PLANMECA

Planmeca PlanScan™ Lab

user's manual

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1 INTRODUCTION

The Planmeca PlanScan Lab application is intended for the creation and editing of a range of images obtained with the Planmeca PlanScan Lab scanners. The application has been designed to allow the following operations:

1. 3D optical scanning: the generation of the range images of the object's portion that is framed by the scanner;

2. Alignment of the range images: the group of functions that allows to integrate the scanning of different objects, or portions of objects, in order to place them accurately compared to each other;

3. Cleaning the range images: tools that allow to delete the undesired scattered points that can be present in the range images;

4. Generation of triangle mesh: the group of procedures and algorithms that can transform the range images into a triangle mesh;

5. Editing the meshes: tools for the elaboration of the mesh of triangles; for example smoothing, deleting peaks etc.

2 INTERFACE

The application consists of a menu bar divided by subject area, a toolbar for the main operations and a toolbar on the far right for the refinement and processing operations of the acquired data.

The rest of the screen is divided into two panels for management and display of the data.
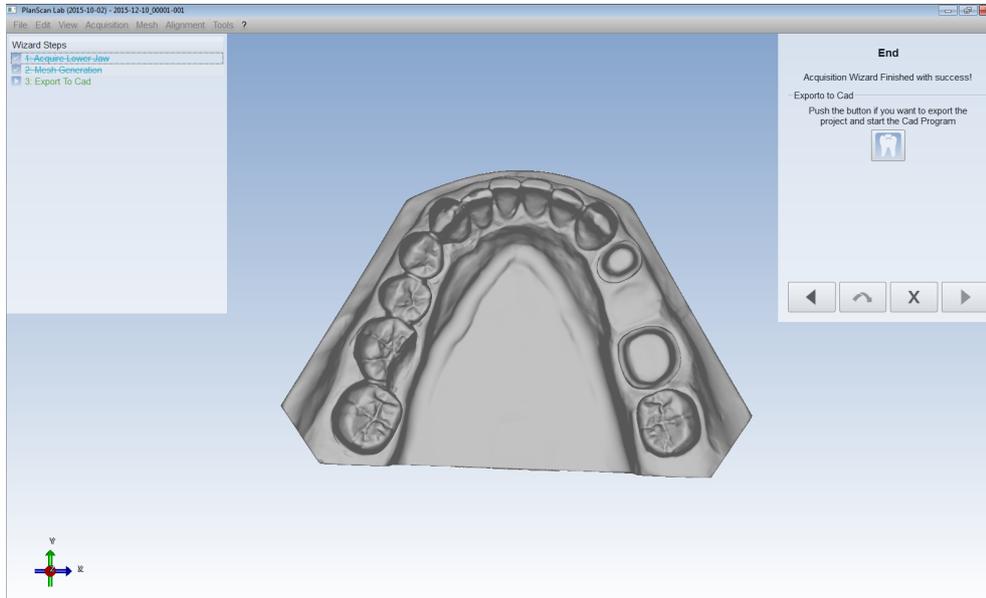
- The 3D View is intended for observing and orienting the range images and the mesh of triangles in 3D selected in the beside box
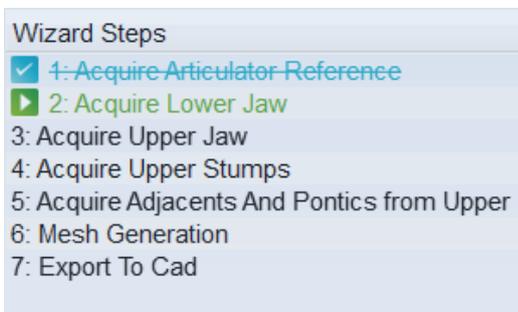
The Project box management panel of the current scanning project contains all of the acquired and modified data; each time an entry is selected, it will be displayed in the adjacent 3D View panel. Thanks to this box, it is possible to carry out the project management main operations, among which loading and saving the range images and the meshes.

Using the F11 key, the software will take up 100% of the screen, also covering the operating system bar.

The project panel may appear empty if the system has been started without using Planmeca PlanManager or it will appear organized as in the picture if the clinical features of the project have been defined in PlanManager.

The coloured squares displayed are used to intuitively show the condition of each project element. If an element has not been acquired yet, the square is gray; light blue means that the element is still in the form of a point cloud, while green means that it has already been converted to a mesh.

NOTE

In case of guided procedure, the software automatically converts the shapes acquired into triangle meshes, in order to prepare all the necessary data for modelling.

For this reason, only the elements strictly necessary to move to the CAD software are transformed into mesh.

2.1 3D view and interactions

The user can interact with the orientation of the image through either the use of the mouse or more specific tools that can be selected in the "View" entry of the Menu bar.

Moreover, to improve the view the user is provided a few mouse/keyboard combinations:

- free rotation: mouse wheel
- free shift; Alt key + right mouse button
- rotation restricted to the Y axis; Ctrl key + mouse wheel
- rotation restricted to the X axis; Alt key + mouse wheel
- rotation restricted to the Z axis; Shift key + mouse wheel
- rotation : scales the area of the currently framed data;
- accesses the menu relative to the type of selected data;
- changes the position of the light source in the image;
- if a selection tool is activated, it allows to select part of the data, it can also be used with some entries of the toolbar;
- if a selection tool is activated, it allows to deselect parts of previously selected data.
- Number from 1 to 7 rotates the 3D view to a default position

Some of the above described interactions can also be activated through some toolbar entries. The application automatically assigns a rotational centre in the barycenter of the selected object. Activating the **Center rotation by view** button, the center of rotation will be placed in the bary centre of the currently displayed data.

In the top left corner, it is possible to activate (*View* Menu > View data window) a box that supplies information about the current view, such as the number of points of the displayed object, the number of selected points and the dimension of the containment polygon of the data itself. Were this box difficult to read due to overlapping with the displayed data, the user could double click with the mouse on it's surface to invert its colours, thus improving the display.

In case of implant projects, it is possible to view or hide the aligned markers and the implant connections once they have been introduced into the project, which means they have to be identified and aligned first. The tools specific to this actions can be found in the view menu or in the purple toolbar.

3 SIMPLE TOOLBAR

The simple interface contains a single toolbar to manage the use of the optical scanner allowing access to all the basic features. In particular in the structured project, by selecting an element of the project this bar will adapt showing any additional options relative to that particular type of selected object.

Some functions are always present and they are, from the left to the right:

- acquisition
- alignment between mesh or acquisitions
- conversion of the acquisition to mesh
- export to PlanCAD Premium
- project menu (last element on the right)

Features specific to types of selected elements will be displayed when selected, between the export to CAD icon and the project menu. For instance this image displays the possibility to integrate the acquisition that has been selected in the project tree.
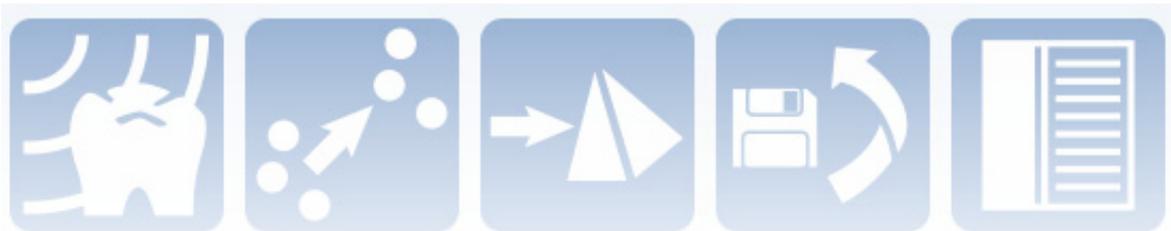
Acquisition

In the structured project, the scanning strategy is established by default depending on the object selected in the project tree on the left. On the other hand, in case of a free project, the dialogue will appear on the top right corner of the screen. The user has to select the best strategy to scan the selected object and, if necessary, also defining the colour of the object.

Alignment

Start alignment as described in section 5.1 "Alignment" on page 10. In the structured project, the function is active even by selecting an individual element, while in a free project at least 2 elements must be selected.

Mesh generation
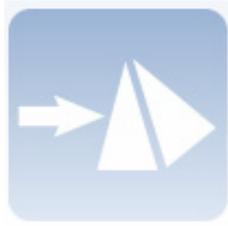
Converts the selected data into a triangular mesh. In the structured project, the software will automatically apply the best strategy, while in a free project a dialogue will be displayed for the selection of the desired strategy.

Integration

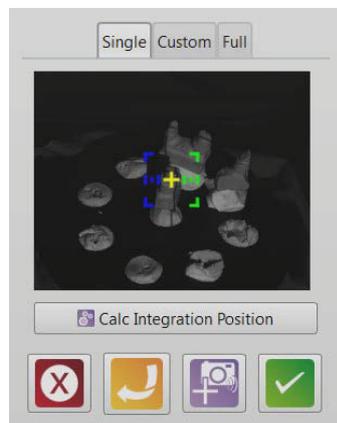Allows to integrate the selected acquisition with others.

In the Single mode it is possible to integrate the acquisition with a single view. The object inside the scanner moves according to the position of the 3D navigator. The user can check the actual position through the live view.

If the model has been moved from its original position or if the alignment is not correct it is possible to recalculate the position of the object by clicking the button Calc Integration position.

CAD software export

When working with a project defined in PlanManager, exporting is very user friendly: by clicking on this button, the PlanCAD Premium will be automatically launched; all of the elements will already be loaded and ready for modelling.

If starting with a free project, export can be managed as described in Chapter 6.

Project management

This command opens a context menu that provides all the features available to interact with the structure of the project. In addition to the standard functions (save, close, create etc.) a very useful option is provided allowing to modify the existing project by directly accessing the initial order sheet.

NOTE
Modifying the structure of a project also makes the guided acquisition sequence inconsistent: the wizard must therefore be rebooted every time such an operation is performed.

4 STARTING SCAN PROJECT FROM PLANMECA PLANMANAGER

When the Planmeca PlanScan Lab software is launched from Planmeca PlanManager the following screen appears.
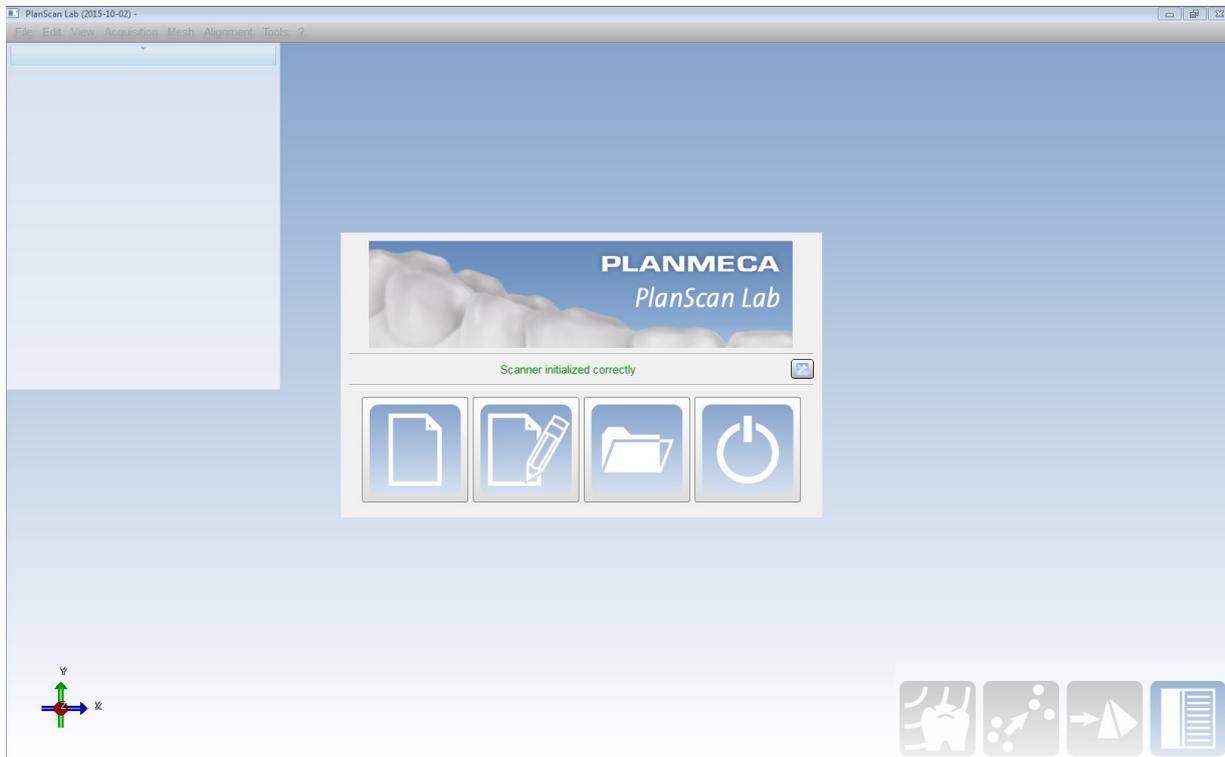
In the middle part of the dialogue there is a diagnostic message; if the scanner is correctly configured this will be green, otherwise if any error would occur it will be red with a description of the errors found. Most of these messages are self-explanatory and allow the users to solve the malfunction by themselves.

The user can decide whether to start the project previously defined in Planmeca PlanManager or to shut-down the software. If the user decides to start the project it is possible, where needed, to modify some advanced parameters:

- Unsectioned Model: if the model to be scanned is unsectioned;

Once the project is loaded, the user can start to scan models aided by a Wizard

4.1 Direct launch

When the Planmeca PlanScan Lab program is launched directly an initial screen with the following options are given in the part immediately below, which the user can select to continue his job, respectively:

•   New free project. The software will operate freely and the user can select the types of acquisitions to perform and when to perform them. The project will appear completely empty and will be populated by the elements as they are scanned; there will be no relationship between the elements and they will all be on the same level. As initial setting, the software will propose a particular folder, but this can be changed by the user at will.

•   Creation of a guided project. In this case, based on the license of the software, it will be possible to define the type of project that is to be performed. In this case, once the type of job has been selected and defined, a structured project, compliant with the filled form, will be created within the software (see Glossary).

•   Load existing project. The software will show a navigation window through which the user can select a project previously created and saved by the software on the PC.

•   Close software. Closes the instance without creating any data on the PC.

4.1.1 Setting up structured project

The scanning software can also be lauched directly from Planmeca PlanManager. In this case, by defining the clinical situation in the odontogram of the Planmeca PlanManager, the software can read the type of clinical situation and prepare the consequent scanning strategy.
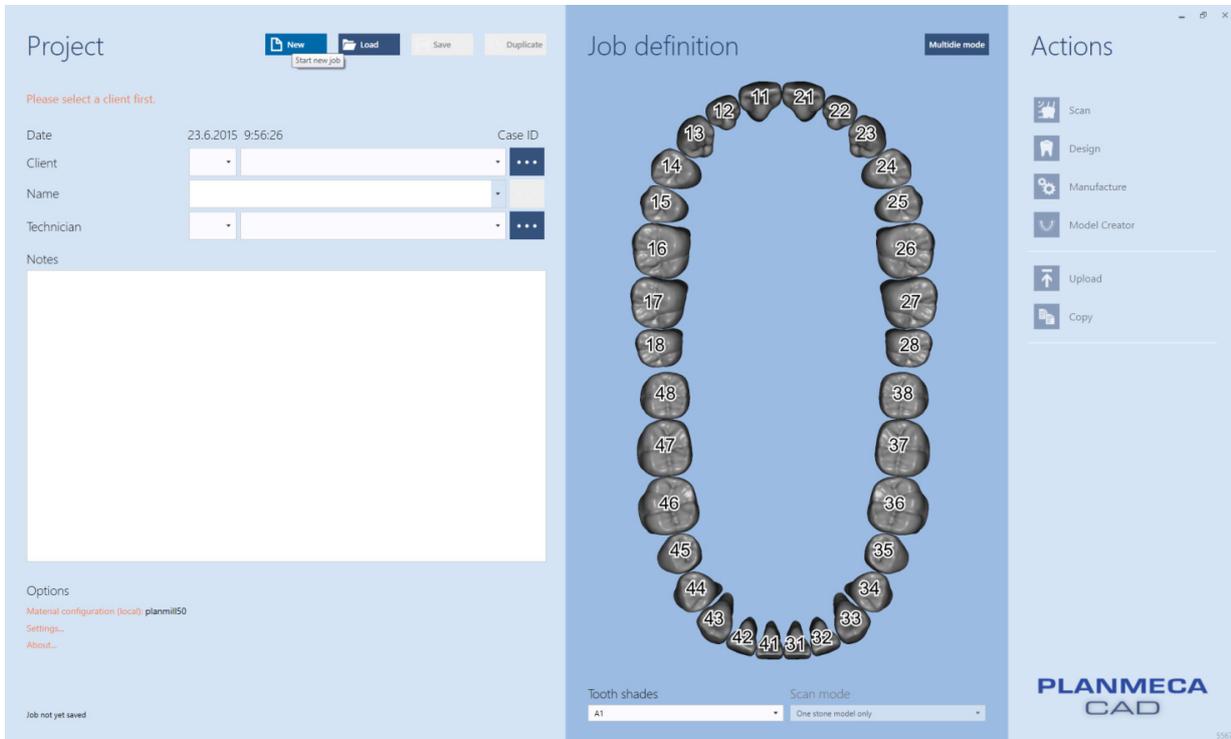
4.2 Working with a defined project

Once the project has been defined, the software will start a different guided procedure case by case and will guide the user in the acquisitions necessary to complete the job.

It will be possible to modify some project features at any time in order to recover any initial errors or oversights; to do this, just enter the File menu and select the modify dental project header characterized by the icon in the Image.

The start odontogram will be shown, which can be updated as required.

NOTE

Modifying a project once the job has started could take the software into a conflictual state: for example, eliminating an element that has already been acquired and that now no longer has a place in the job to be performed. For this reason we recommend the user checks that he has filled-in the job sheet correctly before starting the job.

If you do not wish to follow the guided procedure it can be closed at any time and you can make use of all of the features linked to a structured project. Whenever the software with simple interface is used, the simple bar at the bottom right will adapt to the selection in current project. For example, if a stump is selected and the scan is launched from the simple bar, the software will automatically follow the acquisition strategy defined for that type of element.

5 FREE PROJECT

When starting a free project the tree view of the screen is empty.

As the project is still empty, it is only possible to start an acquisition and a project.

By clicking the Acquisition button the following window appears.

Enter a name for the acquisition.

Select the type of acquisition from the first drop-down menu.

Select the colour of the plaster that may either be the default value or go from very light to very dark; this will improve the rendering of the model

The alignment tool is activated if two or more elements of the same type are selected in the project tree, i.e. all acquisitions or all triangle meshes.

Once this tool has been selected, the pop-up will appear. right. As it is a non-structured project, the software requires specification of which element must be considered fixed and which mobile: only one fixed element can be selected.

By clicking **OK**, the software will perform an automatic alignment by looking for common points between selected elements. If the alignment is successful, the elements will be moved to correct position.

If the automatic alignment is not successful you need to frame the two objects from the same point of view and select one common point on both objects or, select 3 points.
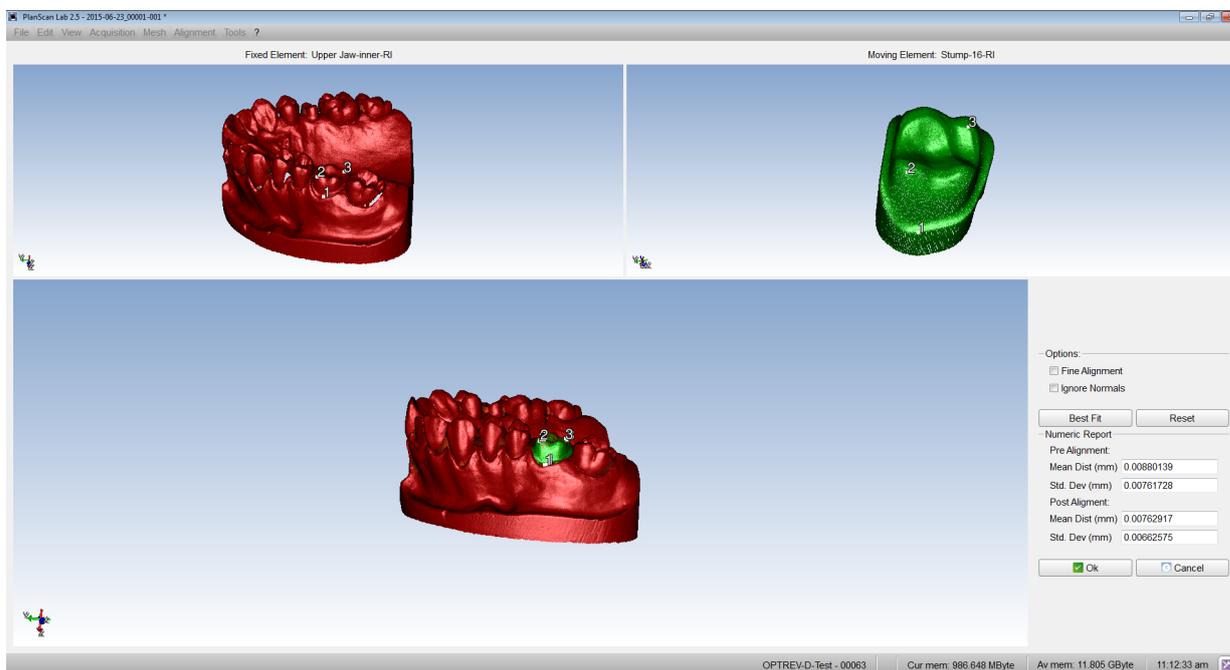

NOTE

Automatic alignment makes use of the shape the two selected elements have in common. If the two elements do not have parts in common or these parts are insufficient, user intervention will be requested. We therefore recommend to check that the selected elements have a sufficient common surface.

6 GUIDED PROJECT

A structured project can be defined both initializing from the options envisioned by the software and from Planmeca PlanManager. In both cases, the software will load a structured project, i.e. a tree project, in which the elements are already defined and present. As default setting, a Project wizard dialogue will also open. You can either follow the dialogue's instructions or close it and complete the job manually.

If you decide to use th dialogue a macro-operations list is shown on the left. During the procedure, the current operation will be highlighted. Otherwise, if you decide to proceed freely, it is shown in the project tree on the left.
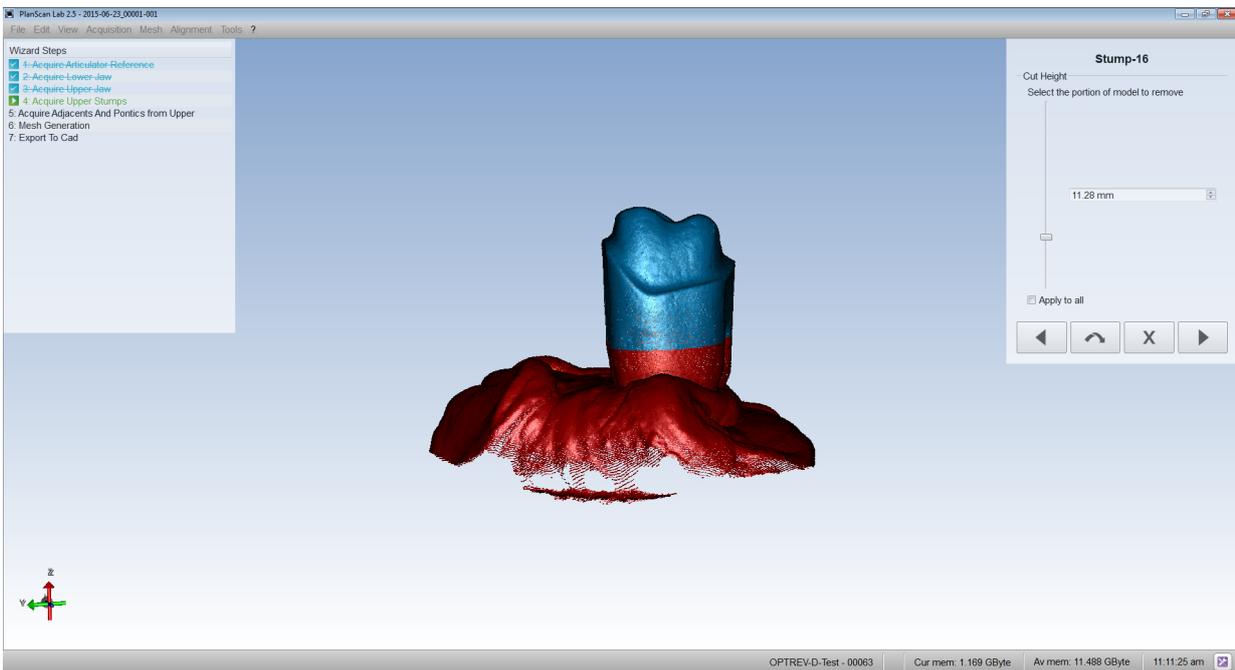
To reactivate the wizard after closing, on the *File* menu select Start > Acquisition Wizard menu. The wizard will start from the beginning.

6.1 Without wizard
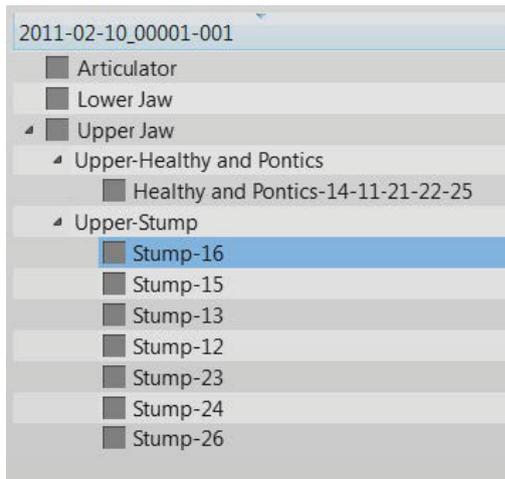
Once the wizard has been closed, the project structure appears on the left: this project could also be empty or partially completed

Select the element to be acquired from the list to proceed with the acquisitions, introduce it into the scanner and start scanning using the first button in the Simple tool bar. The software will automatically apply the best strategy for that particular type of selected object.

The elements acquired according to this procedure obviously will not be aligned with each other as they may have been acquired randomly. However, by selecting an element, the alignment tool is activated in the simple bar and the element selected can be aligned with its "parent" i.e. with the element to which it belongs. For example, if the user wants to align the element *Stump 16* to its reference jaw, the upper jaw here, he just has to press the alignment button in the simple toolbar. The software will automatically detect the upper jaw as reference and it will start the alignment procedure.

Whenever the upper object is not yet present, alignment will not take place. In the same way, the conversion to mesh format must be performed individually by selecting one or more elements and consequently the tool in the bar: the software will apply different strategies for different elements. The last passage is export of the job to the CAD, described in section 7 "DATA EXPORT" on page 20.

NOTE
With a structured project it is not necessary to select 2 objects for alignment: only the individual element must be selected which will be automatically related to the object to which it belongs.

6.2 Using the wizard
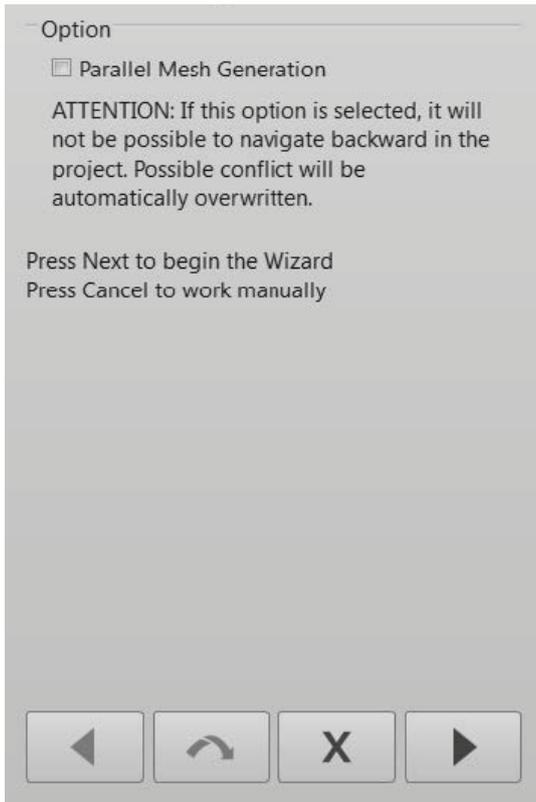
The first screen shown by the dialogue allows to choose whether to continue with the guided procedure or close it.

Optionally, it is possible to continue by starting the generation mode of the parallel mesh. In this mode, once an element has been acquired and correctly aligned with the others, the software converts it directly to mesh data, leaving the operator free to continue scanning.

As for its use, this mode is absolutely clear but allows to spread the heavy computational process of mesh generation during the entire elaboration, thus saving time.

In this case however, it will not be possible to navigate forwards and backwards between the wizard steps as there may be a conflict among the data: the sequence of operations requested is therefore binding.

We will now examine the different elements that will be displayed by the wizard during the acquisition sequence. On the basis of the defined project, these steps can be proposed in a different order; we will therefore examine them individually and independently.

All of the steps shown by the dialogue have the same sequence of commands in the lower part:

- Skip: passes the current step (could lead to conflict due to lack of data)
- Prev: goes back to previous step
- Next: goes to next step (it is enabled once the operation requested at that determined step has been concluded)
- Close: closes the dialogue sequence and allows to continue as described in section 6.1 "Without wizard" on page 13.

The parallel generation of the mesh makes the job quicker but the sequence off the dialogue is binding.

Acquisition
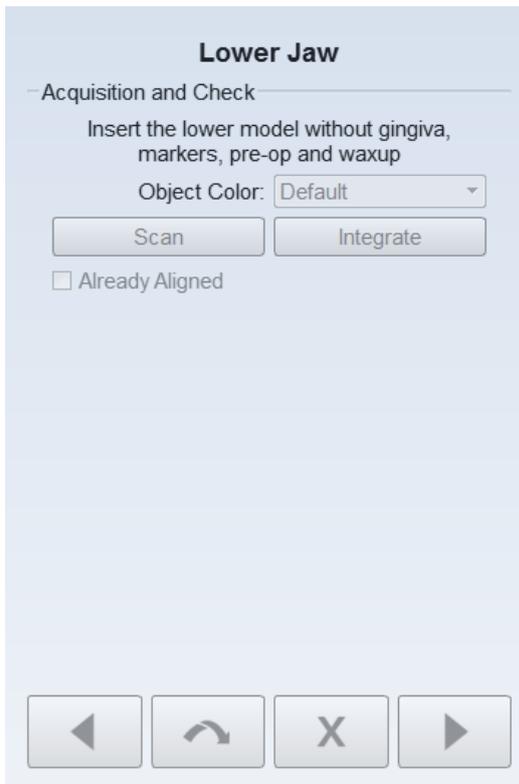
The user is asked to insert the defined element. Moreover, it is provided a small explanation on how to prepare the model to be scanned.

The user is requested to define the colour of the model in order to improve the result of the acquisition; in 90% of cases, an intermediate colour corresponds to the normal laboratory plaster, even if it is light blue or green. The dark element can be used when the material is clearly darker than normal.

Once an acquisition has been performed, the **Integrate** button is activated, it is however possible to rescan the model overwriting the current acquisition.

We recommend that all parts of the screen displayed are read carefully: they are normally self-explanatory and describe what to insert into the scanner in detail.
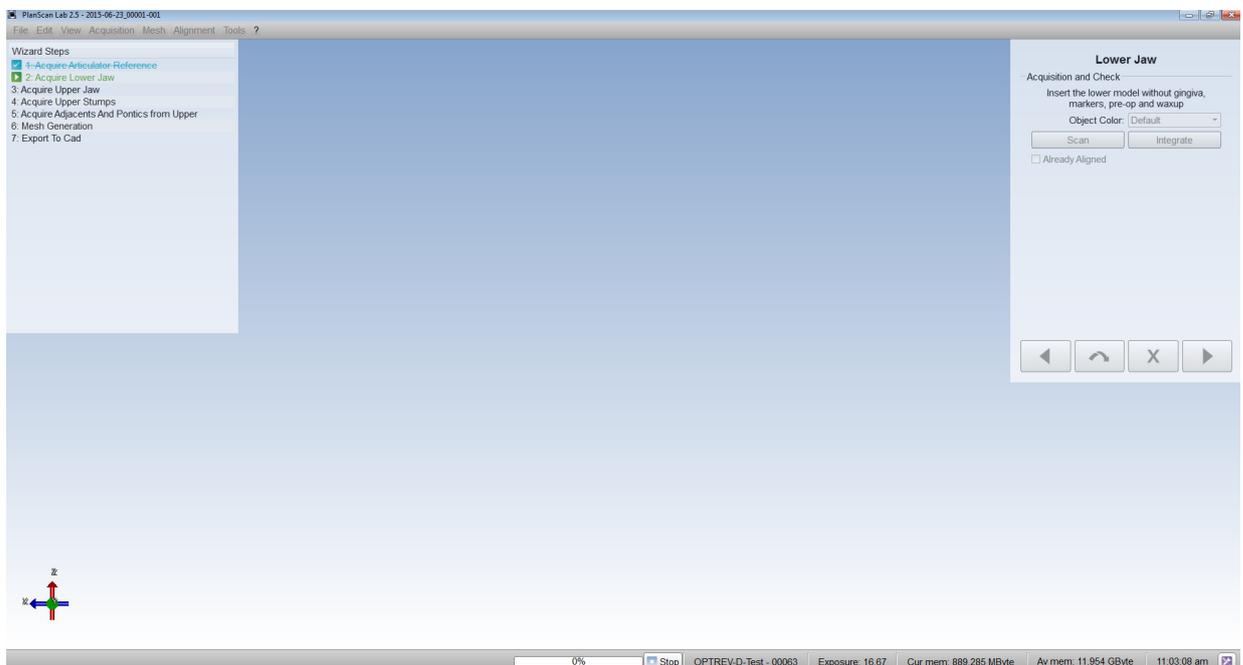
Cut

This step allows to eliminate the base of the acquisition with an horizontal cut.

By moving the cursor in the Image, a larger or smaller portion of the object will be selected and it will be highlighted in the 3D display panel.

The tick just below the cursor allows to apply the same cut level to all elements of the same type during the successive steps. This is particularly useful if the upper and lower models are mounted on the same type of support and therefore with the same portion to be eliminated.
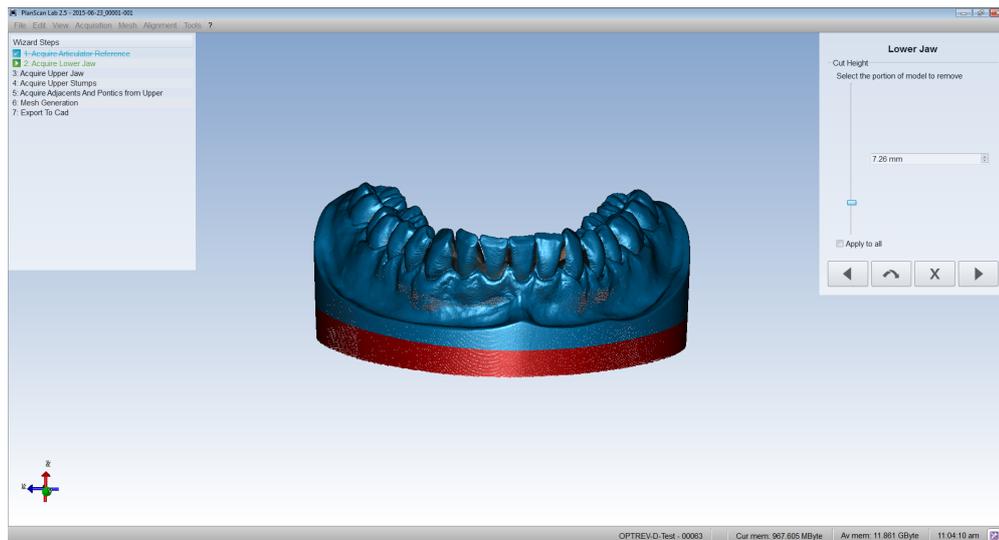
Manual cut

This panel allows to manually clean the models that are shown in the 3D display panel.

All of the selection tools described in section 8.1 "Project management" on page 21 are activated and in the first part it is possible to interact with the selection made by inverting it, deselecting all, deleting the portion selected or, lastly, maintaining only the selected part.
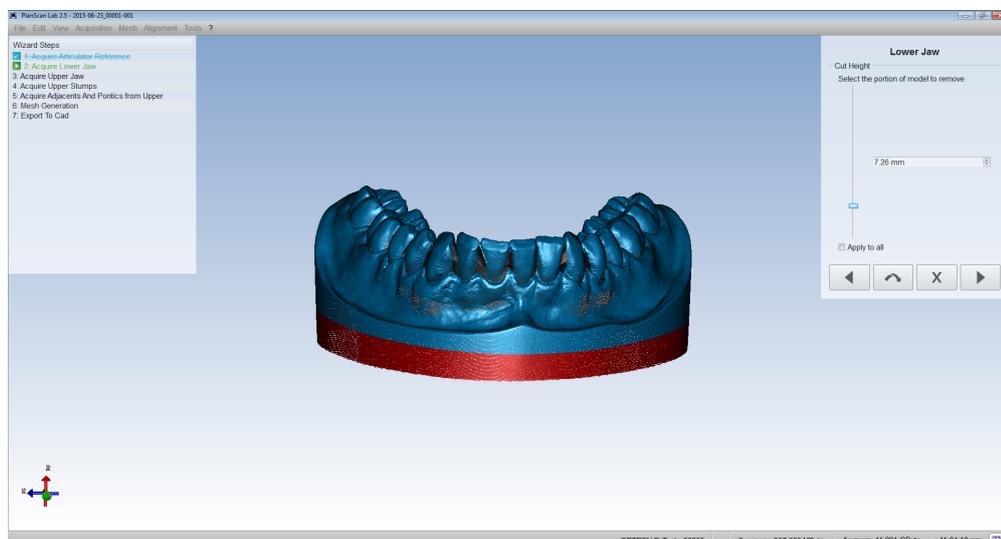
Acquiring single elements

This screen shows the individual elements specified in the project in a variable list. These can be stumps and scan bodies for the detection of implant positions.
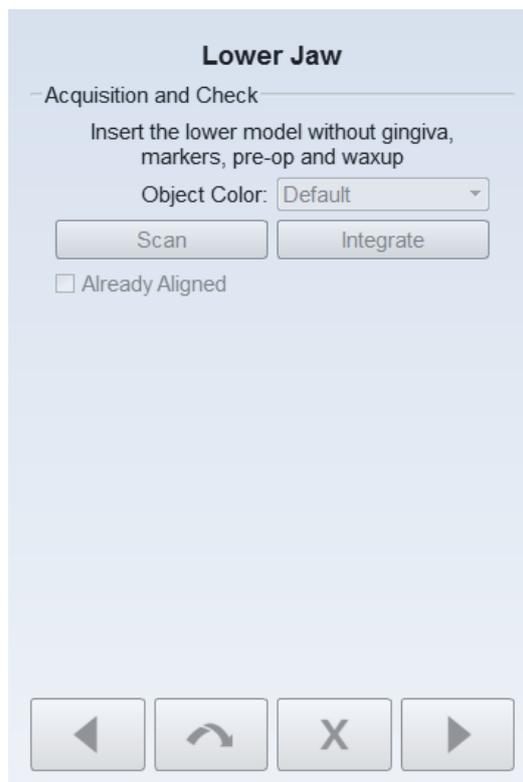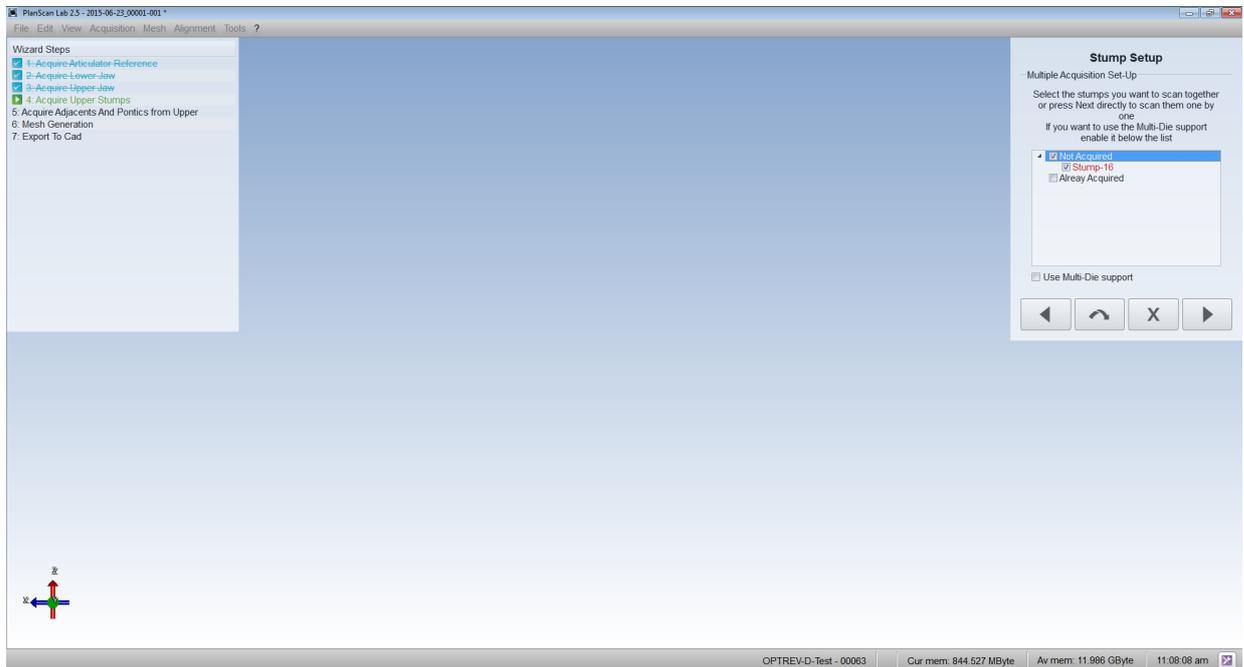

You can select among the ones available, the elements to insert; in the case of stumps they must be removed from the original model and inserted simultaneously while maintaining a distance between them to allow every detail to be acquired. In a case of only 7 elements stumps can be inserted simultaneously on the model holder. It is always possible to insert just a part, tick the relative elements in the list and proceed with scanning. The software will successively request the user to scan the missing elements.

As for implant scan bodies, they need to be mounted directly on the model selecting the ones that are to be scanned; if possible we suggest mounting as many as possible simultaneously, remembering to check the position so that each scan body scan is as detailed as possible.

Stump Setup

Multiple Acquisition Set-Up

Select the stumps you want to scan together
or press Next directly to scan them one by
one
If you want to use the Multi-Die support
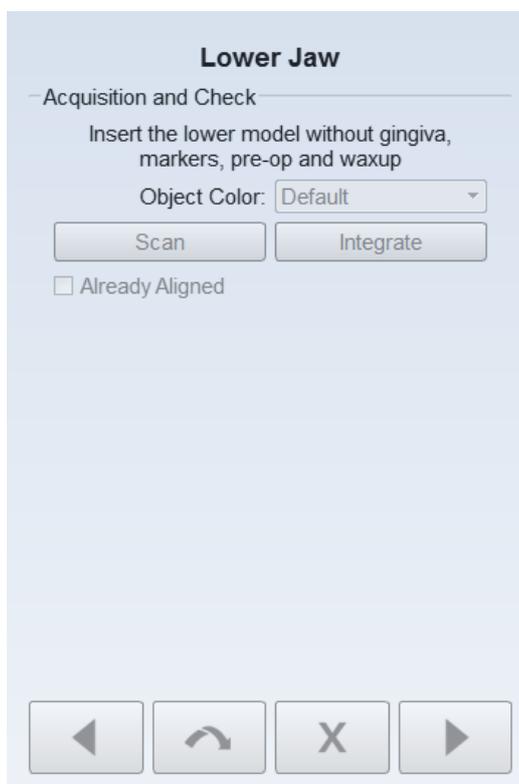enable it below the list

- ☑ Not Acquired
  - ☑ Stump-16
- ☐ Alreay Acquired

☐ Use Multi-Die support

◀ ↷ ✕ ▶
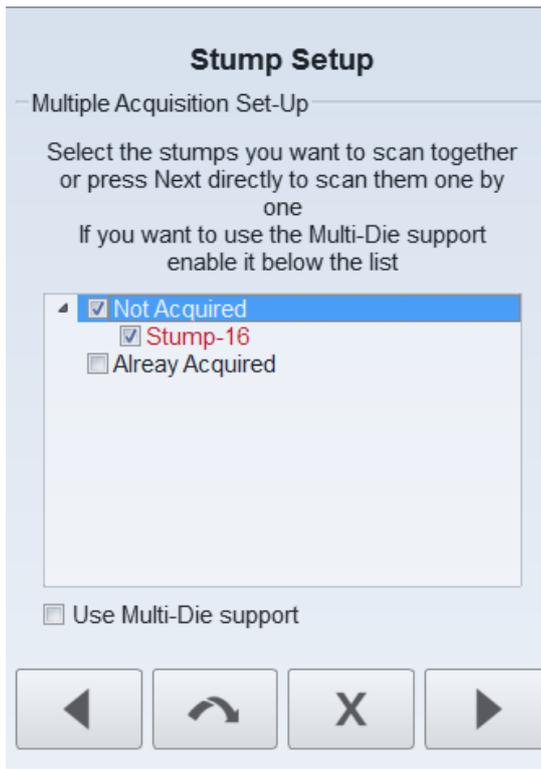
As for stumps, the multi-die support can be used, which requires the user to insert the elements into pre-established positions. In this case, there are a total of 9 positions available and they will be assigned automatically by the software.

Using the multi-die support allows to avoid manual identification (segmentation) of the elements.

Segmentation

Lower Jaw

Acquisition and Check

Insert the lower model without gingiva,
markers, pre-op and waxup
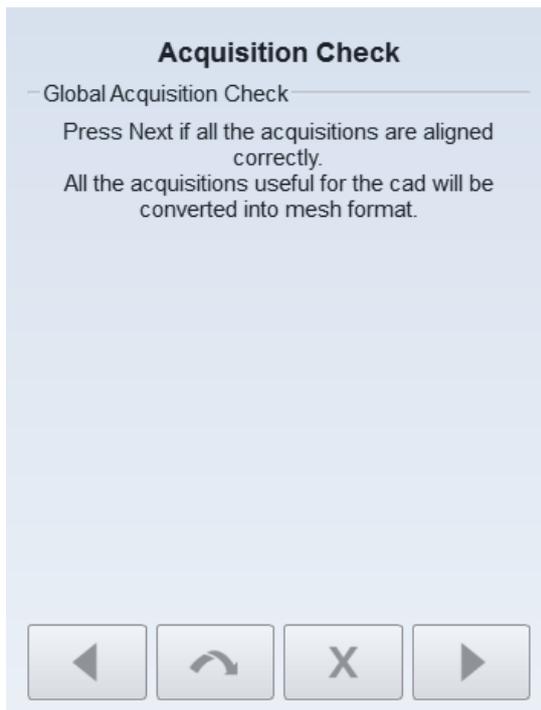
Object Color: Default

| Scan | Integrate |

☐ Already Aligned

◀ ↷ ✕ ▶

Whenever the multi-die support has not been used, the individual elements acquired together must be identified because, as there is no restriction on their positioning, the software cannot do it automatically.

The user must therefore select the portion of interest and then segment it.

Acquisition check

Acquisition Check

Global Acquisition Check

Press Next if all the acquisitions are aligned
correctly.
All the acquisitions useful for the cad will be
converted into mesh format.

◀ ⤺ X ▶

If the parallel generation of the meshes option was selected in the first step, this final step will not be displayed.

If not, the software needs the user's authorization to generate the meshes. By default, the software is set to show each individual element and therefore generate the consequent mesh, to enable the user to check that everything is conform before converting the format. If the project has already been checked, tick the generate all option and the software will generate all the elements.

Before generation of the meshes, the software will display all elements that will be exported, and the user will be able to check that all meshes are correct before exporting to PlanCAD Premium

Once the wizard has been completed, the project remains available. If there were something incorrect or there was the need to change a hand modelled part it is possible to access to the referring options by the project.

When segmenting we suggest selecting the stump as completely as possible. Even though it is not strictly necessary for the CAD design, the software will be able to use all the geometry to align, thus obtaining more reliable results.

7 DATA EXPORT

It is always possible to access the context menu at any time from the project tree by clicking with the right button on the desired element and export it with the desired format to a position of the user's choosing.

The scanning data will be exported into the *.scan format, which allows to reconstruct all of the scanner's information.

The mesh type data can be exported in the following formats: , STL binary, STL ASCII, off binary, off ASCII, ply binary, ply ASCII and waveformat obj.

7.1 Automatic export

The software also provides a feature to automatically export the data to the CAD software by clicking the **Export to CAD** button.
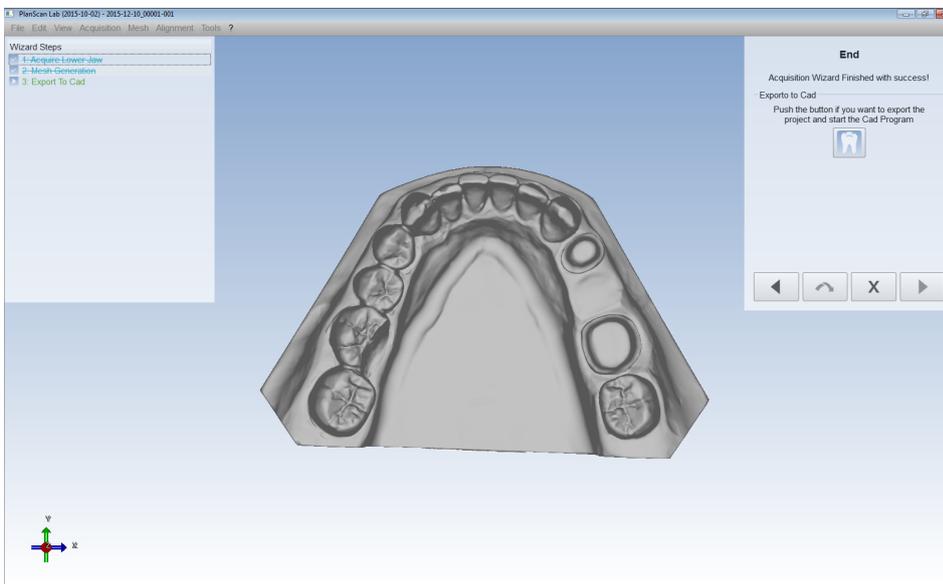
In the structured project, the software already recognizes the parts that compose the job and can export them automatically while maintaining said structure. If the scanner has been launched directly from PlanManager export will be absolutely automatic: Planmeca PlanScan Lab will create a project compatible with the CAD software and will start the modelling program directly.
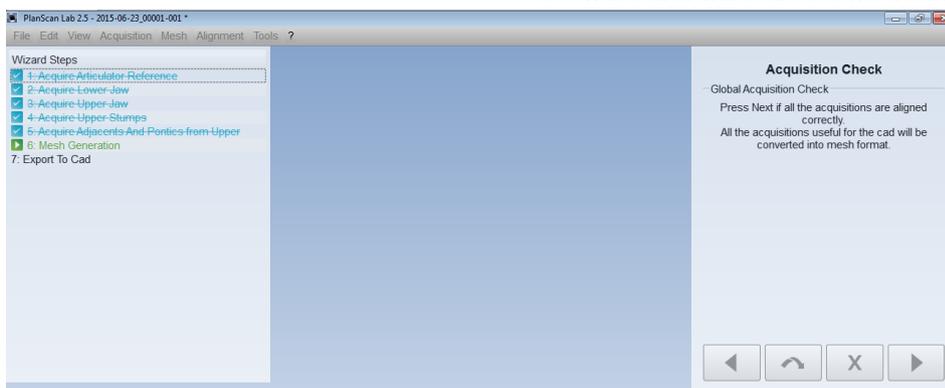
8 TOOLBARS

8.1 Project management

This set of tools allows to save and load entire projects, as well as export and import individual sets of data, to be used in a project different from the one in which they were generated.

- New Free Project: allows to create a new project;

- New Project: allows to create a new job order sheet and the consequent guided project;

- Open Project: allows to open an existing project;

- Save Project: saves the current project;

- Save as: saves the current project with a new name;

- Close Project: closes the current project;

- Import: loads pre-existing data into the current project;

- Export: saves the selected data outside the current project;

- Start acquisition wizard: starts the guided procedure (it is only active if a structured project has been defined)

- Exit: closes the Planmeca PlanScan Lab application.

8.2 Selection tools

Planmeca PlanScan Lab provides a set of tools to select part of the data surface, meshes or acquisitions. The available selection tools are:

- Rectangle selection: traces a rectangular selection area on the surface;

- Ellipse selection: traces an elliptical area on the surface;

- Polygon selection: traces a polygonal selection area, defining the vertexes via mouse;

- Closed freehand selection: traces a freehand selection area, creating a closed shape based on the path followed by the cursor of the mouse;

- Freehand trace selection: traces a freehand selection area based on the path followed by the mouse cursor;

- Segment selection: selects the area covered by a line segment traced by the cursor of the mouse on the surface. By holding the key, it will be possible to trace straight lines that range between them with a predetermined angle (that can be set through the options panel and set as default at 45°);

- Pass-through / non pass-through selection (for mesh only): the first option selects all of the surface areas that intersect the current selection; the second only the currently visible areas . If several surface layers overlap, the first option selects part of every layer, the second only the visible one.
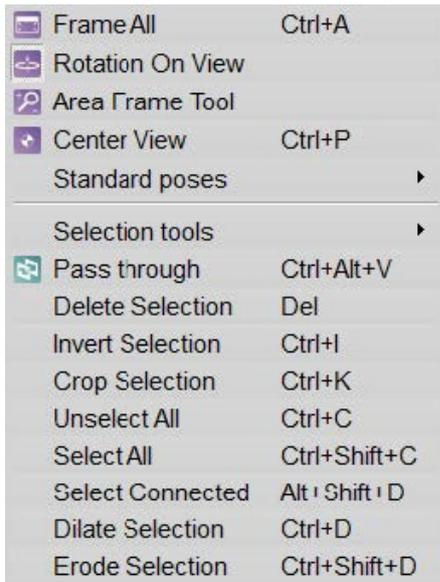
For each of the tools above, described by holding the right key of the mouse, it is possible to shift the currently selected area. Moreover, by pressing the **Esc** key, the currently displayed selected area can be deleted.

|	
Frame All	Ctrl+A
Rotation On View	
Area Frame Tool	
Center View	Ctrl+P
Standard poses	▶
Selection tools	▶
Pass through	Ctrl+Alt+V
Delete Selection	Del
Invert Selection	Ctrl+I
Crop Selection	Ctrl+K
Unselect All	Ctrl+C
Select All	Ctrl+Shift+C
Select Connected	Alt+Shift+D
Dilate Selection	Ctrl+D
Erode Selection	Ctrl+Shift+D

8.3 Acquisitions management

- Generate mesh: converts the currently selected range images into a mesh. The generation parameters are set automatically by the application once the user has specified the type of object to convert.
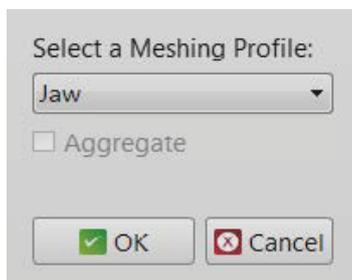
In the structured project the panel in will not be shown because the software will automatically start the best strategy for the conversion to mesh for the type of selected data. For example, if the acquisition of a stump is to be converted into mesh, the level of detail will be higher of that dedicated to the acquisition of an antagonist.

Select a Meshing Profile:

Jaw ▼

☐ Aggregate

✔ OK   ✖ Cancel

9 SCANNER RECALIBRATION
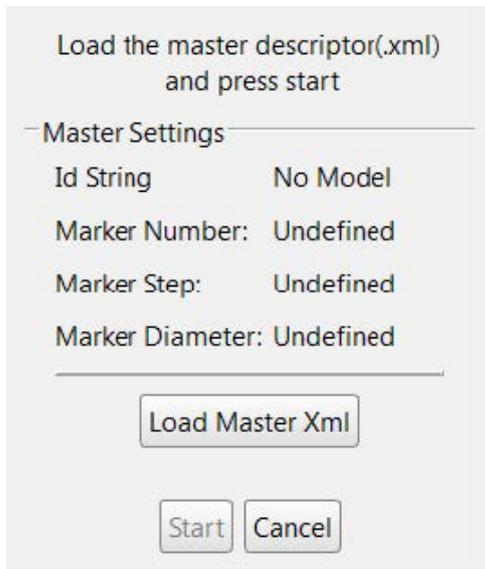
After moving or after accidentally hitting the scanner it is good practise to recalibrate the instrument. To carry out this operation it is necessary to have a calibration kit available, composed by a master, an xml file, describing the specific master, and a normal scanning model. Each xml file is associated to a calibration plate that can be identified by the number on the rear of the plate itself; the xml file associated to the master supplied is provided in *C:\ProgramFiles\PlanScanLab 2.5*.

Scanner recalibration is articulated into two steps: recalibration of the optical head and recalibration of the movement system.

To start the recalibration procedure, select the **Recalibrate head** command from the Tools menu. A dialogue window with a request to enter the master into the scanner and to load the associated xml file will open.

Once ready, the automatic procedure can be launched by pressing the **Start** button. After head calibration, it is requested to remove the calibration master from the scanner and to insert a scanning model. Once introduction has been confirmed, the scanner will start the calibration procedure of the moving system.

At the end of the operation, the success of the operation is confirmed and the scanner is ready for use.

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