

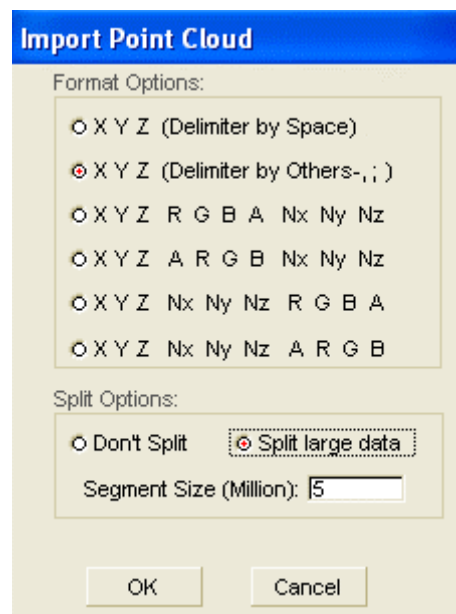
Point Cloud Processing Tutorial

Objective: Learn how to process point cloud data. Use the Lasso tool to clean up the points. Use the Global Registration function to automatically register and merge multiple point cloud patches into a single object. Use the Decimate and Denoise functions to reduce the number of points and remove noise from the scan data while keeping an accurate geometric shape. Use the Point Cloud to Mesh function to triangulate point clouds into a polygonal model.

Files: There are 18 point cloud patches (*.asc files) of a scanned tooth model.

Step 1: Import points

Click the **Import** command from the File menu, choose the **Point Cloud File** type (*.txt, *.asc, *.xyz) displayed in the Files of Type box. Highlight all 18 ASC files to open by choosing one of the options that describes the data structure, as shown below. Meanwhile, The software allows you to split a large dataset into several parts, which will speed up the importing process.



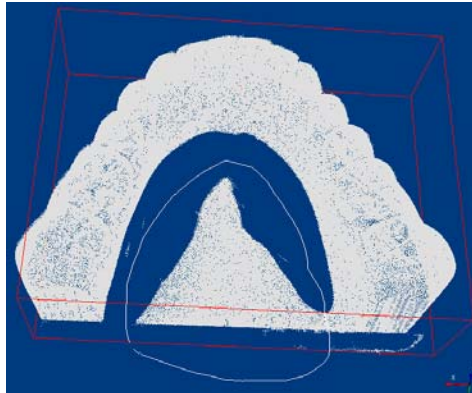
Step 2: Manipulate points

After the point cloud patches are loaded, the file names are shown in the Object Tree Window on the right side of the screen. Clicking over a tree item will select the object for use. You can then use the right-mouse menu to change the selected object's visibility, color, transparency, or rename it, etc. By pressing and dragging with the mouse scroll wheel, you can rotate around the model.



Step 3: Clean up points

Click the **Cut by Lasso** command from the Cloud menu or the Modify menu. Hold the Left Mouse Button, drag the cursor around the desired points, and release the mouse button to delete the points. Checking the option of **Apply to All Objects in Group** in the Parameter Window on the right side of the screen applies the cutting operation to all patches instead of the selected patch only.

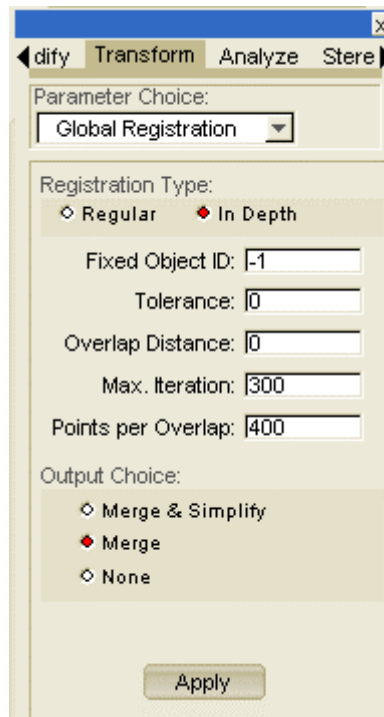


Note: Instead of manually deleting points, you can choose the **Remove Isolated Points** command to automatically delete clusters of points that are separated from the majority of the points over a defined distance.



Step 4: Register points

Click the **Global Registration** command from the Registration menu, and specify the parameter setting in the Parameter Window (shown below). Press the [**Apply**] button to register and merge the points.



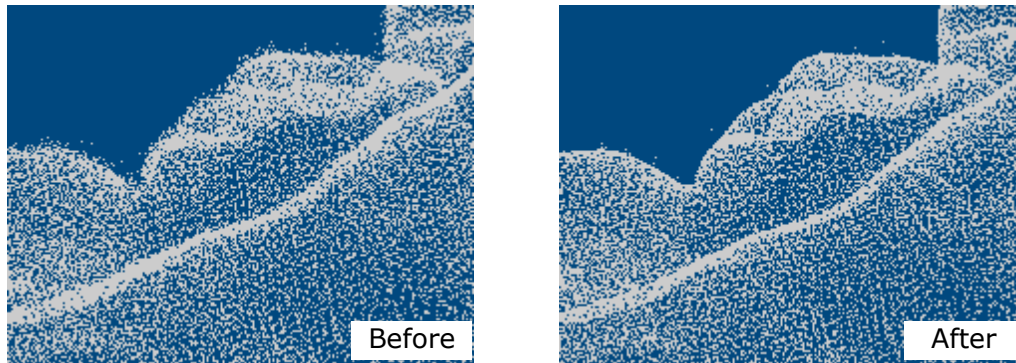
Notes:

- The **Global Registration** command automatically aligns all point clouds (or meshes) in the selected group by searching for overlapping regions for each pair of point clouds (or meshes) and best-fit mapping overlapping regions.
- The typical value of **Maximum Iteration** may be set at 50, 100, 200, or 300. Increase this value to speed up the registration convergence if the repeated steps are more than seven.
- The value of **Points per Overlap** defines the minimum number of vertices to examine. A smaller value results in more overlapping regions and better quality. If the number of overlapping regions is around one hundred, it should yield good results. The number of repeated steps and overlapping regions is shown in the prompt window below the screen.
- To speed up the process, you can click the **Clear Undo** command from the Edit menu or use the shortcut **[Ctrl] + Q** to empty the undo buffer. To abort the process, press the **[ESC]**.



Step 5: Remove noise

Click the **Denoise Point Cloud** command from the Cloud menu. Specify the **Smoothing Iteration** at around 12, and press the **[Apply]** button to smooth the points. Depending on how much noise is present in the points, this may not be necessary.



Note: the preservation of important surface features such as sharp edges and corners is controlled by the **Smoothing Weight** parameter. This value defines the degree of the smoothing for sharp edges.



Step 6: Decimate points

Click the **Decimate Point Cloud** command from the Cloud menu. Specify the **Decimation Percentage**, and press the **[Apply]** button to reduce the number of points.



466,395 points



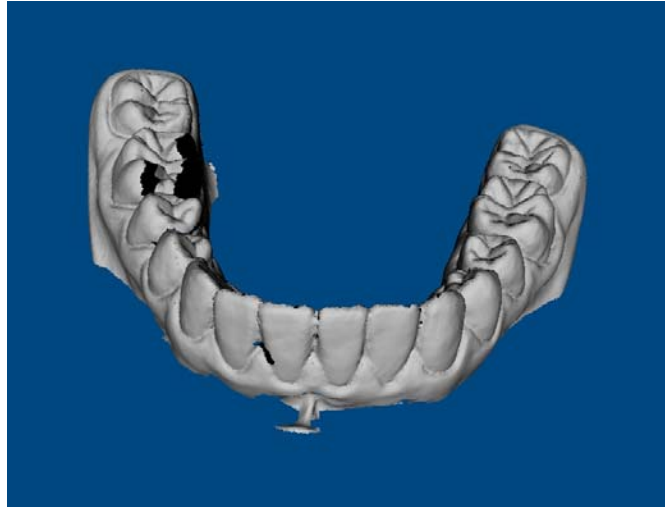
Decimated 50% off

Note: The **Remove Redundant Points** command can also reduce the number of points. It removes redundant points according to a defined minimum distance and curvature weight. It makes a more uniform distribution of points on flat regions than the **Decimate Point Cloud** command does, but it takes a slightly longer time.

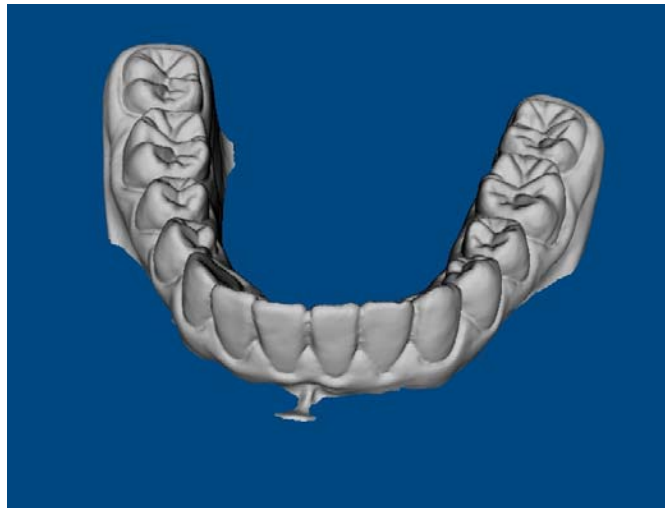


Step 7: Triangulate points

Click the **Point Cloud to Mesh** command from the Cloud menu and specify the noise level of the points in the Parameter Window. Press the **[Apply]** button to start the triangulation process. When finished, you will get a polygonal model like the image shown below.



Note: After the polygonal model is created, you may use the mesh repair functions listed in the Analysis Wizard or from the Modify menu, e.g. **Fill Hole**, **Unify Normal**, **Remesh Smoothing**, etc., to fix the meshes as needed. The image below shows the high quality meshes after modification.



End of Tutorial