NextEngine 3D Scanning Tutorial

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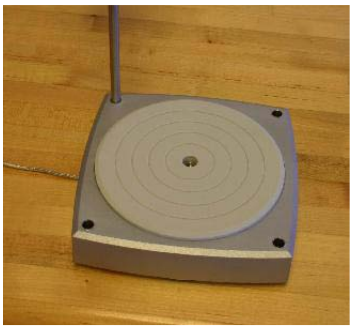
1.0 Parts

Scanner

AutoDrive



MultiDrive

allows for tilt rotation of objects

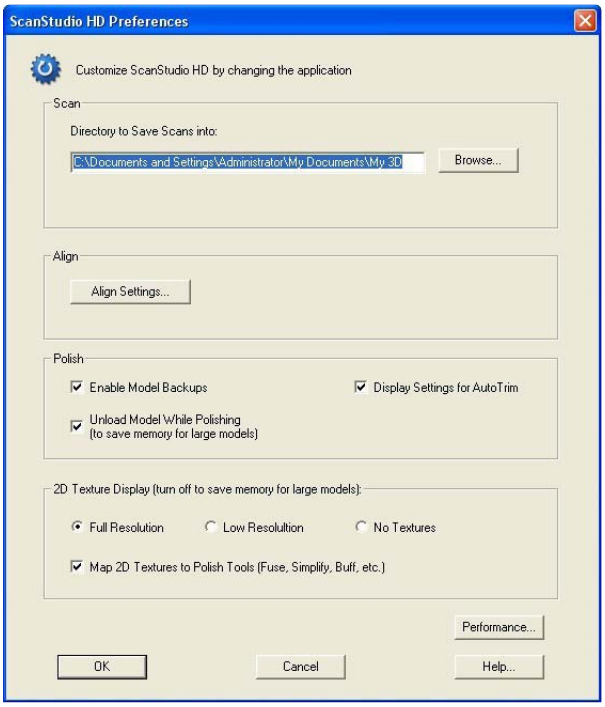
PartGripper

for use only with the AutoDrive

2.0 Setting Preferences

Preferences

-The Application Preferences Dialog is available from the Edit-Preferences menu and can be used to customize ScanStudio to fit your usage



Scan
-By default, the scan save directory is located under your My Documents\My 3D folder under your username.
-You can customize the directory after installation

Polish
-Turn On/Off Model Backups which can be used to undo changes and restore from corrupted files
-Optionally display a settings dialog as part of AutoTrim
-Turn On/Off the unloading of models while Polish to help save memory

2D Texture Display
-Enable/disable texture loading and display (can be disabled to save memory).
-If it is disabled your model will only be displayed in solid mode.

3.0 General Setup

Surface Prep

Prepare dark, shiny or transparent objects using included tools to help the lasers capture the data.

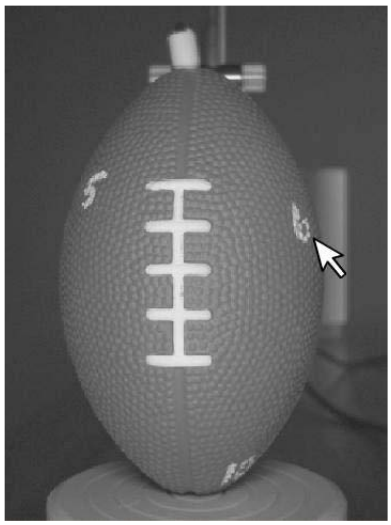
Paint Pens: Washes off most

Powder: Talc

**Other spray alternatives such as foot powder spray or white hairspray can be used as well.

Alignment Prep

It may be helpful prior to scanning to make alignment marks using the alignment pen. These marks will make it easier to place pins and identify locations on the object. Alternatively, the 3D geometry that the Scanner captures can be used to align scans.

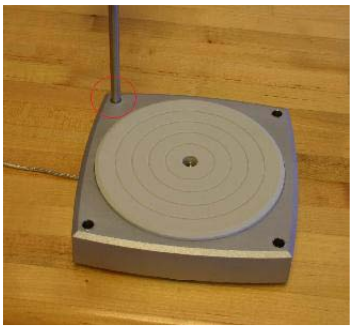


4.0 Using the AutoDrive or the MultiDrive

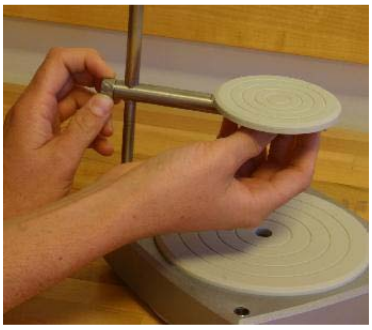
AutoDrive

Setting up the AutoDrive and PartGripper:

- Screw PartGripper into one of four corner sockets on AutoPositioner



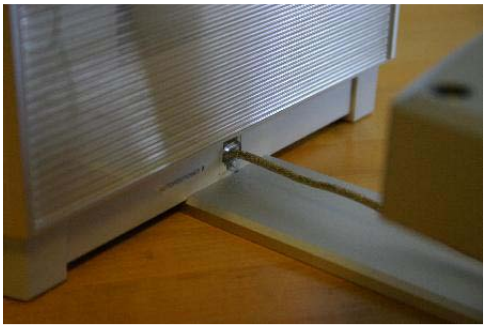
- Tighten Platter on PartGripper



- Rotate Post clockwise (about 6 turns) to tighten PartGripper into AutoDrive

MultiDrive

-**Plug** in the MultiDrive to the scanner



-**Start** ScanStudioHD and proceed to Calibration

Calibration

CALIBRATING THE MULTIDRIVE

You can

-This function is available for re-calibration when alignment results in an error or when the MultiDrive was detached and is reattached.

Scan Process

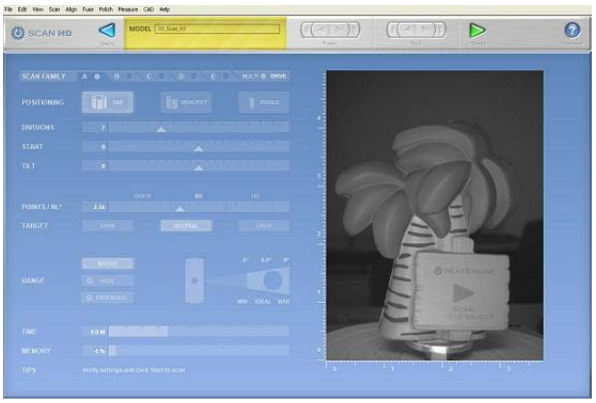
SCANNING PROCESS

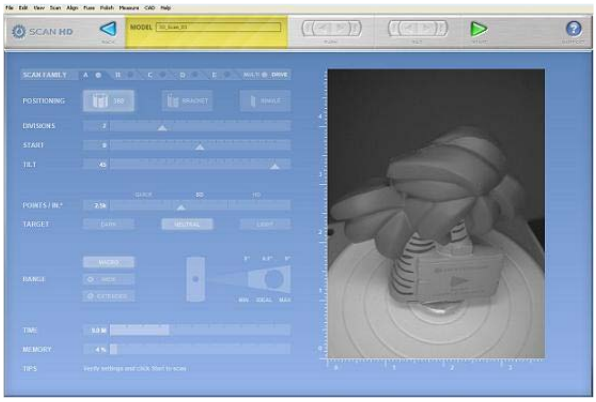
After calibration is

A new scan panel will be loaded when

-Five families are now available for predefined settings for Positioning, Divisions, Start Angle, Tilt Angle, Points/IN^2 and Target
-Clicking on the family name will enable the tab to edit the settings.
-To enable or disable a family, simply check or uncheck the circle next to the family name.
-Starting positions can be set for both the initial and tilt axis by moving the slider bar arrow.
-The start axis has the full 360 rotation and tilt axis is bounded to -35 to 45 degrees.
-Use the top slider bars to visually set the starting and tilt positions. (This will update the settings for the scan family)

-Select the scan settings for each tab and check the tabs you want to have scan.
If the setting for a tab have been adjusted, but the tab is not checked it will not scan.





-All MultiDrive scans are to be in MACRO mode.
-Select a ROI for your model to prevent the MultiDrive from being scanned in for certain tilt angles.
-If additional scans are needed, enter scan panel and position the model by using different starting and tilt angles to capture additional scans.
-If you physically adjust the part, then a 3 pin alignment will be needed to align.
-When finished, trim unnecessary data and "Fuse" or "Volume Merge" the model for export: ->

Troubleshooting

ADDITIONAL TIPS AND TOOLS

Switching between AutoDrive and MultiDrive
- Simply plug in an AutoDrive to display the proper UI.
- When reattaching the MultiDrive, make sure to recalibrate as needed.

-When more than 5 Scan families are required, then just click on scan to enter the scan panel, and you can add 5 more new sessions. These scans should auto align to the previous scans assuming all the movement and rotations were done by the turntable. If they don't auto-align , just drag the scans into the green and refine (no pins required)

-Force Calibration. If your scans are not coming in aligned, you may need to run a force calibration. You can do this from the drop down menu , Align, then go down to Calibrate MultiDrive

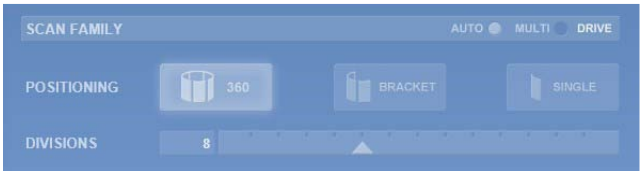
5.0 Scanning

Intro

- Enter the Scan Panel by clicking the Scan button

- Customize your scan name in the yellow toolbar

There are 3 main types of scans:



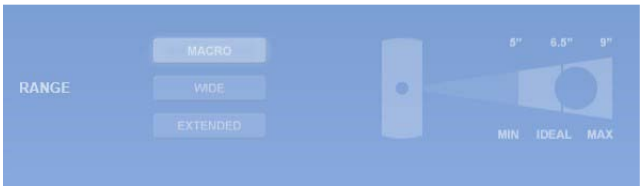
360:
- Select the "360" scan option in the scan panel to scan the object from every angle.
- The number of divisions will control the degree of rotation between scans and the total number of scans
- The individual scans will be grouped as a family.

Bracket:
- Select "bracket" scan in the scan panel to scan three consecutive angles.
- The number of divisions will control the degree of rotation between scans
- The three scans will be grouped as a family. More on Scans and Families

Single:
-Single scan of the object from one angle.

Speed

Precision:
Choose MACRO or WIDE distance based on object size and desired resolution



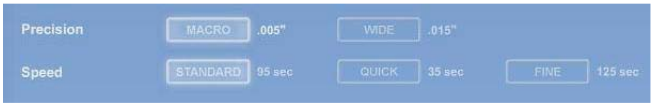
Macro = 0.005" accuracy, 3x5" field of view
- Place object 6.5 inches from the front of the scanner

Wide = 0.015" accuracy, 10x13" field of view
- Place object 17 inches from the front of the scanner

Extended = 0.015"+ accuracy, 16x22" field of view
- Available with HD PRO
- Objects can be placed up to 30" from the face of the scanner

Speed:

ScanStudio CORE
Choose Standard, Quick or Fine scan speed based on desired scan time and quality



ScanStudio HD/HD PRO

Speed		Decimation			
		HD		HD PRO	
		Points/IN²	Triangle Size	Points/IN²	Triangle Size
1	HD	40k(2x)	0.0050"	160k (1x)	0.0025"
2		17k(3x)	0.0075"	40k (2x)	0.0050"
3		10k(4x)	0.0100"	17k (3x)	0.0075"
4	SD	4.4k(3x)	0.0150"	10k (2x)	0.0100"
5		2.5k(4x)	0.0200"	4.4k (3x)	0.0150"
6		1.6k(5x)	0.0250"	2.5k (4x)	0.0200"
7	Quick	1.1k(4x)	0.0300"	2.0k (3x)	0.0225"
8		700(5x)	0.0375"	1.1k (4x)	0.0300"
9		500(6x)	0.0450"	700 (5x)	0.0375"

Macro Reference Table

Speed		Decimation			
		HD		HD PRO	
		Points/IN²	Triangle Size	Points/IN²	Triangle Size
1	HD	4.4k(2x)	0.0150"	17k (1x)	0.0075"
2		2.0k(3x)	0.0225"	4.4k (2x)	0.0150"
3		1.1k(4x)	0.0030"	2.0k (3x)	0.0225"
4	SD	500(3x)	0.0450"	1.1k (2x)	0.0300"
5		280(4x)	0.0600"	500 (3x)	0.0450"
6		180(5x)	0.0750"	280 (4x)	0.0600"
7	Quick	125(4x)	0.0900"	220 (3x)	0.0675"
8		80(5x)	0.1125"	125 (4x)	0.0900"
9		55(6x)	0.1350"	80 (5x)	0.1125"

Wide/Extended Reference Table

Tips
- For ScanStudioHD, go to Scan -> Settings -> Texture Capture Mode - and choose Monochrome for faster scan speed.
- Choose Fine or HD Speed for the greatest resolution.
- Choose Quick Speed to capture data the quickest with lowest resolution (not recommended for most parts).

Position

- Orient object in viewfinder using Rotate buttons

Turn/Step Arrows:

- One click on a Turn Arrow rotates the AutoDrive a single increment for more precice positioning.
- One click on a Step Arrow rotates the AutoDrive one division.
- For example, if the divisions is set at 4, clicking on the step button will rotate the object 90 degrees.

- The left arrow rotates the object clockwise.
- The right arrow rotates the object counterclockwise

Note: The AutoPositioner should only be rotated using the Rotate Arrows and should not be done manually.

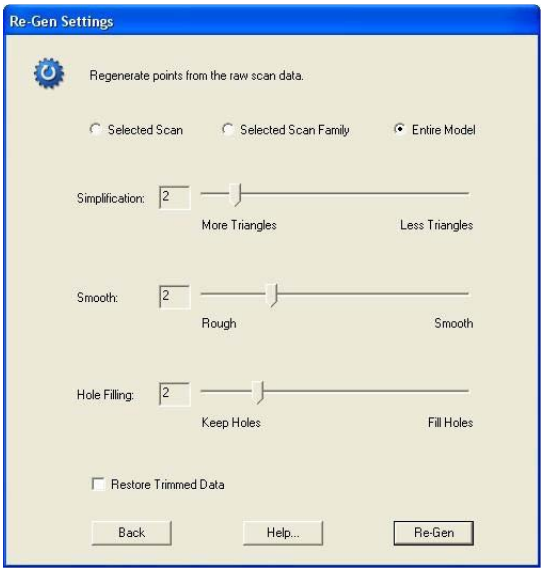
Region of Interest
- Drag the cursor around the object to select a smaller scan area

Regenerate

- Since the raw scan data is saved at scan-time, you can regenerate the points at any time with different point-generation settings.
- These settings have the same effect as the sliders on the scan setup screen.
- Re-Gen is particularly useful for changing the decimation value after a scan has been completed.

Steps:
- Click on Fuse, Re-Generate Scan(s)

- Select new scan settings for reprocessing



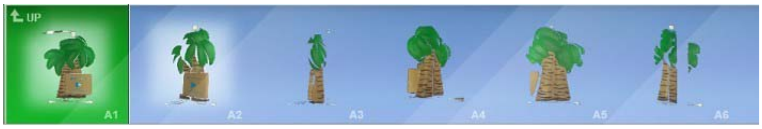
- Restore Trimmed Data: Choose this option to restore the trimmed data from either a single scan, family or the entire model.

6.0 Aligning

Intro

Note:
- Prior to scanning, it may be helpful to make alignment marks using the alignment pen.
- These marks will make it easier to place pins and identify locations on the object.
- For the Palm Tree image below, the markings on the model can be used for our reference points.

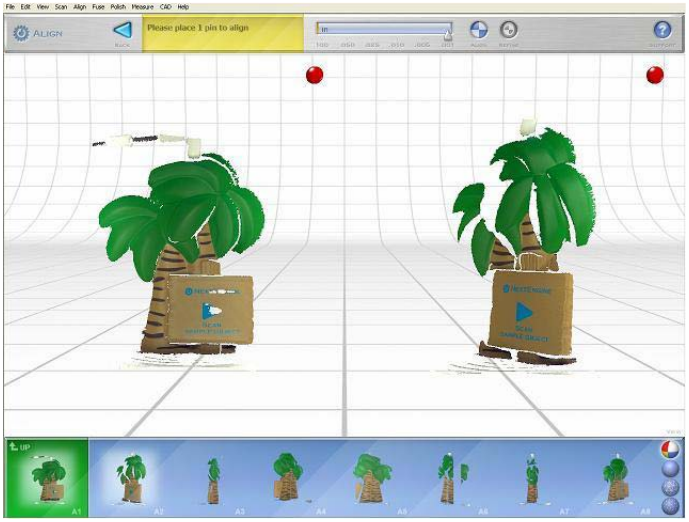
Selecting Scans to Align
- Double click on thumbnail of a family to separate the family into individual scans



Alignment Screen

Click on Align to enter

- When you enter Alignment, you'll see a split screen view
- The left side shows an assembly of scans/families that are already aligned
- The right side shows the next piece that you're attaching to that assembly

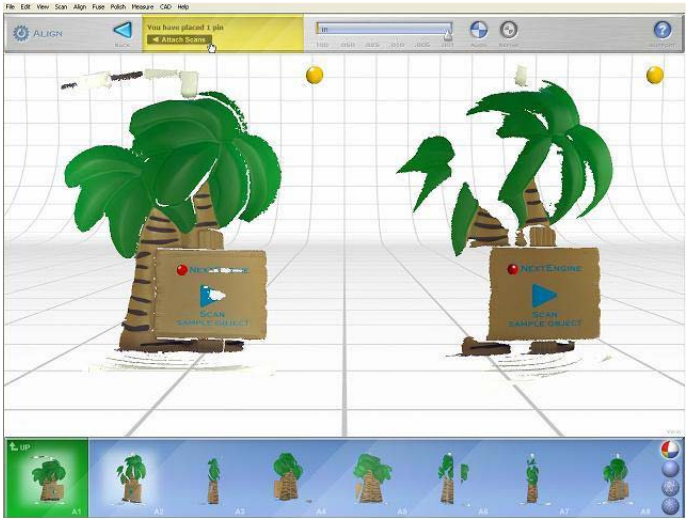


Thumbnail Bar

- The green side contains scans and families that are already assembled
- The blue side is for pieces that aren't part of the assembly yet
- To break apart or assemble your model, simply drag parts from one side to the other

Single Family

Alignment for 360 or Bracket Scans
- Place 1 pin on a common location between 2 scans within the family.
- Drag the pin to the location or double click on the point to place the pin.



Attach Scans

- The yellow status bar will walk you through the process
- Click "Attach Scans" to add your scan to the assembly

- Click File > Save after each alignment in order to save pin locations
- You can detach a scan by dragging it from the green to the blue and then you can adjust the pin.

AutoAlign
AutoAlignment uses previous AutoDrive alignment information to position the scans relatively close then refines the alignment to accurately align scans using the AutoDrive as they are captured, without requiring any user input.

AutoAlignment will result in accurate alignments if the AutoDrive and Scanner are close enough to the same relative position as the last manual turntable alignment (for each depth range).

For Example:
- Start up the scanner for the first time and place the turntable where you want it.
- Do your first scan and manually align by placing pins.
- Then if you scan again either that object or a different object without moving the turntable with respect to the scanner it will auto-align.
- You can then restart ScanStudio or start a new scan and as long as the turntable is not moved it will auto-align.

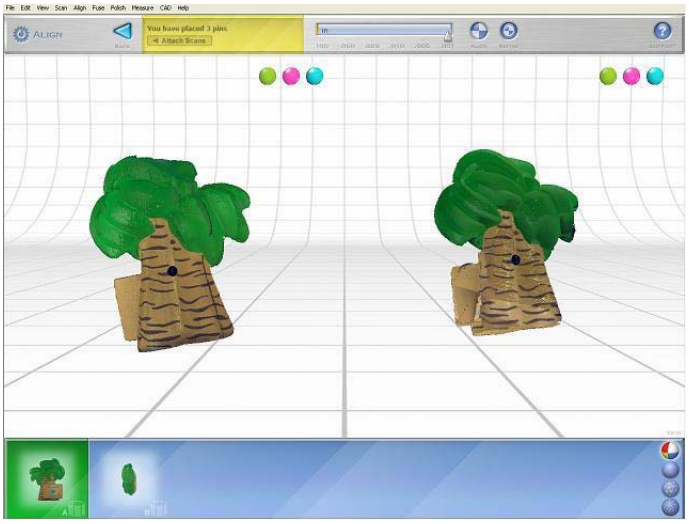
- If AutoAlignment does not result in an accurate alignment, the standard Align tool can be used to place correspondence points and align the scans.

MultiFamily

- Multiple families can be aligned together.

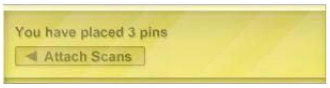
- Place 3 pins on common locations between the 2 families

Two pins placed in front



Third pin placed in back

Attach Scans
- The yellow status bar will walk you through the process
- Click "Attach Scans" to add your scan to the assembly

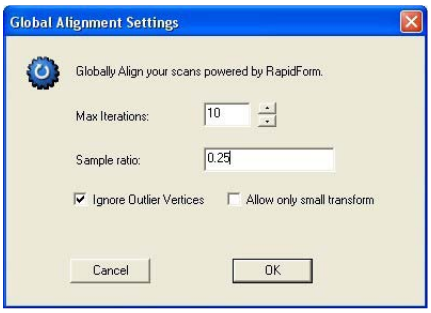


- Click File > Save after each alignment in order to save pin locations
- You can detach a scan by dragging it from the green to the blue and then you can adjust the pin.

Next Step: Once it's all put together, learn how to trim and fuse your scan data ->

Align Settings

Advanced Settings



Max Iterations
-Input a value which limits the number of times of iteration of the fine alignment.

Sample Ratio
-1/1, 1/4, 1/9, 1/16, 1/25, 1/36, 1/49 and 1/64.
-If you are dealing with a large data set, you may sample it. Doing this, the registration result won't be sacrificed, but the processing time greatly decreases.

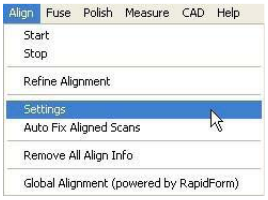
Ignore Outlier Verticies
-If checked, data which is far from the average will be ignored during calculation.

Allow only small transform
-The entire overlapped region is considered while assuming that the initial alignment is already well done.
-It is recommended to check this option if there are few geometric features in the overlapped region.

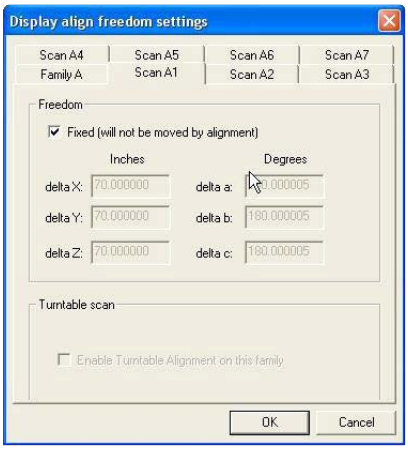
Fixing Scans

When aligning multiple families it may be beneficial to lock the individual families in place so that any future alignment does not disrupt the already aligned families.

Fixing a Single Family
-After your single family alignment is complete (double click on the family if you need to expand it out), then go to Align, Settings.

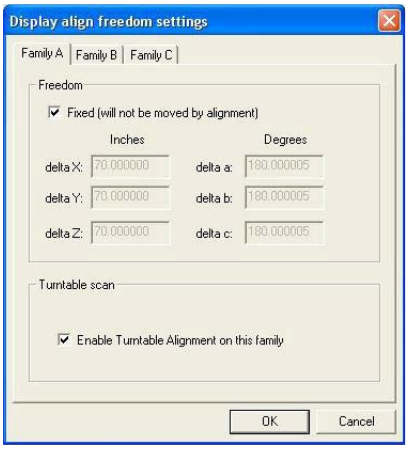


-Check the box "Fixed (will not be moved by alignment)" for scans A1-An. This will lock the individual scans in the family and not be moved with future alignment.
-If you check the Fixed button for the Family A tab, then this will lock the entire family in place and not just the individual scans for that family.



Fixing Multiple Families

-For multiple families, go to Align, Settings and check the box "Fixed (will not be moved by alignment)" for the families that have been sucessfully aligned and wish to be locked in place.



Example:

- Starting out with three families (One 360 and two brackets)
- Attach Family A to Family B (both families are not fixed)
- Go to Align, Settings and check "Fixed" for Family A and Family B (They are now locked in position)
- Proceed to attach Family C to A and B.
- After C is sucessfully aligned, then go to Align, Settings and fix Family C
- Repeat for any additional family attached.

7.0 Trimming

Intro

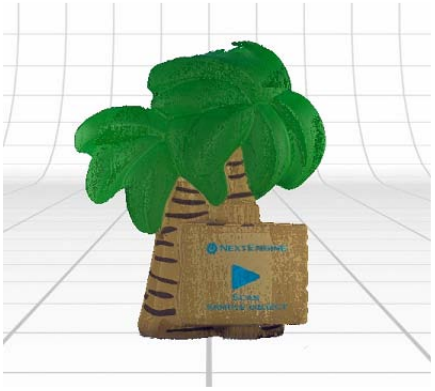
- Back up your scan file as a different copy unless ScanStudio has not done so already.

Click the 'Trim' button in the

- Click the cirlce/square/square selector/poly selector button in the toolbar to select data

- Select the area on the scan to be removed and continue selecting until all unwanted area is highlighted
- To remove selected area, click on the "Trim" button in the toolbar
- Continue the process until all unwanted area has been removed

Before Trim



After Trim

Deselecting

- If an area is incorrectly selected it can be deselected before trimming takes place.
- To deselect an area, click on the "minus sign" in the toolbar, which will turn the selectors to blue

- Then click on the area to be deselected.
- Click on the "plus sign" in the toolbar to return the circle/square to red and resume selecting area to be removed

- Select "undo" under Edit in the toolbar to undo the last trim. (This will only work if you have Enabled Model Backups)
- You can also restore trimmed data through Regeneration of your scan found here: ->

Navigating

- Click on the "pointer button" before zooming or repositioning the object

- Drag object up/down while right clicking to zoom.
- Drag the object while holding down both mouse buttons to pan ->.
- Hold down center scroll to rotate object without selecting any areas.

When to Trim

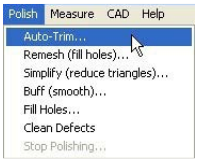
- You can trim completed individual scans of 360/bracket scans while other scans are finishing.
- Before alignment you should not trim away parts of the object, only parts of the PartGripper.
- After alignment you can trim overlapping data to improve fusing/merging.
- Double click on the aligned family and drag the scan to be trimmed into the blue thumbnail bar

Next Step: Fuse your scans to remove any remaining overlap -> or align your scans if needed ->

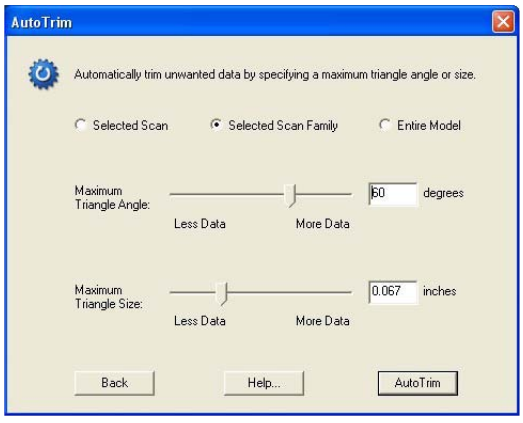
AutoTrim

- Auto-trimming automatically detects and removes data that was captured at a steep angle relative to the line of sight of the scanner.
- This can be useful in removing data that may negatively affect alignment or blending.

- Auto-trimming is available under the Polish menu and should be run before aligning, fusing or merging multiple scans together.



- With this option selected you can choose the angle for trimming.



8.0 Fusing

Fuse

The Fuse tool Volume Merges, Remeshes, Fills Holes and Simplifies your aligned scan data.

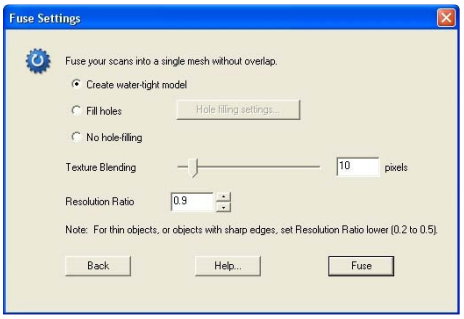
- Ensure that the data that you would like to fuse is aligned in the green section of the bottom view bar.

Click Fuse

Choose Simplification Level

- Enter the desired deviation tolerance for any mesh simplification (decimation)
- 0.00" simplification will not simplify the data
- Increasing the simplification will simplify your model and make the file size smaller.
- It will perform intelligent simplification, which keeps more points in detailed areas and fewer points in larger planes.

Click to enter Settings



- The Hole Filling Slider controls the max. circumference size of holes to fil.
- Control how much blending of the textures to perform (to account for brightness variations):
- Resolution Ratio determines the new average vertice length in relationship to the current length.

- Values less than 1 will decrease your triangle size. Values greater than 1 will increase your triangle size.
- It is best to keep this at the default of 0.9.

Click FUSE

New family C is created

Volume Merge

The Volume Merge tool eliminates the overlap from multiple scans and merges them into a single mesh.

Volume Merge can be used in place of Fuse if you do not wish to Remesh or Hole Fill your scans.

To Merge multiple scans into a single mesh:

- Ensure that the scans to merge are in the green section of the bottom view bar.

Select Volume Merge

- Values less than 1 will decrease your triangle size. Values greater than 1 will increase your triangle size.
- It is best to keep this at the default of 0.9.

Click FUSE

New family C is created

Volume Merge

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To Merge multiple scans into a single mesh:

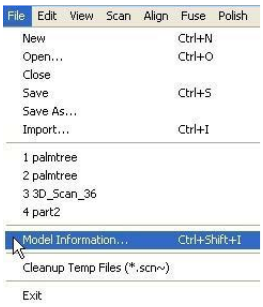
- Ensure that the scans to merge are in the green section of the bottom view bar.

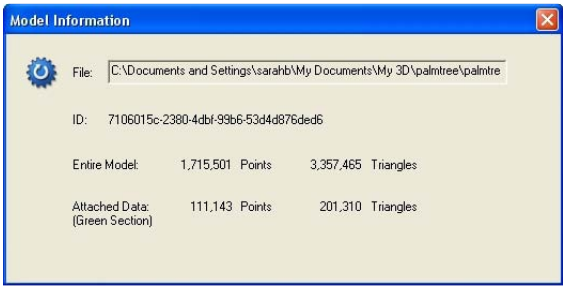
Select Volume Merge

Graphics Card:
512+ MB GPU (Dedicated, non-integrated)

Operating System:
Windows XP 64 Bit
Windows Vista 64 Bit
Windows 7 64 Bit

You can check the number of points in your model under File->Model Information.





To reduce the number of points in your model Regenerate your data a higher simplification level. See next section for instructions for regenerating.

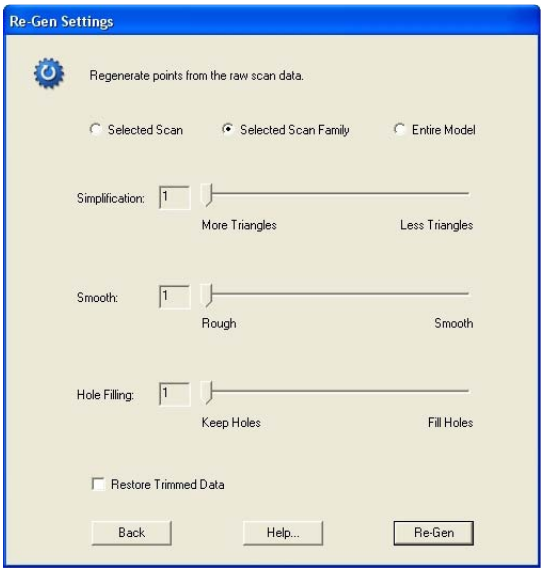
Regenerate

Since the raw scan data is saved at scan-time, you can regenerate the points at any time with different point-generation settings. These settings have the same effect as the sliders on the scan setup screen.

Re-Gen is particularly useful for changing the simplification value after a scan has been completed.

Steps:

Click Fuse, Re-Generate



Select new settings for reprocessing

- Higher Simplification values will result in fewer points in the model.
- Simplification level of 2 will result in 1/4 of the original data, level 3 will result in 1/9 of original data...
- Simplification can be increased and decreased at any time without losing original data.
- Restore Trimmed Data: Choose this option to restore the trimmed data from either a single scan, family or the entire model.

Texture Quality

Texture Blending

- Prior to fusing there is overlap between scans.
- When you fuse a model the best 3D data for each point is kept and the rest is removed to create a single mesh.
- There may be varying shadows on the final fused result depending on which 3D data and associated texture remains post fuse.

Tips to improve textures:

- Ambient lighting- Minimizing the ambient lighting in the room can help improve textures.

- Object Distance- If you are repositioning the object make sure to keep the same approximate distance to reduce color variation.

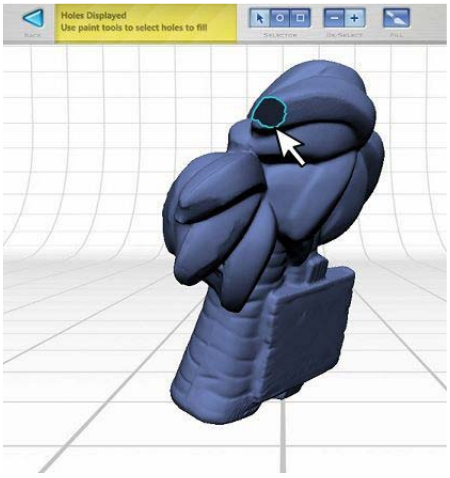
- Shadows- Try to minimize shadows as much as possible. Keep in mind the PartGripper can cause shadows. Prior to scanning you can preview the rotation using the STEP and TURN buttons in the scan panel. If necessary you can adjust the position of the rotations to reduce shadows. If you have a single scan with an extreme shadow you can try to trim out the shadow as long as the data was capture from a different angle.

9.0 Polishing

Hole Fill

- Enter the Polish panel.

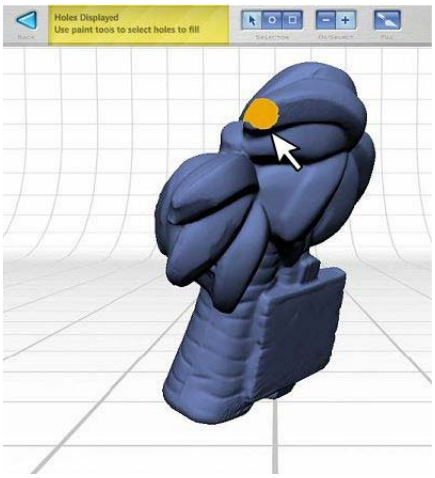
- Select the Fill tool.



Holes are automatically detected

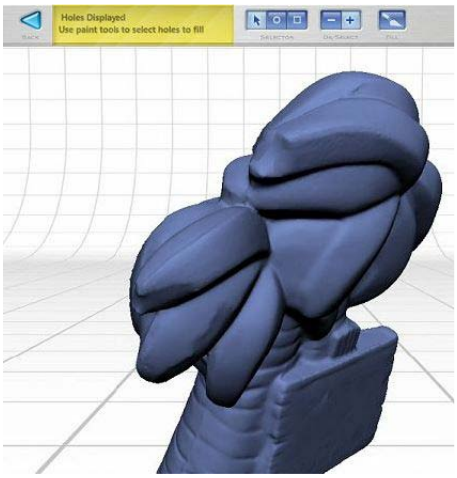
Note: Please make sure that when using the Fill tool, you are working with a fused, merged or a single scan model.

- Use the selector tools to select the holes that you would like to fill.



Selected holes will turn orange

- When you finish your selection(s), select the Fill button to permanantly commit these triangles into your model.



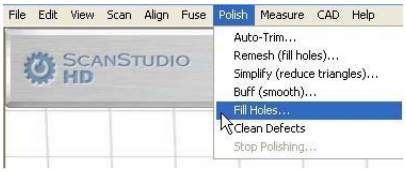
After Fill

Auto Hole Fill

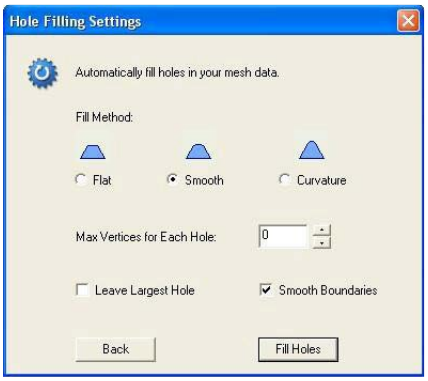
To have ScanStudio automatically fill holes in the scan data:

- Ensure that the data that you would like to fill holes on is a volume merged model in the green section of the bottom view bar.

- Select the Fill Holes tool from the Advanced Polish Menu.



- Enter desired Hole Filling Settings.



a. FILL METHOD:
- Flat Fill will fill the holes along a flat edge.
- Smooth Fill will fill the holes along a smooth edge.
- Curvature Fill will analyze the neighboring geometry and try to match the overall curvature.

b. MAX VERTICES: Controls the maximum number of vertices for holes to fill. Increase to fill more holes.
c. LEAVE LARGEST: Enable this option to leave the largest hole in the scans.
d. SMOOTH BOUNDARIES: Enable this option to smooth the vertices on the edge of the holes as part of the fill process.

You can also use the Remesh tool to automatically fill holes in merged data: ->
You can alternatively use the ScanStudio manual hole filling tool to manually select and fill holes (more info: ->).

If you have any further questions, please click on the Ask? button.

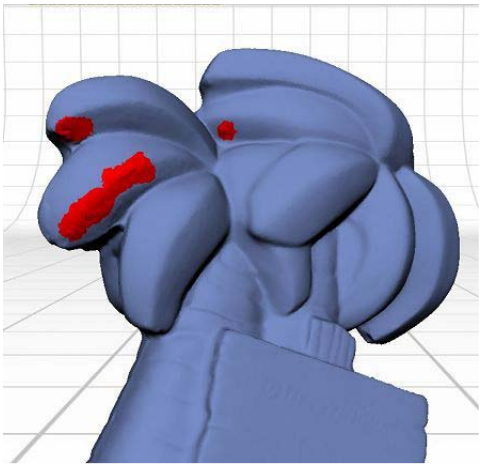
Buff

- Click on the Polish tool.

- Then click on the Buff tool.

Note: When buffing, please make sure that the model is a fused or merged model.

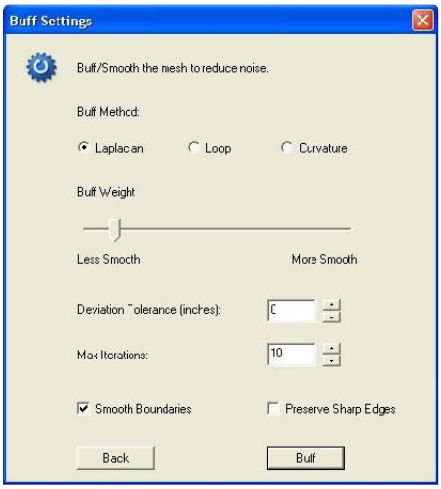
- Select localized data to smooth or all for the entire mesh.



Selected data will be highlighted red

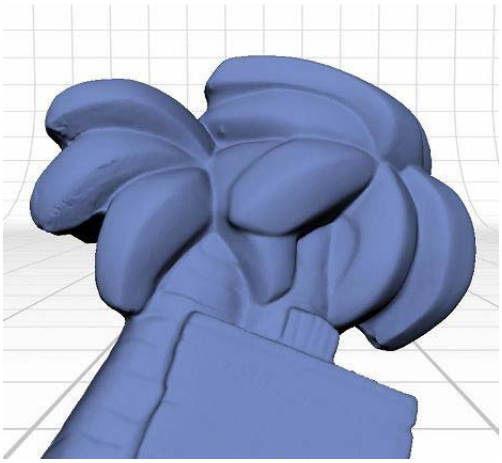
Settings

3. Enter the desired buff options:

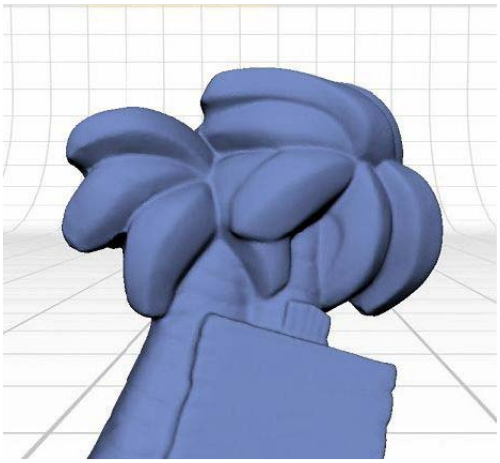


a. Buff Method: Laplacian and Loop are two different smoothing methods. The Curvature option can be used for curvature based smoothing.
b. Buff Weight: Increase to run a higher level of smoothing (when the Loop method is used, the number of iterations is all that needs to be specified, the smoothing weight has no impact).
c. Deviation Tolerance: Optionally enter the allowable deviation for the smoothing.
d. Max Iterations: Increase to run more iterations of smoothing and therefore reduce more noise.
e. Smooth Boundaries: Enable this option to smooth vertices around the edges of holes.
f. Preserve Sharp Edges Enable this option to try and retain sharp edge detail.

Results



Before



After

If you have any further questions, please click on the Ask? button.

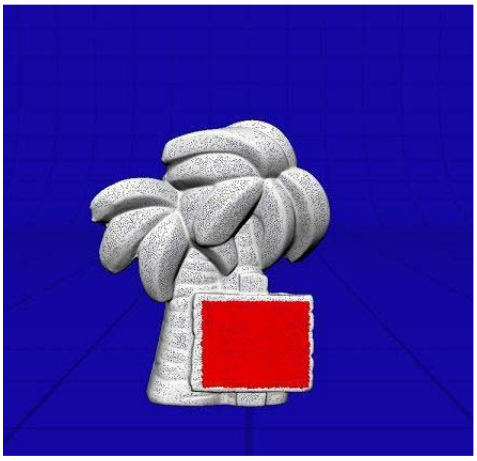
Simplify

Note: When using the Simplify tool, please make sure that you are working on a fused or merged model. Simplifying prior to fusing/merging will create non-uniform mesh. Please regenerate scans if you need to decrease model size before fusing (more info ->).

- Click on the Polish tool.

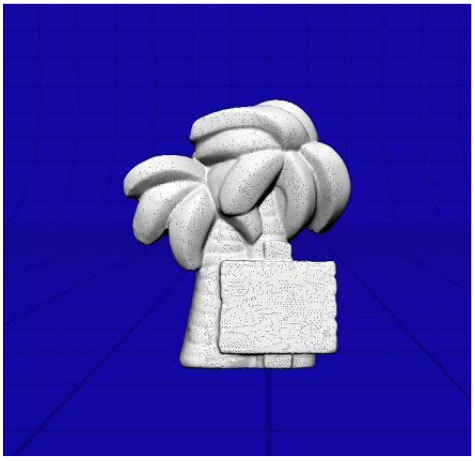
- Click on the Simplify tool.

- Select the local data to simplify or select all.

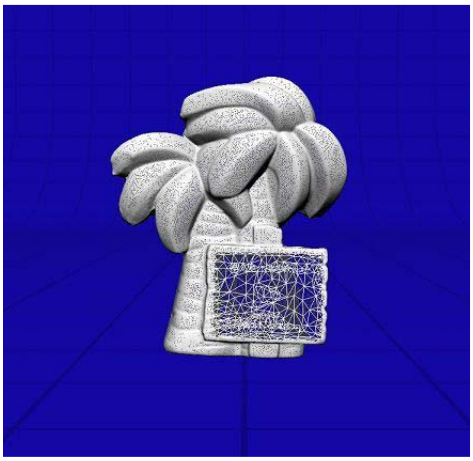


- Choose the desired simplification tolerance from the top menu bar slider.

- Click the SIMPLIFY button.



Before Simplify



After Simplify

If you have further questions on the simplify tool, please click on the Ask? button.

Remesh

- Ensure that meregd or fused model is in the green section of the bottom view bar

Note: It is advised to remesh scans that have been merged/fused. For more info: ->.

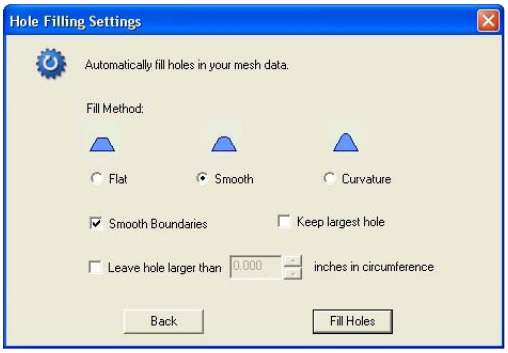
- Select the Remesh tool from the Advanced Polish Menu.

Choose Remesh Settings

Resolution: Controls the size and amount of triangles that will be in the remeshed result.

Values from 0-1 will result in smaller triangles than those presently in the scan.
Values larger than 1 will result in larger triangles with a possible loss of detail.

Fill Holes: Select the Hole Filling Settings to fill some or all holes.



Fill Method: You can experiment with the different fill methods to see which works best for your model and the sizes and shapes of the holes.

Smooth Boundaries: Select this option to smooth the boundary of the newly filled holes.

Keep Largest Hole: If your object has an opening that is part of the design select this option to keep that hole from filling.

Keep Holes Larger Than: If you don't want to fill all holes, then you can manaully set which holes of circumference size to fill.

The Remesh tool can be very useful when run after Merging Scans to create a water-tight mesh.

If you have any further questions, please click on the Ask? button.

Clean Defects

Clean Defects should be run at the end of your polishing process and can be used to automatically eliminate any self intersecting or non-manifold triangles.

To Clean Defects in your mesh:

1. Ensure that your Merged and Remeshed model or fused model is in the green section of the bottom view bar.

2. Select "Clean Defects" from the Polish - Advanced menu.

Any defects in the mesh will be automatically detected and cleaned.

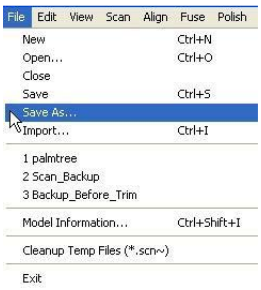
If you have any further questions, please click on the Ask? button.

10.0 Exporting to Other 3D Programs

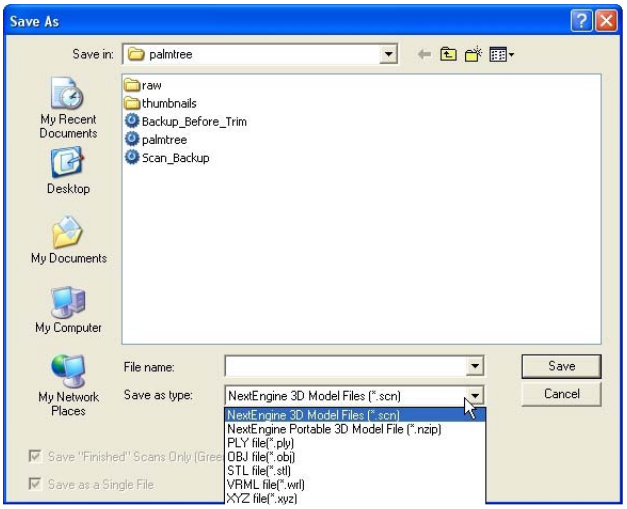
- Click the OUTPUT button to ouput the scan model.

-Choose the type of file you want to output

You can also export through the File-> Save As option.



Mesh Files



- ScanStudio HD allows the export of PLY, U3D, OBJ, XYZ, STL and VRML files.

****For Rhino: export to a OBJ file and see the "Using Rhinoceros: Scan. Cleanup and Remodel" PDF**