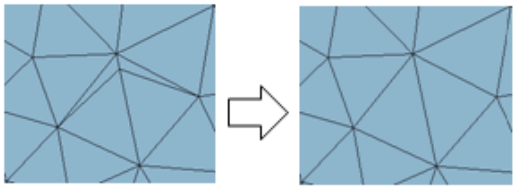


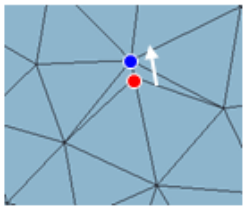


quadrilateral diagonal

Merge Vertices

Move a vertex to its adjacent vertex, and combine the two vertices into one vertex.

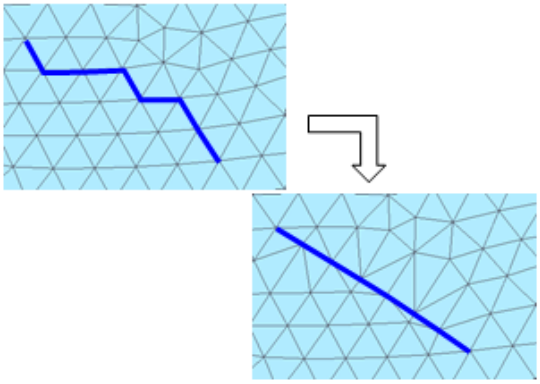




Move red vertex to blue vertex, and combine the two vertices into one.

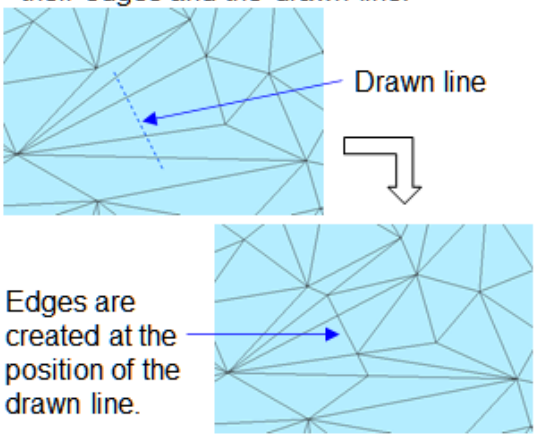
Align Vertices

Adjust the positions of the vertices so that the edge strings are connected smoothly.



Divide Faces

Faces are divided at the intersection of their edges and the drawn line.



Edges are created at the position of the drawn line.

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5.4 Evaluation tab

The “Evaluation” tab contains commands for measuring, evaluating, and inspecting meshes.

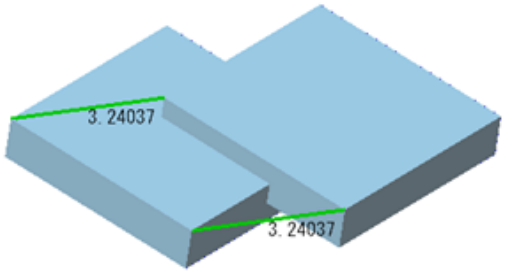
Property

The following features related to the shape of the mesh are displayed.

- Surface area, Volume
- Center of gravity
- Size(Length of the range where the mesh exists in each coordinate axis direction)
- Number of shells
- Number of shell boundaries
- Average / Maximum / Minimum edge length

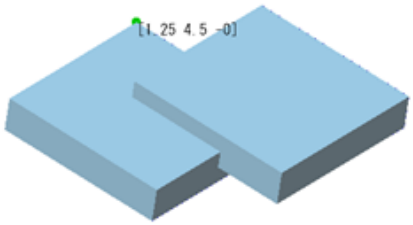
Distance

Measure the distance between the two vertices.



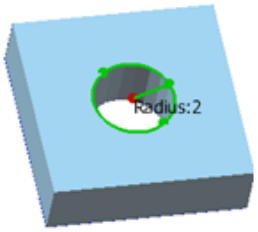
Coordinates

The coordinate value of the specified vertex is displayed.



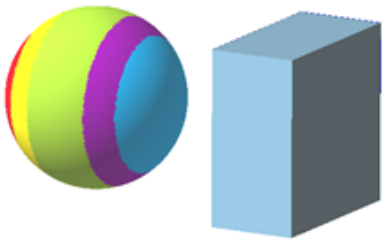
Circle radius

Calculate the radius, diameter, and center coordinate values of the circle passing through three vertices.



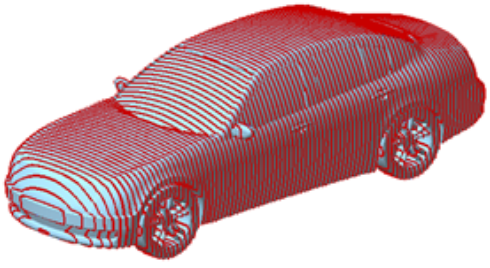
Distance Contour

The distance between two figures (between shells / before and after processing / polygon data in the external file and mesh) is painted with a color according to the distance for each face.



Display Section Lines

Display intersections between the mesh and planes.



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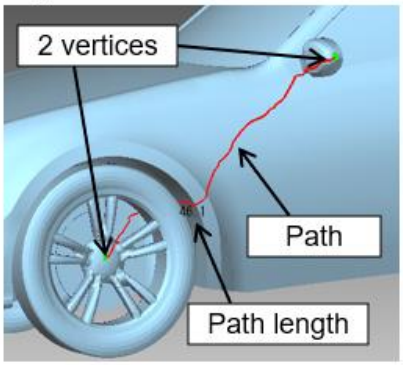
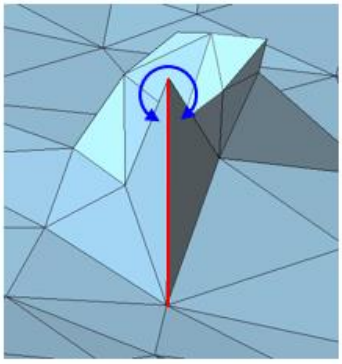
Find Path

Display the shortest path (edge string) that connects two vertices by following an edge.



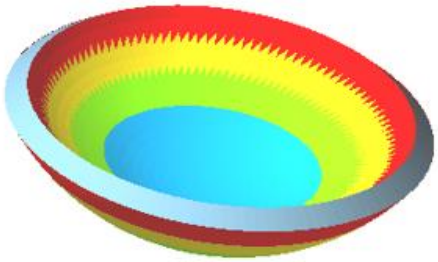
Crease Detection

Detect edges that are bent more than the specified angle.



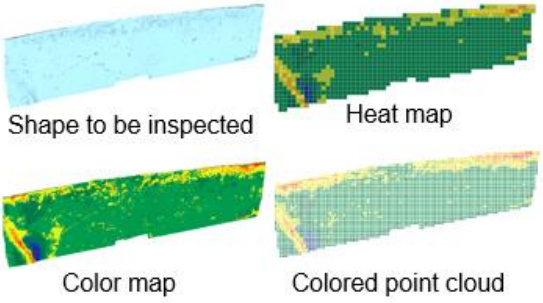
Thickness Inspection

The color map of the mesh thickness is displayed.



Unevenness Test

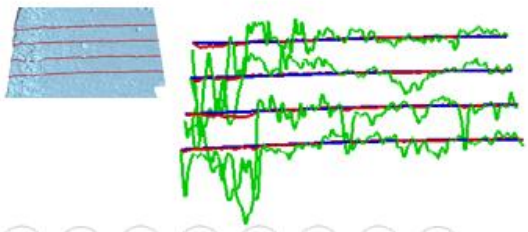
The fine irregularities that occur in the mesh and point cloud are displayed in a color distribution (color map, heat map, colored point cloud).



Display Enlarged Section Lines

Shows the difference in cross-section between an uneven mesh and a smooth shape close to that mesh.

Red: Cross-section line of uneven mesh
Blue: Cross-section line of smooth shape
Green: Line that enlarges the difference



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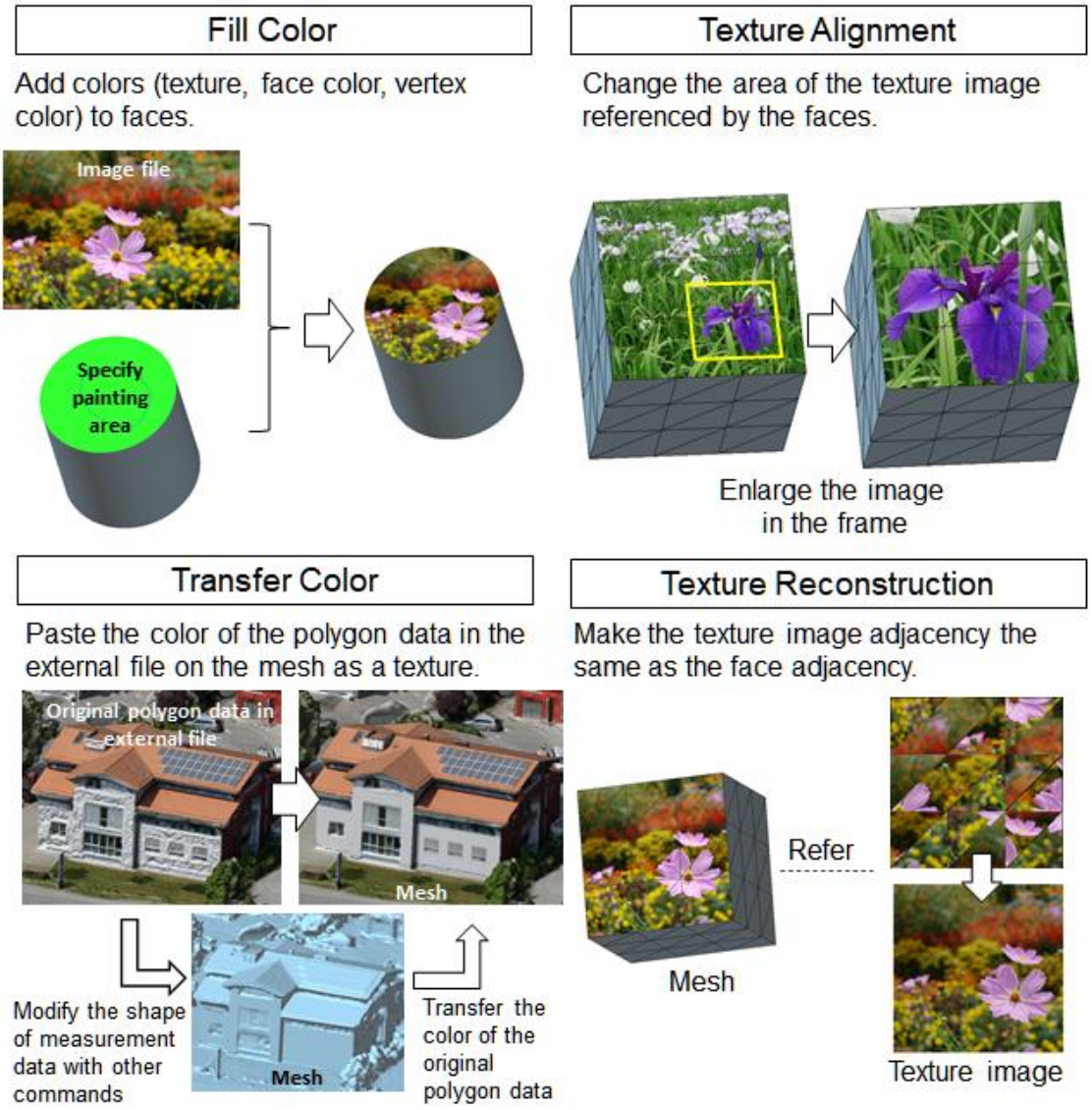
5.5 Colors

The tab “Colors” includes commands for coloring meshes and editing the colors.

In addition, there is a command to divide into segments (faces with the same face color) and edit them.

See the ‘2.3 Color Terms’ about colors.



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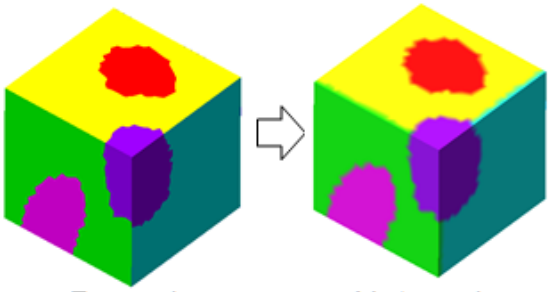
Convert to Vertex Color

Change the "texture" or "face color" on the mesh to "vertex color".

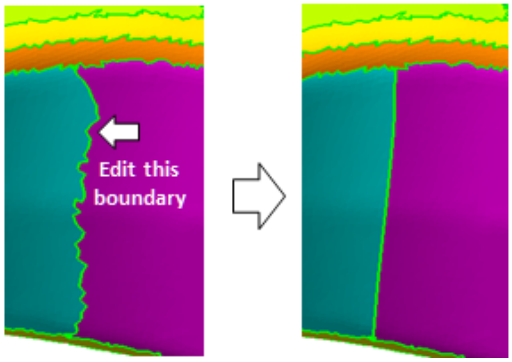


Segmentation

Divide the mesh into multiple color-coded areas based on shape feature.

Edit Segment Boundary

Merge segments divided by "Segmentation" command.
And smooth segment boundaries.



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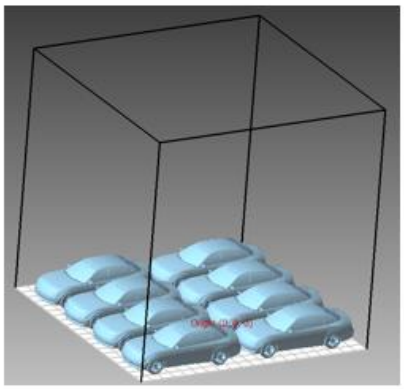
5.6 3D Print

The tab “3D Print” includes commands to aid in preparatory work for molding with a 3D printer.

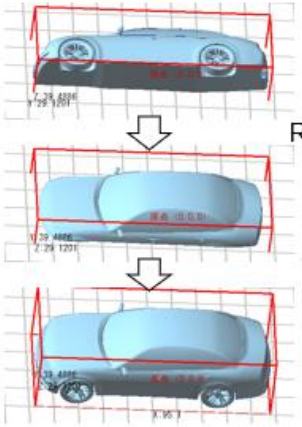
Display Forming Table

This function displays the forming table of the 3D printer in the figure display area.



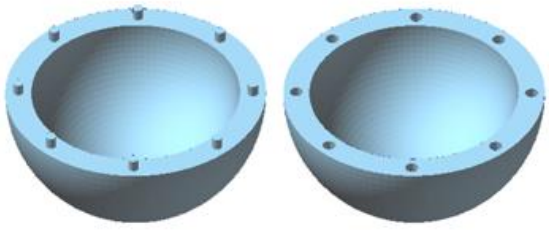
Forming Arrangement

Arrange the mesh or shell on the forming table with a simple operation.



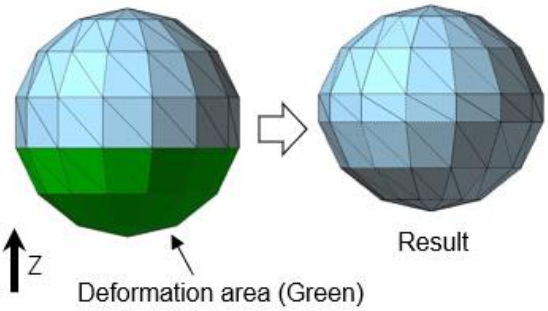
Pinned Cut

Cut the mesh, and add protrusions and holes to the cut surface.(For assembling 3D printed objects)



Z Correction

Move the face group whose front direction is Z-minus (the Z component of the front normal vector is minus) by the specified amount in the Z-plus direction.



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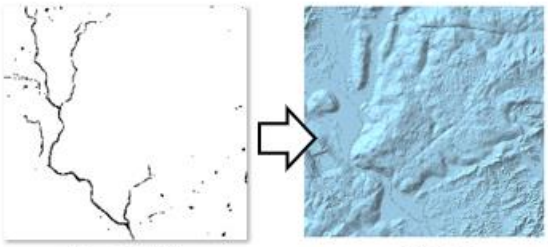
5.7 Geography

The tab “Geography” includes commands to create a mesh from terrain and geographic data, and to evaluate the mesh, and to display GPS trajectory.

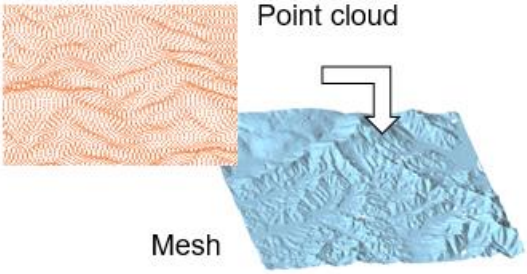
Terrain Meshing

Read the Geographic Information (GeoTIFF) file and create a mesh that reflects the written geographic information.



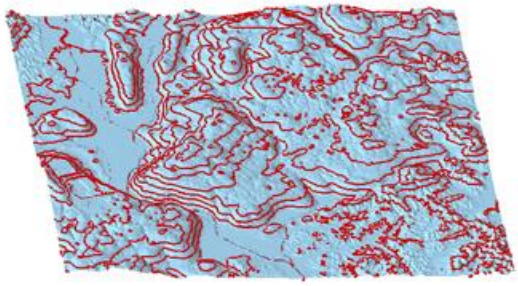
Create Grid Mesh

Read a point cloud file and create a mesh in which the vertices are arranged in a grid pattern when viewed from the Z direction.



Display Contour Lines

Display contour lines.

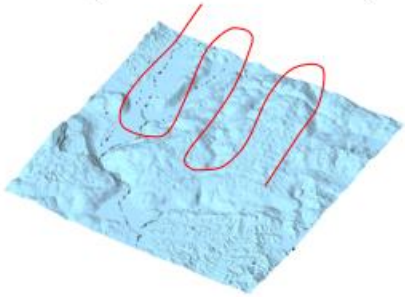


Soil / Space Volume

Displays the amount of soil volume or space volume (volume required to fill the soil) in the specified area.

GPS Track Log Display

Reads the GPS trajectory information file such as the drone trajectory and displays it as a line sequence or point sequence in the specified geodetic coordinate system.



Dekigata Heat Map

The height difference between a specified area and point cloud or polygon data of an external file is displayed as a heat map.

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5.8 Relief

The “Relief” tab includes commands capable of creating meshes out of images, and creating patterns on meshes through the use of images, letters and hand-written lines.

Relief

Create an uneven mesh based on the color of the image.

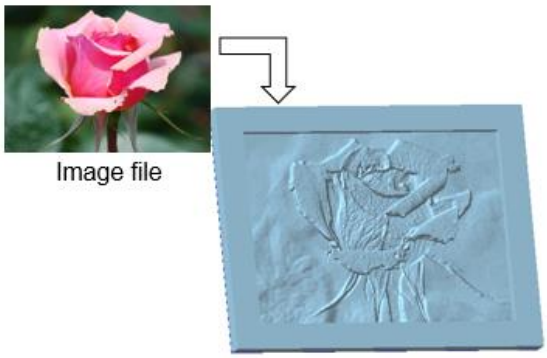
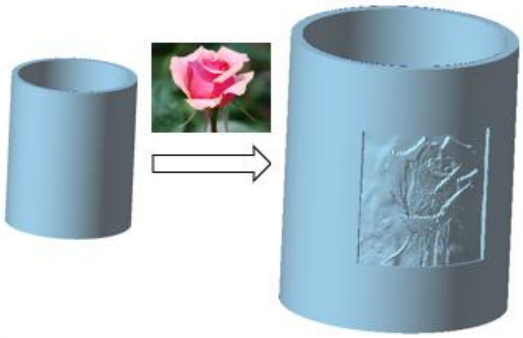


Image file

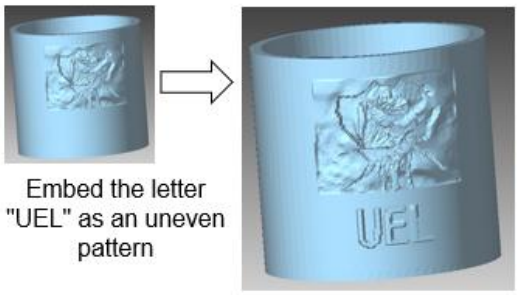
Embed Relief

Add an image to the mesh as an uneven pattern.



Stamp

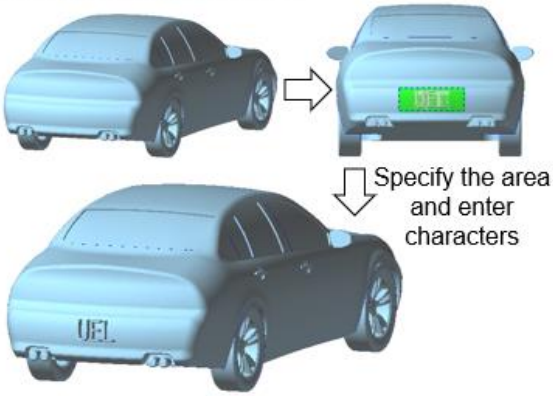
Add a pattern to the mesh with the characters and handwritten lines to enter.



Embed the letter "UEL" as an uneven pattern

Letters Relief

Adds an uneven pattern of input characters to the mesh.



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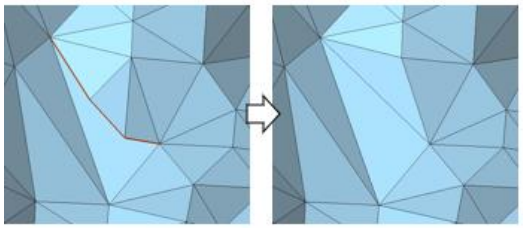
5.9 Beta Version

The tab “Beta Version” includes test-version commands for reference.

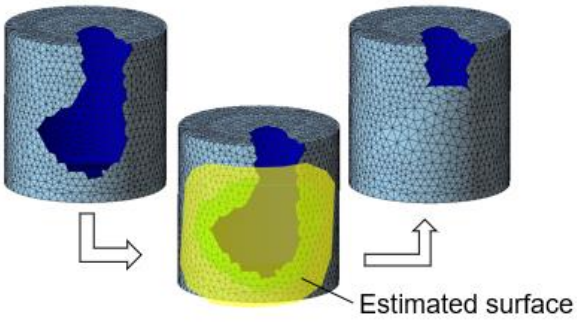
Creased Faces Removal

The edges where the faces on both sides are bended beyond the specified angle are detected, and the parts that can be corrected are deformed to eliminate the crease state.



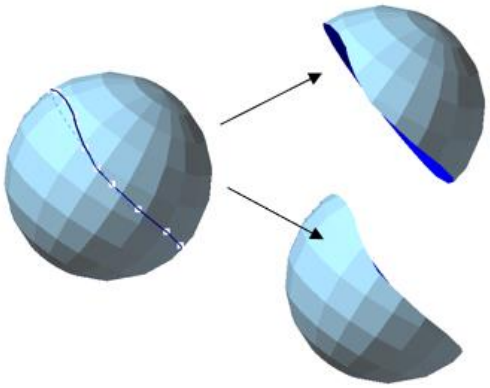
Fill Region

Estimate a surface that passes through the peripheral shape of the hole and create faces that fills the hole so that it rides on the surface.



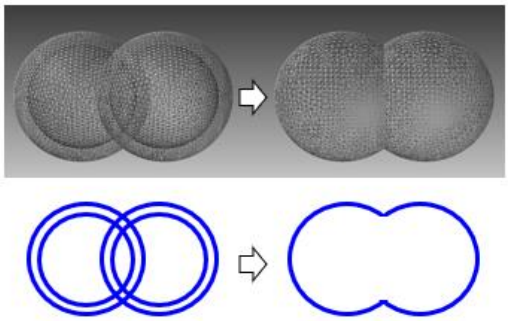
Loop Trim

Divide the mesh by the drawn closed line.



Wrapping

Create a new mesh using only the outside of the mesh.



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5.10 Help

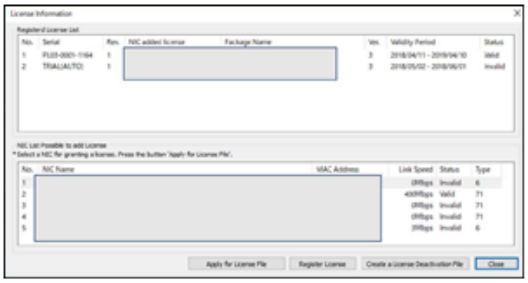
The Help tab has commands for linking to the POLYGONALmeister website, browsing manuals, and managing licenses.

Website

Show the POLYGONALmeister webpage. The Japanese web page will be displayed, so switch to English with the button at the top right of the screen.

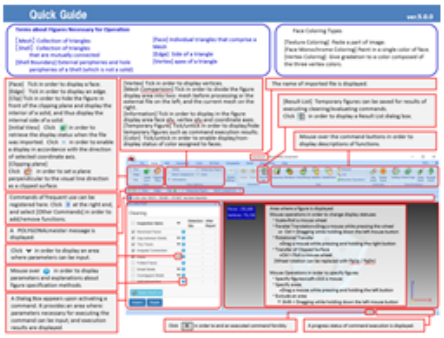
License

Register the POLYGONALmeister license.



Quick Guide

Show the minimum information required to operate POLYGONALmeister.



Manual

Show the operation manual for POLYGONALmeister.

License Guide

Show the POLYGONALmeister license guide.

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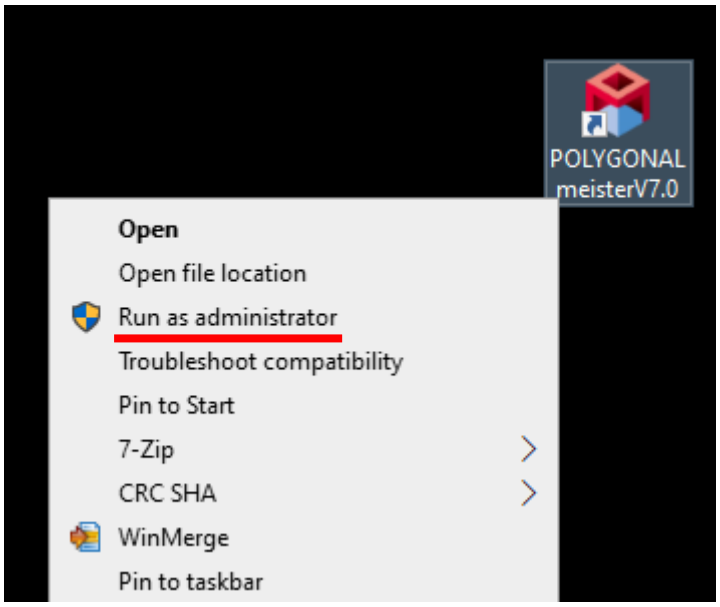
6 Precautions for operation

- Operation

<Notes on the first startup of “CAD Surface Export”>

Depending on your PC environment, the message "The file could not exported." May appear when you use the " CAD Surface Export " command for the first time. In that case, right-click the POLYGONALmeister icon and select "Run as administrator". From the second time onward, you do not need to do this operation.



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7 Settings

7.1 System Requirements

See below the necessary environment where POLYGONALmeister can operate.

	Minimum Operational Specifications	Recommended Specifications
CPU	Core i5 or higher	Core i7 or higher（Xeon of 4 physical cores or more is recommended）
Memory	4GB or higher	16GB or higher
Free Space on Drive	1GB or higher	2GB or higher
Video Memory	512KB or higher	1GB or higher
Video Card	Intel Iris or higher	NVIDIA Quadro / GeForce
Supported OS	Windows 8.1（64-bit） Windows 10（64-bit）	
Display Resolution	1280 × 800 or higher TrueColor（32bit）	
Others	Internet Explorer 11 or higher, OpenGL 3.3 or higher	

7.2 PC Settings Capable of Handling Polygons in Quantity

Try the measures below if POLYGONALmeister cannot process a large quantity of polygons.

1) Add memory to PC

If your PC can accept additional memory, install the memory in order to enable it to process a larger quantity of polygons more effectively.

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2) Create page file on SSD

If an SSD has been installed in your PC, create a page file (swapping area) on the SSD in order to process a larger quantity of polygons without compromising speed.

3) Create page file on HDD

If an SSD has not been installed in your PC, create a page file on HDD in order to enable your PC to prioritize processing quantity over processing speed.

[Operating procedure on Windows 7, Windows 10]

a) Select 'System' from 'Control Panel'.

b) Select 'Advanced System Settings' in the lest menu.

c) Select 'Settings' of the 'Performance' section of the 'Advanced Settings' tab.

d) Select 'Change' of the 'Virtual Memory' section of the tab 'Advanced'.

e) Untick 'Automatically manage paging file size for all drives (A)' if it has been ticked.

Select the fastest SSD or HDD in the 'Paging file size for each drive' table.

Select 'Custom size'. Set 'Initial size' and 'Maximum size' to appropriate values. Click the button [Set], and click the button [OK].

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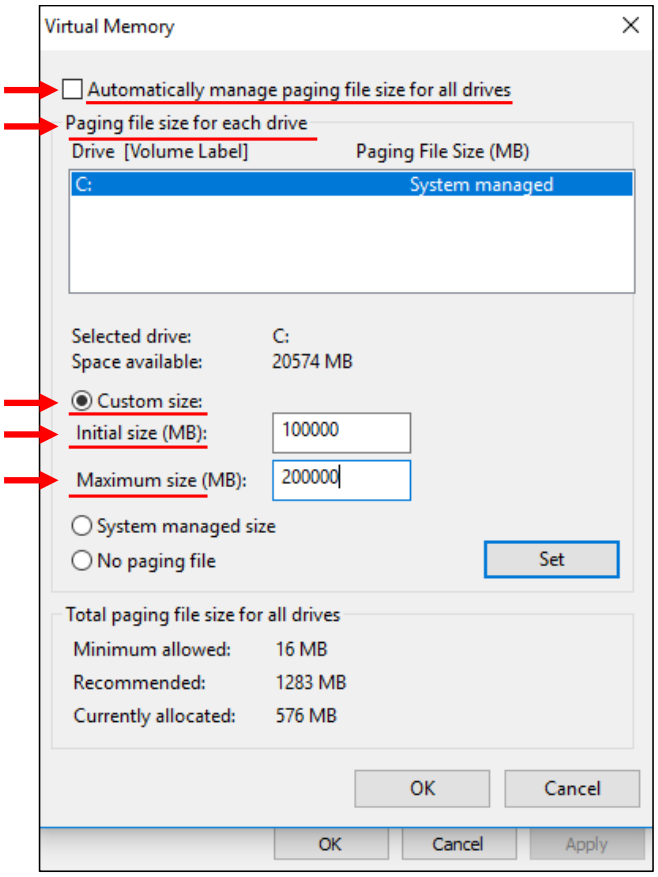

f) Click "OK" button and restart Windows.

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8 Limitations

If the following conditions are met, POLYGONALmeister may terminate abnormally.

■ Conditions

- If "Intel® Optane Pinning Explorer Extensions" is installed on your PC, POLYGONALmeister may terminate abnormally by operating in the following order.

  1. Execute the command to display the temporary figure.
  2. Perform an operation to display the file selection / save dialog.

- If your PC uses an NVIDIA graphics board, POLYGONALmeister may terminate abnormally by performing one of the following operations.

  - Execute the “Display Enlarged Section Lines”.
  - Perform “Display Section Lines”.
  - Perform “Display Contour Lines”.

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