headus PlyEdit v3.05

User Guide - 04 Mar 2015

Table of Contents

About PlyEdit 1
- Conventions Used in This Guide 2

Loading Meshes 4
- Mesh 4
- Map 4
- Ghost 5

Mesh Display 6

H - Hiding 8
- Voxels 8

V - Voiding 11

F - Filling 12
- Automatic Hole Filling 12
- Individual Hole Filling 12
- After Filling 14

Brushes 16

G - Mark 17
- Additional Tools 18

3 - Noise 21

4/5 - Sculpt 23
- Additional Settings 23

6 - Smooth 26
- Additional Settings 26

7 - Comb 28

Macros 29

Reduce/Multiply 31

Import Align Combine 32
- Offset 33
- Mark Intersect 33
- Plot Error 34

Body Dewobble 38

3D Paint 39
- Color Tools 39
- 3D Paint 39

Table of Contents

Dirt.....43

Clean.....46

Saving Meshes.....48

Undo.....49

Glossary.....50

Notes.....51

About PlyEdit

PlyEdit is used to edit PLY format 3D geometry files. Its main use is for the clean-up and combining of 3D scans.

When running, PlyEdit consists of 2 windows:

GUI window
: Usually opens up towards the top left of the desktop, and is where you'll find push buttons, value fields, sliders etc. See Fig 1.

3D window
: Opens up to the right of the GUI window, and is where the PLY mesh itself is displayed. Where the User Guide refers to a key action (e.g. **<H>** to hide), you will need to move the mouse pointer into the 3D window before using the key.

Over the following pages the PlyEdit interface will be described. Use the menu to the left to move through the various chapters.

When you click on the **About PlyEdit** button, a window pops up (see Fig 2), showing the version and build date of the PlyEdit that you are currently running.

Run Licensing GUI
: Runs the licensing GUI common to all headus applications. Here you can check your local and floating keys, and edit the local keys file.

View User Guide
: Click this button to view a PDF version of the User Guide in your default browser. Its loading a file included in the software installation, so you don't need to be connected to the internet to view it.

Optional Products
: *This only applies to users who are running PlyEdit via floating licenses*. By default PlyEdit is greedy and will grab all available optional licenses. For example, to use the Body Dewobble tool, a CyEdit license is required; PlyEdit will grab that license from the license server if one is available. If you aren't going to use the Body Dewobble tool then you can turn CyEdit off under the Optional Products panel, and that license will then be available for other users.

Preferences
: Click on this button to open up the **Preferences** panel. In there are a couple of settings you can change that will be remembered next time you run UVLayout.

  Auto Shade By Default
  : Turns on the Mesh Display **A** option by default, where PlyEdit automatically selects a wire or shaded display depending on the number of faces visible.

  Mouse Buttons
  : Sometimes PlyEdit will get confused about the number of buttons your mouse has, particularly if you're on a laptop and are swapping between an external mouse in an inbuilt touch pad without completely rebooting. This may affect things like the Space-MMB action to move objects around. You can use this setting to force PlyEdit to treat the mouse as though

it has the number of buttons you select.

Restore GUI panels
: If you turn this on, then panels opened up when you exit PlyEdit are reopened the next time PlyEdit is run.

Min. Size
: By default, PlyEdit will display a warning if the PLY file being loaded is smaller than 50mm in size. You can change that minimum size here.

Flash Sculpt Brush
: Normally the sculpting brush (e.g. for smoothing) will indicate which faces are being editing by briefly drawing them in a different color; this appears as flickering or flashing of those faces. With some graphics hardware the drawing is so quick that the flashing isn't visible, so ticking this option will make sure it is.

Conventions Used in This Guide

"Tap/Type/Use the <X> key" : press and quickly release the X key on the keyboard.

"Type <X><Y>" : press and release the X key, then press and release the Y key.

"Hold the <X> key" : press and only release the X key once the desired operation is complete.

"<Shift-X>" : first press and hold the Shift key, then tap or hold the X key.

"<Ctrl-X>" : as above, but with the Ctrl key.

"Click the <LMB>" : click the left mouse button once.

"Double click the <LMB>" : click the left mouse button twice, quickly.

"Drag the <LMB>" : press and hold the left mouse button while dragging the mouse.

"<Ctrl-LMB>" : first press and hold the Ctrl key, then do the left mouse button click or drag.

"<MMB>" : middle mouse button, or the right mouse button if you only have a 2 button mouse.

"<RMB>" : right mouse button.

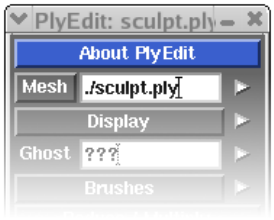

Fig 1. PlyEdit GUI

Fig 2. Preferences

Loading Meshes

PLY files can be loaded into PlyEdit in a few different ways:

1. Right click on the PLY file and select "Edit with PlyEdit".
2. Drag'n'drop the PLY file onto the headus desktop icon.
3. Run "plyedit <file.ply>" from a command shell window.
4. If PlyEdit is already running, use the **Mesh** arrow button.

Mesh

Click on the right arrow to open up a file selection dialog (see Fig 3). If a mesh is already being edited, loading a new PLY file will **replace** that mesh. If you wish to **add** a PLY to the mesh being edited, use the Import Align Combine tools instead.

Clicking on the Mesh button itself will open up a panel showing various details about the loaded file:

F
: Number of faces.

P
: Number of points.

Cntr
: XYZ position in millimeters of the center of mesh.

Size
: Bounding box size in millimeters of the mesh.

A
: Total area of the mesh surface.

V
: Total volume of the mesh if there are no holes.

Map

If the PLY file being edited has UV coordinates, then the Map option will appear (see Fig 4). Click on the right arrow to open up a file selection dialog where you can load the color map for that PLY file. Only a small number of editing tools currently support UV color, where CPV is fully supported.

Clicking on the Map button will open up a row of additional options:

Max U

Defines the maximum U dimension of tiled color maps. *Only used with CySlice color map resampling*.

X

Use this button if you want to unload the UV color map.

Ghost

Click on the right arrow to optionally load a ghost mesh (see Fig 5). This mesh cant be edited, but is used as a visual reference or source for cut'n'paste operations. In theory the ghost can be any mesh, but is usually an unedited version of the mesh currently loaded. You can flick between the ghost mesh and the edit mesh with the **<0>** key.

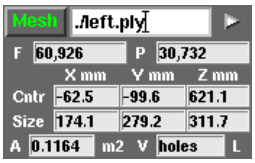

Fig 3. Loading Meshes

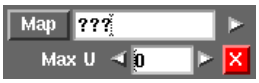

Fig 4. UV Map

Fig 5. Ghost Mesh

Mesh Display

In the Display panel you can control various settings about the camera and mesh appearance.

Persp Ortho
: Toggle between a perspective and orthographic camera. You can also use the **<O>** key in the 3D window to flick between these two.

Up X Y Z
: When rotating the view with the **<LMB>**, the mesh will spin about its **Up** axis. If you load your mesh and its appears to by lying on its side, try a different **Up** axis to get it upright. Alternatively, you can use **<Ctrl-LMB>** to spin the mesh around the center of the window until its **Up** is correct.

Wire
: When selected, the mesh is always drawn using a limited number of wire-frame triangles. This is the fastest display mode, but you will need to use the **<S>** key to see the mesh shaded.

&
: The mesh is drawn in wire-frame when the view is being changed, and is shaded otherwise.

Shade
: The mesh is always drawn shaded, even when changing the view. This can be slow if your mesh is very detailed.

A
: Automatic, where one of the above settings is used depending on the number of triangles visible.

Opacity
: Drag the slider to the left to make the mesh more and more transparent. This is mostly used in PlyEdit when lining up imported meshes (see Fig 7).

Smooth
: Turns on smooth shading whenever the mesh is drawn shaded.

Color
: Turns on the CPV or UV color whenever the mesh is drawn shaded.

Light
: Drag the slider to the left or right to change the direction of the light source used when shading the mesh. Click the Light button itself to turn the light source on and off; you might do this if you want to see the mesh's color without any surface shading (see Fig 8).

Fig 6. Mesh Display

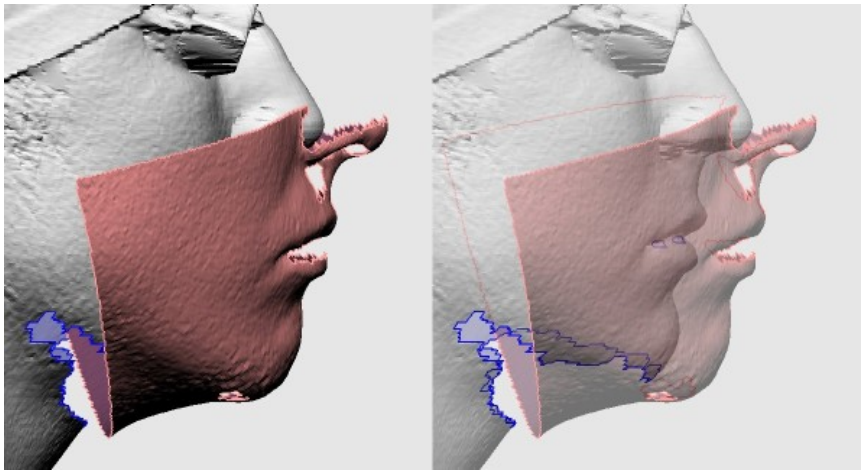

Fig 7. Mesh Opacity

Fig 8. Light On and Off

H - Hiding

Being able to hide faces, particularly when working with dense meshes, can greatly speed up the editing process. There are a hand-full of hiding operations, all accessed via the **<H>** key.

Fig 9 shows you what you get once you have hit the **<H>** key; a menu of further key commands down the bottom of the screen.

<LMB> - Hiding Inside a Box

If you draw out a box with **<H><LMB>**, then all faces inside this box will be hidden (see left side Fig 10).

<RMB> - Hiding Outside a Box

If, however, you draw out a box with **<H><RMB>**, then all faces *outside* the box are hidden (see right side Fig 10).

<G> - Hiding Marked Faces

You can hide all the green marked faces by typing **<H><G>** (see Fig 11).

<F> - Hiding Using Filling

Typing **<H><F>** is a shortcut version of the surface hiding sequence **<G><F> <H><G>**. Because it uses the marking mechanism to select the faces, any faces that happen to be already marked will also be hidden.

<S> - Swapping Hidden Faces

Type **<H><S>** to swap the visible and hidden faces.

<U> - Showing Hidden Faces

Type **<H><U>** to unhide all hidden faces.

<Home> or **<H>** - Hide Outside Focus

Aim the mouse pointer at some section of the mesh, then type **<H><Home>** or **<H><H>**, and everything except that part of the object is hidden. The camera will also focus in automatically on the remaining visible faces. Aim the mouse pointer at some background, then type **<H><Home>** or **<H><H>**, and all faces are made visible and the camera re-focuses on the entire mesh.

Voxels

When you think you've finished editing a mesh, its a good idea to do a final check. Often defects can be hidden in the shadows, or behind other features, so they are hard to spot when viewing the mesh normally. The **Voxels** tool is a way to ensure you get to see every part of the mesh close-up enough to spot any final problems that need fixing. A voxel is the 3D equivalent of pixels in an image, so in this context it means that the mesh is divided up into a number of equal sized boxes or cells (see Fig 12), and the faces inside each one of these is examined in turn.

To start, type the **<]>** key. You will be prompted for a number of voxels, and then the number of X, Y and Z divisions is displayed that most closely matches the number of total voxels you entered. You have the option

then to type in a different number of divisions before proceeding. The first voxel with any number of faces in it is then displayed, and you can spin the view around to check that everything is OK. If you have the **Mesh Display** mode set to **A** (i.e. auto) then there's a good chance that the mesh will automatically shade because only a small fraction of the total number of faces will be visible at any one time.

When you are "inside" a voxel, the editing functions work as they normally would. All that the voxel viewing tool is doing is hiding the other parts of the mesh, so you can use **<H><U>** if you want to see where the voxel is in relation to other parts of the mesh.

To move to the next voxel, type the **<]>** key again. At the top left of the window, a counter will display which voxel you are up to, and how many voxels in total there are. If you want to go back to a previous voxel, type **<[>**. If you want to exit from the voxel viewing mode, type **<{>** or **<}>**.

Fig 9. Hiding Faces

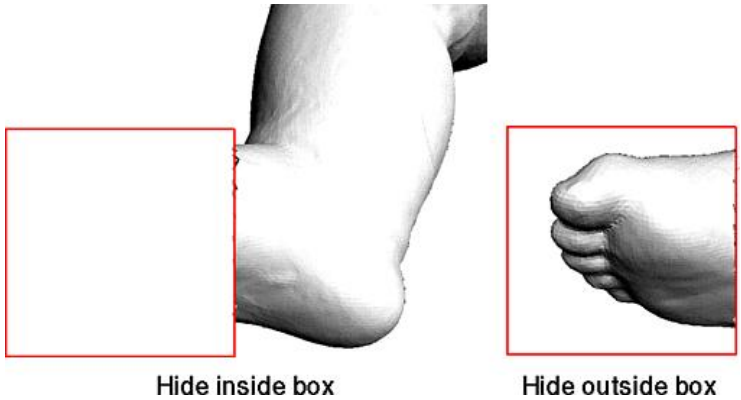

Fig 10. Hiding With the Box

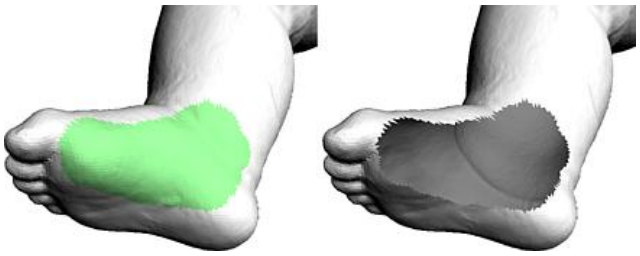

Fig 11. Hiding Marked Faces

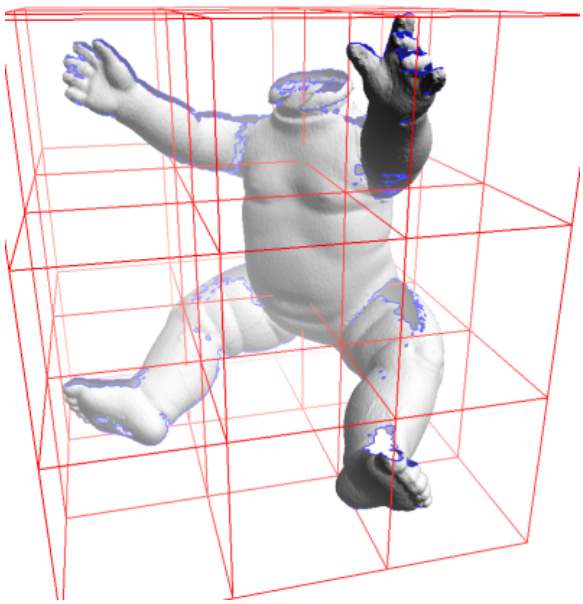

Fig 12. Voxels

V - Voiding

Voiding is the process of deleting unwanted faces. There are a hand-full of voiding operations, all accessed via the **<V>** key.

Fig 13 shows you what you get once you have hit the **<V>** key; a menu of further key commands down the bottom of the screen.

<LMB> - Voiding Inside a Box
: If you draw out a box with **<V><LMB>**, then all faces inside this box will be removed.

<RMB> - Voiding Outside a Box
: If, however, you draw out a box with **<V><RMB>**, then all faces *outside* the box are deleted.

<G> - Voiding Marked Faces
: You can delete all the green marked faces by typing **<V><G>**.

<U> - Undo Last Void
: Type **<V><U>** to undo the last void action. There is only one level of undo though, so you can only undo the last void action, not any previous to that.

<S> - Swapping Voided Faces
: Type **<V><S>** to swap the deleted and remaining faces; this can be used to recover faces voided before the last void action. Type **<V><S>**, then void the faces you want to restore, then type **<V><S>** a second time to get your mesh back.

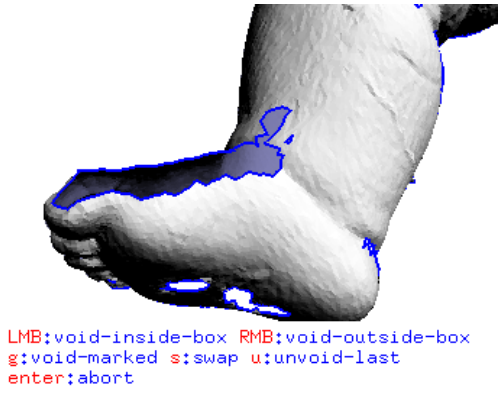

Fig 13. Voiding Faces

F - Filling

Holes in the mesh are outlined in blue. There are a hand-full of hole filling operations, all accessed via the **<F>** key.

Fig 14 shows you what you get once you have hit the **<F>** key; a count of the number of visible holes, followed by a menu of further key commands down the bottom of the screen.

Automatic Hole Filling

<F> - Fill All

Type **<F><F>** to fill all visible holes. You will be prompted for the number of holes to leave, so type something in and hit **<Enter>**, and all but that number of the largest holes will be filled. Just hit **<Enter>** if you really do want all visible holes filled.

<H> - Holes Only

The **Fill All** tool doesn't distinguish between genuine holes and floating faces, its just looks for blue edges and fills between them. If you use this **Holes Only** tool instead, it will look more closely at the surrounding faces, and will only fill if its an obvious hole. The unfilled edges are protected (as if you'd used the **<P>** key).

<P> - Protecting Holes

You can protect holes from being filled with **<F><P>**. **<LMB>** stretch a box over some holes and they'll turn from blue to red, indicating their protected status. Do the same again to unprotect those holes.

<U> - Unprotect All Holes

You can unprotect all holes, making them fillable, with **<F><U>**.

Individual Hole Filling

The auto fill its a excellent way to fill a large number of small holes quickly, but for complex holes you may want more control over the fill shape. The **<N>** key can be used to fill individual holes.

<N> - Go To Next Hole

Typing **<N>** will focus the view onto the next unfilled hole, and a new menu of key commands is displayed (see Fig 15).

If you are inside the **<F>** menu, the **<N>** key takes you to the next larger visible hole. If you use the **<N>** key outside of the **<F>** menu, then you are taken to the hole closest to the face under the mouse pointer. So, if you want to fill a specific hole, just aim the mouse pointer close by and type **<N>**.

<T> - Triangulate

Typing **<T>** will cycle through 3 different hole filling methods (see Fig 16):

1. The first method is to fill with approximately the same density of faces as the surrounding mesh; this may take a long time for very large holes, but you can stop it mid-way if you wish by holding the space bar, and you'll get fewer triangles.
2. The second method is to simply connect the boundary points; no additional points are added.
3. The third method is to insert a single point in the center of the hole, and then all boundary edges are connected to this center point.
4. Typing **<T>** a fourth time will take you back to an unfilled hole.

Occasionally a hole is too complex for triangulation, and an error is displayed. In those cases you can use one of the following tools to clean-up or simplify the hole ready for a second fill attempt.

<B> - Bridge

To connect together a pair of edges, use the **<B>** key. You might use this if you want specific edges connected with a perfectly straight line, or to simplify a complex hole by splitting it into smaller ones.

First move the mouse pointer over one of the blue highlighted edges, then type **<B>** and that edge will be highlighted with a thicker yellow line. If you have accidentally selected the wrong edge, aim the mouse pointer at the background, or some other part of the mesh (but not another edge!), and use the **<Backspace>** key to unselect it.

Next move the mouse pointer over the second edge and type **<B>** to connect the two edges. If you accidentally selected the wrong edge at this point, you will need to use the **<Backspace>** key to deleted all of the newly created bridging faces. In this case you do need to move the mouse pointer so its over the blue edges when holding the **<Backspace>** key.

If you are just viewing the mesh, you can also use the **<B>** key to bridge between a pair of blue highlighted edges (see Fig 17). Use **<Backspace>** again if you accidentally pick the wrong edges.

<Backspace> - Delete Edge

The **<Backspace>** key can also be used to delete any blue highlighted edges. Just aim the mouse pointer at the edge and type **<Backspace>**, or hold the **<Backspace>** key down and move the mouse pointer about to delete multiple edges. Deleting edges with **<Backspace>** works both inside and outside of the **<N>** key menu.

<Space-Backspace> - Delete All Edges

Delete all faces adjacent to the current hole with **<Space-Backspace>**. You might use this when the boundary of a hole is very messy and the triangulation fails.

<Home> - View Focus

If you want to know where the current hole is in relation to the rest of the mesh, type **<Home>**. This shows you the mesh in wireframe, with an arrow pointing to the hole's location. Type **<Home>** again to get back to the zoomed in view.

<Enter> - Stop Filling

To exit from the **<F>** key or **<N>** key menu, type **<Enter>**.

After Filling

All holes are filled with green marked faces (see the G - Mark chapter for more details). This allows you to perform other actions that improve the quality of the filled faces, such as smoothing. In particular, the default **<F4>** macro does an excellent job at cleaning up newly filled holes.

Fig 14. Filling Menu

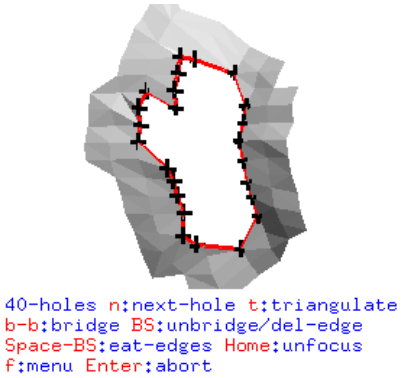

Fig 15. Filling A Hole

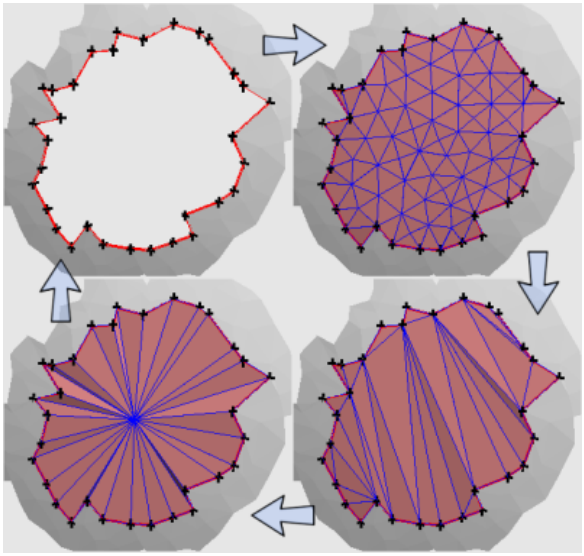

Fig 16. Triangulate Loop

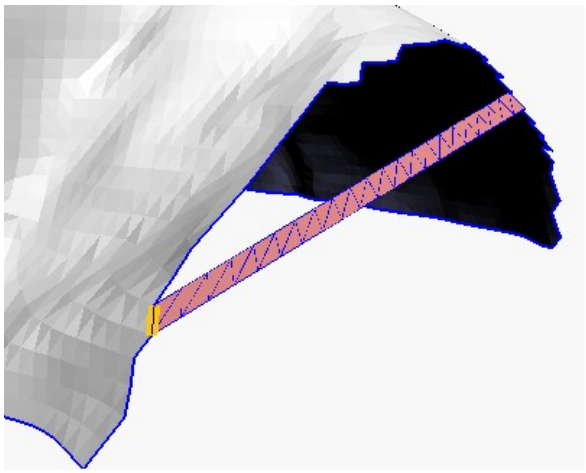

Fig 17. Bridging

Brushes

The **Brushes** panel is used to change parameters of the various sculpting brushes (see Fig 18). The first column **Key** indicates the key used, the second column **Action** describes what that key does, and the **Amount** column is where the strength of that brush is adjusted. The specific details of each of the different brushes are described in the following sections.

If you have the parameters setup just perfectly for a particular project or type of mesh, then you can save those out to a settings file than can be reloaded at a future date. The **Load**, **Save** and **Delete** buttons at the top of the **Brushes** panel are used to handle the settings files. If you save the current settings to a file called **default.settings**, then those parameters will be automatically restored whenever you start PlyEdit.

Common to all of the sculpting brushes are the **<->** and **<=>** keys. These are used to adjust the size of the brush, by either typing in an exact radius, or by repeatedly tapping the **<->** and **<=>** keys until the displayed radius is whats desired. If the mouse pointer is over a section of mesh, then a blue circle is displayed to show the area of affect of the current radius. Type **<Enter>** or click the **<LMB>** to accept the radius setting.

If you click the gray **Set Brush Size** button, then you can adjust the *relative* sizes of the different sculpting brushes (see Fig 19). Its perfectly OK to leave these all on **1.0**, but I personally run my Noise brush at **1.5**, which means that no matter what size I select with the **<->** and **<=>** keys, the Noise brush will always be 50% bigger than the other brushes. Click the gray **Set Brush Size** button a second time to bring back the normal Brush panel buttons.

Fig 18. Brushes

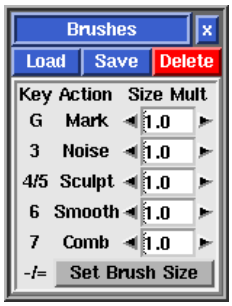

Fig 19. Relative Sizes

G - Mark

Marking lets you select faces in various ways for later hiding, smoothing or removal. There are several marking operations, all accessed via the **<G>** key. Marked faces are drawn green, that's why the **<G>** key is used.

Fig 20 shows you what you get once you have hit the **<G>** key; a handy reference to the various operations towards the bottom of the window.

<LMB> - Marking Inside Box

You can draw out a box by holding down the **<LMB>** while dragging the mouse; let go of the mouse button and all faces inside the drawn box will be marked (see Fig 21). This includes faces that might be on the other side of the object, obscured behind the faces at the front. Hidden faces will not be marked.

<RMB> - Unmarking Inside Box

Draw out a box using the **<RMB>** and all faces inside the box will be unmarked (see Fig 22).

<G> - Painting

You can use the mouse pointer to mark faces in a more interactive way using the painting method. By typing **<G>** a second time you'll paint a single dot under the mouse pointer. Unlike the box selection method, only the faces you can see are marked; the painting doesn't go all the way through the object.

If you want to paint more than one dot, just hold down the **<G>** key and faces will be marked wherever you move the mouse pointer (see Fig 23). When you want to stop painting, let go of the **<G>** key.

If you want to unmark using the painting method, use **<Shift-G>** instead.

<F> - Filling

To mark an area of unmarked faces in a flood fill fashion, move the mouse pointer into some part of that area (see left side Fig 24) and type **<G><F>**. The flood fill will not cross a boundary of already marked or hidden faces (see right side Fig 24).

In Fig 24 the smile of the face has been extended to fully encircle the ankle, before filling, otherwise the whole leg would have been marked.

You can unmark using the flood fill method by just pointing the mouse pointer at an area of marked faces before filling.

If you want to stop the flood fill, hold the **<Space>** key.

<=>/<-> - Grow and Shrink

Use **<G><=>** to grow or **<G><->** to shrink the current marked area by one row of faces. The marking menu will remain active after the change, so you can use **<=>** or **<->** again to further expand or shrink the marked area.

<S> - Swapping

To swap the marked and unmarked status of all visible faces, type **<G><S>** (see Fig 25).

<U> - Unmarking

To unmark all visible faces, type **<G><U>**.

<Home> - Focus

To focus the camera on all visible marked faces, type **<G><Home>**.

Additional Tools

If you click on the gray **Mark** button in the **Brushes** panel, then some additional marking tools are shown (see Fig 26). Click on the **Mark** button again to hide these away.

Largest

The largest contiguous piece of mesh is marked, and the camera focuses in on this area.

Next

The *second* largest contiguous piece of mesh is marked, and again, the camera focuses in on these marked faces. This can be used in conjunction with **<B>** key bridging to join the largest pieces of "floating" mesh to the main mesh.

Facing

All visible faces that are facing the camera are marked. The number value is the threshold angle, and setting it to **180** for example will mean that all the faces you can see are marked.

Paint Thru

Normally when painting faces with the **<G>** key, only the foremost faces under the mouse pointer are marked. By ticking this option, *all* faces under the mouse pointer are marked, even those you cant see on the back side of the mesh.

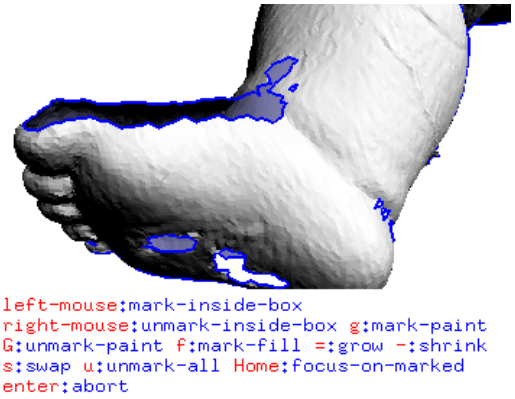

Fig 20. Marking Menu

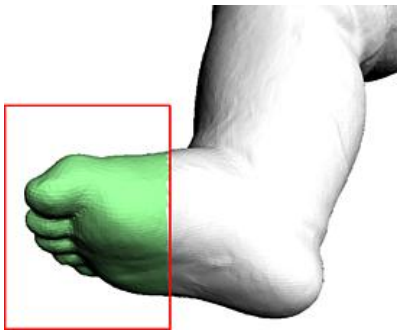

Fig 21. Marking Inside a Box

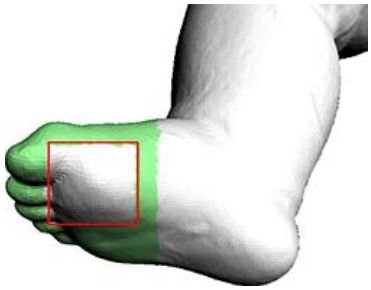

Fig 22. Unmarking Inside a Box

Fig 23. Painting

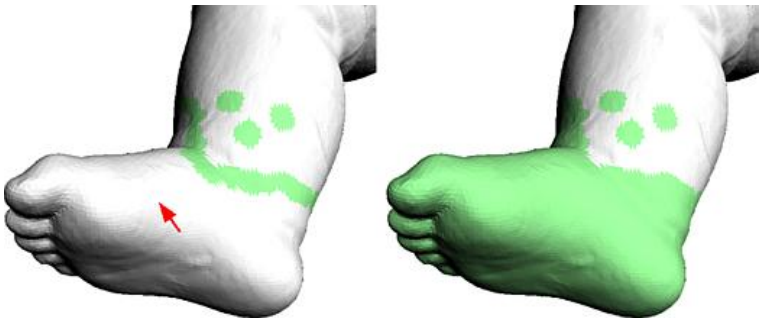

Fig 24. Filling

Fig 25. After Swapping

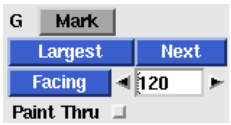

Fig 26. Additional Tools

3 - Noise

The Noise tool does the opposite of smoothing. Normally 3D scans have a bit of noise in them, but filled holes are perfectly smooth, so the noise brush can be used to make the filled areas look more like real data.

Fig 27 shows you what you get when you use the **<3>** key; there's only two options:

<3> - Painting
: Press and hold the **<3>** key to apply noise at the mouse pointer location. You can adjust the degree of noisiness under the **Brushes** panel.

<G> - Noise Marked Area
: Or you can use the **<G>** key to mark an area out first, then use **<3><G>** to apply noise to that area.

  First you will be asked for a **Border** value; this is the area *outside* of the marked faces that is used to blend in the noise texture (see Fig 28).

  Next you'll be prompted for the noise amount; the value here is a percentage of the size of the faces being affected. For example, if a face is 1mm long, then a noise amount of 100% will add up to 1mm of noise to the vertexes of that face. A typical setting here would be around 10%.

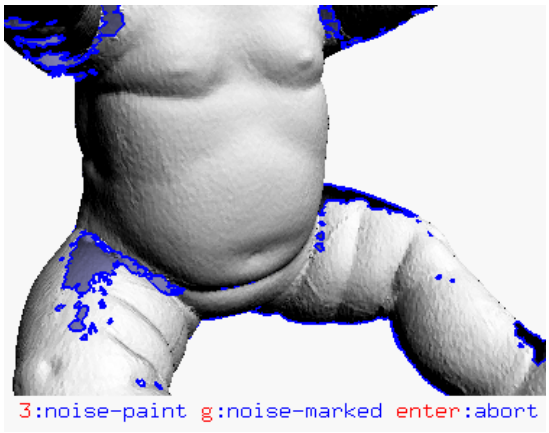

Fig 27. Noise Menu

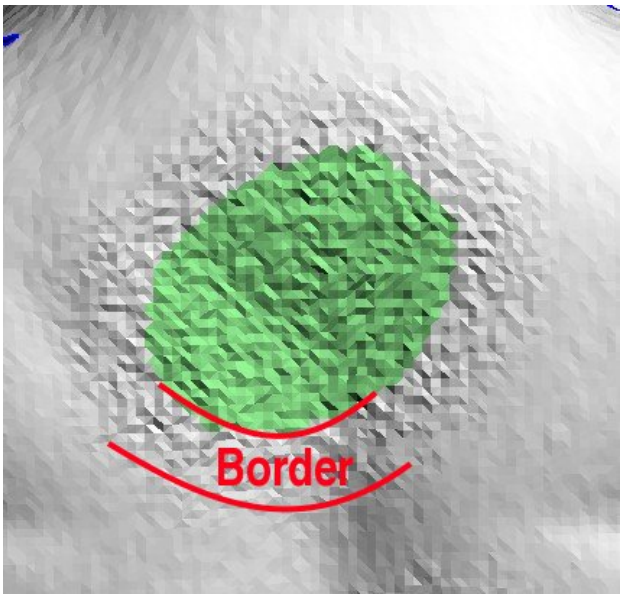

Fig 28. Noise Marked

4/5 - Sculpt

The **<4/5>** tools are used to pull out or push in the surface.

Fig 29 shows you what you get when you use the **<4>** or **<5>** keys:

<4> - Push
: Press and hold the **<4>** key to push in the surface at the mouse pointer location.

<5> - Pull
: Press and hold the **<5>** key to pull out the surface at the mouse pointer location.

<G> - Sculpt Marked
: You can use **<5><G>** to pull a marked area out, or **<4><G>** to push it in. First you will be asked for a **Border** value; this is the area *outside* of the marked faces that is used to blend in the sculpted amount (see left side of Fig 30). Next you'll be prompted for the sculpt amount itself, and then finally the affected area will be shaded blue and you are asked to confirm with a **<Y>** key if the modification should proceed. Type **<N>** if you want to abort at this point.

<Shift-G> - Sculpt Marked Inwards
: If you only want the marked faces modified, then use **<4><Shift-G>** to push or **<5><Shift-G>** to pull. You are prompted for the sculpt amount, and straight after that the surface is modified. The sculpt amount is blended across all of the marked faces, with zero at the boundary and the maximum amount towards the center (see right side of Fig 30).

Additional Settings

If you click on the gray **Sculpt** button in the **Brushes** panel, then some additional settings are shown (see Fig 31). Click on the **Sculpt** button again to hide these away.

Shape
: Sets the shape of the push and pull brushes (see Fig 32).

Dir
: Sets a special direction for the push or pull action.

  Off
  : No special direction. All points are moved in the direction of the average surface normal at the mouse pointer location, and this is good for most sculpting work.

  Eye
  : All points are moved directly towards or away from the eye/viewer.

  Out
  : Each individual point is moved in the direction of the surface normal at that point.

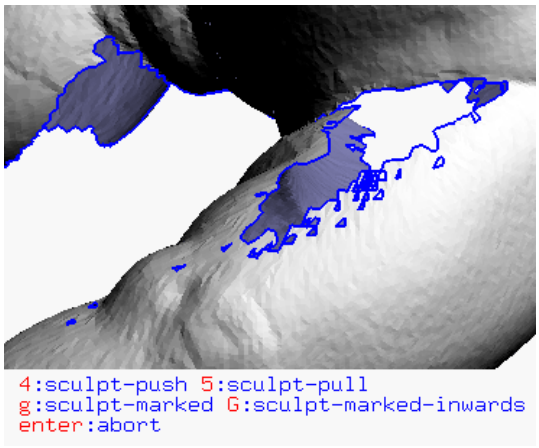

Fig 29. Sculpt Menu

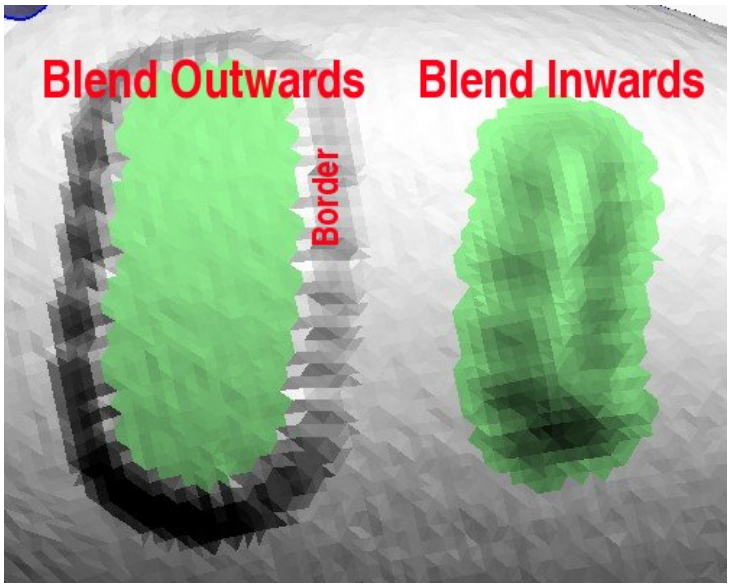

Fig 30. Sculpt Marked

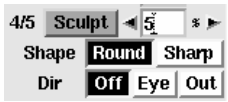

Fig 31. Settings

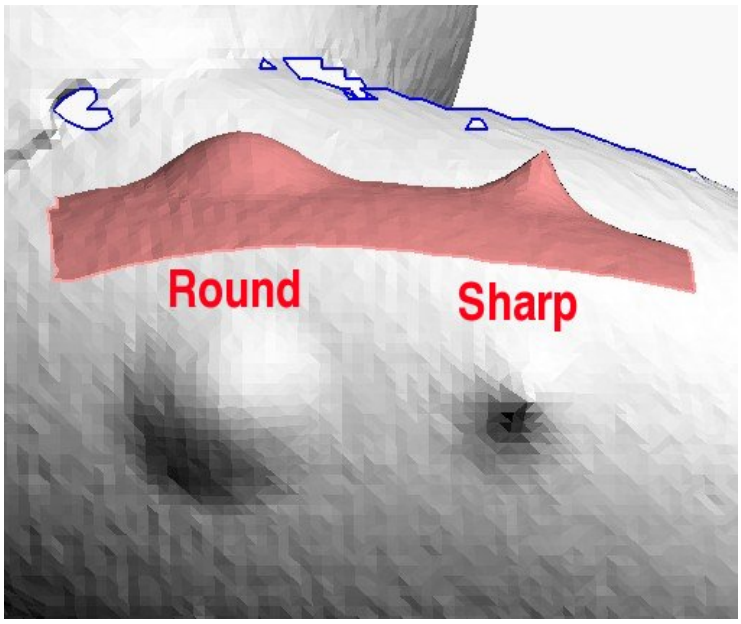

Fig 32. Shape

6 - Smooth

Fig 33 shows you the menu that appears when you use the **<6>** key.

<6> - Painting

Press and hold the **<6>** key to smooth the mesh at the mouse pointer location. You can adjust the degree of smoothing under the **Brushes** panel.

<E> - Smooth Everything

This will smooth the entire mesh, even the hidden parts. You are asked for the smoothing amount, and then **<Y>** to confirm before the anything is done.

<G> - Smooth Marked Area

Or you can use the **<G>** key to mark an area out first, then use **<6><G>** to smooth just that area. First you will be asked for a **Border** value; this is the area *outside* of the marked faces that is used to blend in the smoothing. Next you'll be prompted for the smooth amount itself, and then finally the affected area will be shaded blue and you are asked to confirm with a <Y> key if the modification should proceed.

Additional Settings

If you click on the gray **Smooth** button in the **Brushes** panel, then some additional options are shown (see Fig 35). Click on the **Smooth** button again to hide these away.

Normal

Smooth both the geometry and the color in the normal way. It uses a very simple averaging algorithm that makes it fast, but it will shrink protruding features (see Fig 34).

Volume

Volume preserving smoothing. This is slower, but will attempt to preserve the volume of small protrusions and thin walls during smoothing.

Color

Only the CPV color is smoothed; the geometry is left alone.

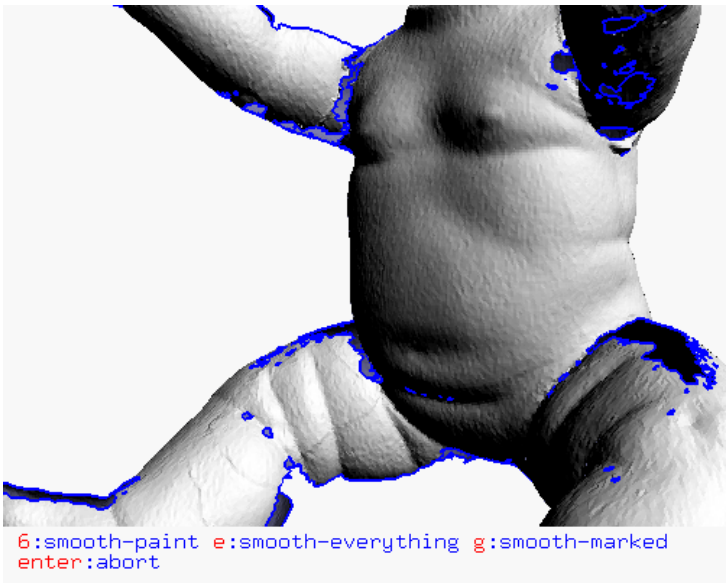

Fig 33. Smooth Menu

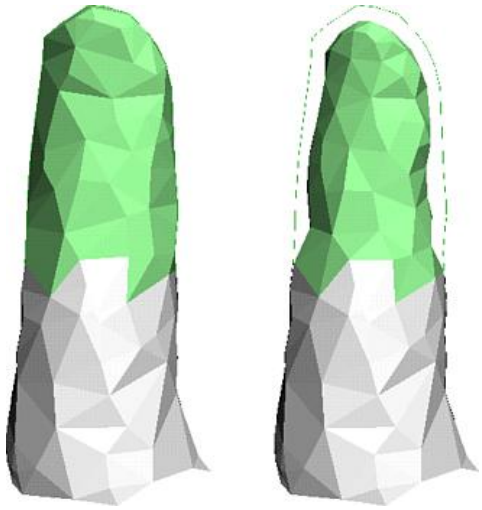

Fig 34. Normal Smoothing

Fig 35. Options

7 - Comb

Press and hold the **<7>** key, then move the mouse pointer over the mesh to align edges in that direction (see Fig 36).

This sometimes improves the appearance of feature lines in the mesh, such as wrinkles or ridge lines.

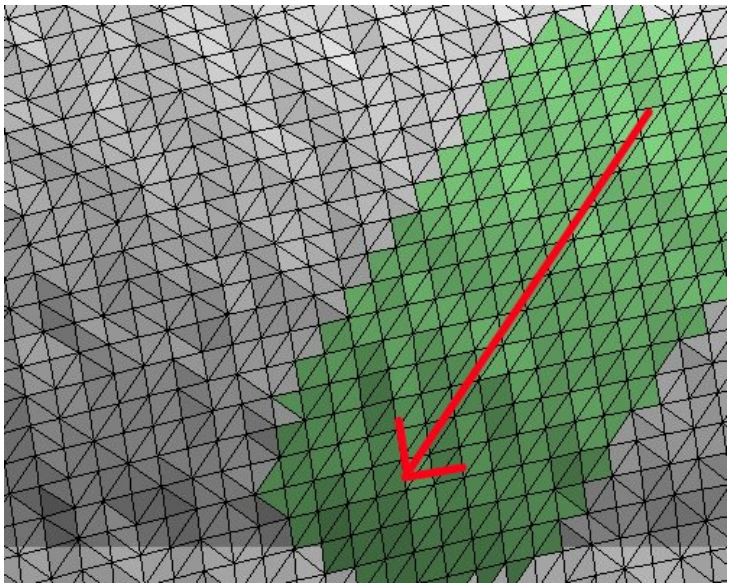

Fig 36. Combing Edges

Macros

Macros in PlyEdit are programmable buttons that are a handy way to execute a series of commands or hotkey actions with one key or button click. By default they are set up to multiply, smooth or add noise to **<G>** key marked faces, which are all actions that can be performed in other ways already (e.g. see the Brushes chapter), but they're much quicker via the macro button or **<F1>** to **<F4>** keys.

Load

Load an existing macros file. The file selection dialog that pops up also gives you the opportunity to edit the macros file before it is loaded; if you click on the **Show** button, the selected macros file will be loaded into a text editor.

The default macros file looks like this ...

```
Mult 1.5,g* 1.5 1
Smooth 2,6g 1p 2
Noise 40%,3g 1p 40
Mult Smooth Noise,g=,g=,g* 1.5 1,6g 2p 10,3g 2p 40,g-
```

The first comma separated field is the label that appears on the macro button in the GUI; any text can go in here. The remaining comma separated fields are the actions that that macro performs, and the green highlight values are the one you will most likely be wanting to change. If, for example, you want the **<F1>** key to multiply more than the default setting, increase the green highlighted multiply amount of the first macro. When you have made your adjustments, save the text file and click the file selection dialog **Load** button to load those macros in.

PlyEdit supports up to 12 macros at any one time, but only the first 4 are mapped to function keys; the fifth to twelfth macros in the file are only given a button in **Macros** panel.

Save

Save the current macros to a new or existing file. This may be a good idea if you are experimenting with programming a new set of macro buttons; save the default macros into a new file, edit and load that file as you work on the macros, then over-write the *default.macros* file when you are ready to make them the defaults.

Delete

Delete a macros file you no longer need.

R

Click the **R** button and your key strokes are recorded into the macro definition until you click the same button again to stop recording. The macro button then becomes an editable field, where you set the name for the new macro. If you are having problems editing the macro definitions directly via the text editor, this is an alternate method to program new macros.

The topic of Macro programming is quite an advanced one, but the aim of this chapter is to give you an overview of the possibilities when talking to software support about developing new macros.

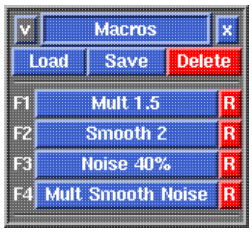

Fig 37. Macros

Reduce/Multiply

The **Reduce/Multiply** panel is used to either reduce (i.e. decimate) or increase the number of faces in a marked area.

First use **<G>** to mark out the area you want to modify, then you have the option to click one of the shortcut buttons along the bottom, or enter a specific target into the **Num** or **Percentage** fields. If you enter a value into either of the target fields, make sure you type **<Enter>** to update the other field, then click on the **Do It** button to perform the operation.

The following additional parameters apply to decimation only:

Feature Weight
: Set this percentage higher to retain more faces in areas of greater detail. Set it lower to more evenly decimate faces across the marked areas.

Smooth After Reduce
: After the faces are decimated, a subtle smoothing is applied to the marked areas to help get rid of thin triangles. This is recommended if you are going to reduce the marked areas to even lower levels of decimation.

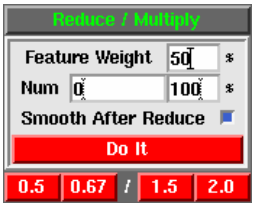

Fig 38. Reduce/Multiply

Import Align Combine

The **Import Align Combine** panel is used to cut'n'paste pieces of mesh within or between PLY files.

Import

Load in another PLY file as a separate mesh. Fig 40 shows the different coloring applied when multiple meshes are loaded. As you can see, its possible to have many meshes loaded, but only the 2nd "red" mesh can be moved around or sculpted. To avoid confusion, its recommended that you only work with 2 meshes at a time, that is, the 1st "white" mesh and the 2nd "red" mesh.

Fig 41 shows the mouse controls you use to move the 2nd "red" mesh about. You don't need to aim the mouse pointer at the mesh, just have it anywhere inside the graphics window to perform the action.

Replace

If two meshes are loaded, a file selection window pops up, and the PLY selected will replace the 2nd mesh. If three meshes are loaded, the 2nd is deleted and the 3rd is moved into that position. This tool is normally used to substitute a hirez mesh for a decimated copy that has already been positioned in the scene.

Cut

Removes **<G>** marked faces from the 1st mesh and puts them into a new mesh at the end of the list.

Copy

Copies **<G>** marked faces into a new mesh.

Roll

Changes the mesh ordering by one step. If there's only 2 meshes, this swaps the 1st and 2nd meshes around.

Paste

Copies the faces in the 2nd mesh into the 1st mesh, then deletes the 2nd mesh.

Blend

Smoothly blends in faces from **all** the other meshes, then deletes those meshes. You will be prompted for a brush size in the 3D window; if the overlapping faces aren't intermixed that well, then you may want to increase the default brush size to make sure that faces further apart are still blended together. If the brush size is too small then you will end up with a double skin in the overlapping areas.

Delete

Delete **all** other meshes, leaving just the 1st mesh.

Space Mode

Normally the 2nd "red" mesh is rotated by holding **<Space>** then click'n'dragging the **<LMB>**, and moved with **<Space-MMB>**. For safety reasons, you can only scale the 2nd mesh by first selecting **Scale** next to the **Space** option, then use **<Space-RMB>** to resize.

Mirror

Mirrors the last mesh in the list about the Y-Z plane (i.e. its X coordinates are reversed).

Refine

If you need to align two meshes together that are the same shape, then the **Refine** tool can be used to calculate a closer fit than you could ever get my manually positioning them. You still need to roughly position them over the top of each other with **<Space>**, but once that's done, just click **Refine**. The 2nd "red" mesh is then rotated and moved around in gradually smaller amounts to get the best fit between itself and the first "white" mesh.

The five toggle boxes underneath (numbered 1 to 5) represent the 5 stages of refinement, where 1 is the coarsest, and 5 is the most fine. The first stage is designed to be quick and dirty, pulling meshes closer together that are far apart, but sometimes this stage actually moves meshes out of alignment; this is especially a problem when there's not a lot of overlap between the two meshes. If this happens, turn off number 1 and re-run the refine. You can turn the other stages of refinement on and off for finer control over the process.

Show

Tick either of the boxes to show or hide the first or second meshes. You can also use the **<1>** or **<2>** hotkeys to toggle each mesh on and off.

Sculpt

Select which mesh is affected by the sculpting brushes.

Flip

Inverts the surface normals on either the 2nd "red" mesh, or the green selected faces on the first "white" mesh.

Offset

The **Offset** tool is used to add a "back face" to a section of mesh. First **<G>** key mark the faces you want to offset, set the thickness amount, then click the **Offset** button. The marked faces are copied, flipped so their normals are facing backwards, then each vertex is pushed back in the direction of the surface normal at that point.

Convex surfaces will balloon out, and concave surfaces will end up self-intersecting if the offset is large enough, so sometimes its a good idea to do an initial offset of about half what you think you want. You can then check the offset surface, maybe even smooth or sculpt it a bit to remove the self-intersecting faces. Click the **Offset** button a second time and, because you already have an offset surface created, that surface is simply push back a bit more; there's no copying of faces or flipping of surface normals.

For example, this tool can be used to add some mesh behind the ears, something that is usually missing from cylindrical type head scans (see Fig 42). In Fig 43 you can see that the front of the ear is marked, its offset by around 4 or 5 mm, then the resulting mesh is sculpted and blended in with rest of the ear.

Mark Intersect

The **Mark Intersect** tool is used to green mark faces near the intersection of two or more objects. These marked faces could then be voided, and the gap bridged across, to join the two objects together.

The three buttons are:

Mark Intersect
: When you click this button, you're prompted in the 3D window for a **Tol** value. Faces are then marked, at the junction between the two objects, if they are within this distance apart. See Fig 44 for a before and after image.

  Sometimes though, particularly if the tolerance value is less than the size of the faces, you'll end up with gaps in the strip of marked faces (see left side of second image). If you see this happening, or expect it will because of a low tolerance value, use either one of the following buttons.

x2
: This button does an initial intersection test at 2 times the tolerance value, then multiplies the faces found, then does a second intersection test at the original tolerance value. Its slower than the simple test from above, and creates more faces around the junction, but that may be be quicker in the long run than having to manually find and fix the gaps yourself. See Fig 45 for a before and after image.

x4
: Same as above, but the initial test is done at 4 times the entered tolerance value. To be used if the faces are quite a bit larger than the tolerance value entered.

Plot Error

The **Plot Error** tool is used to visualize the difference between a pair of meshes.

1. Use the main GUI **Mesh** input to load one of the meshes.
2. Use **Import** to load the second mesh.
3. Use the **<H>** hotkey to hide parts of the meshes that might adversely affect alignment.
4. If it isn't already, use **<Space-LMB>** and **<Space-MMB>** to position the second mesh closer to the first, then click on **Refine** to do the alignment.
5. Hide the second mesh by unticking **Show 2nd**.
6. Use the **<G>** hotkey to mark out the area that you want to compute the difference for.
7. Set the error threshold then click on **Plot Error**.

A histogram window pops up, and the first mesh is re-colored in the marked area. Red is where the first mesh is over the top of the second, blue is where its underneath, and solid red/blue is where the error is greater than the threshold setting (see Fig 46).

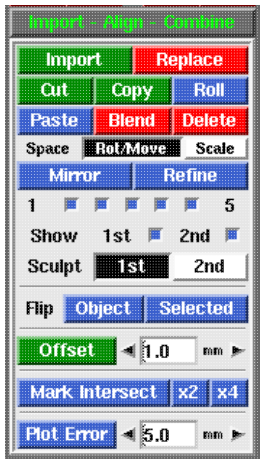

Fig 39. Import Align Combine

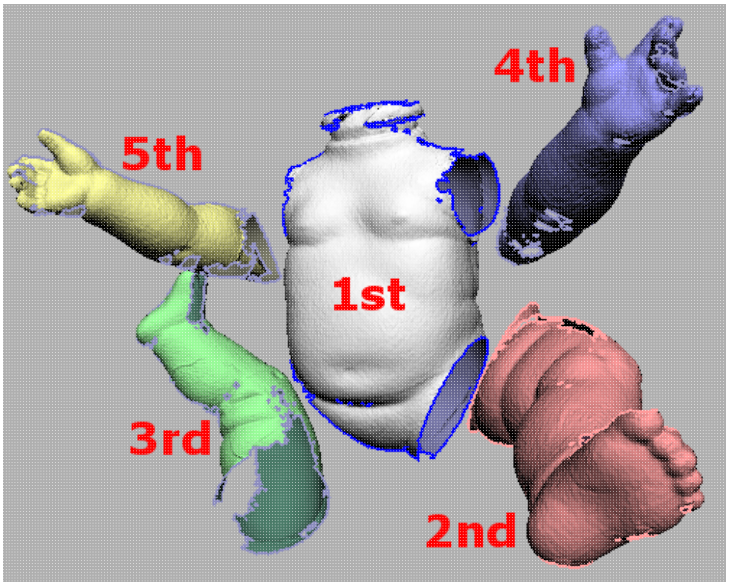

Fig 40. Mesh Colors

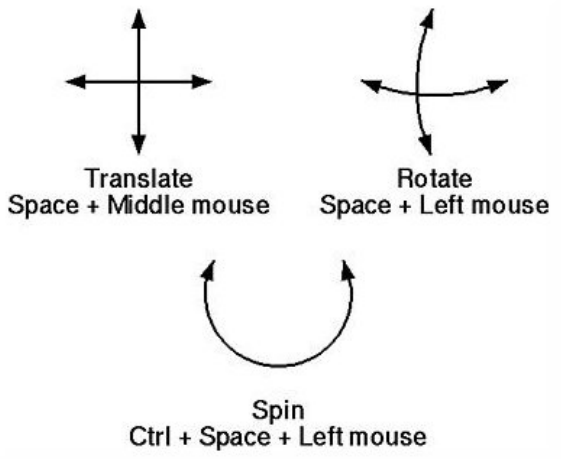

Fig 41. Postioning Meshes

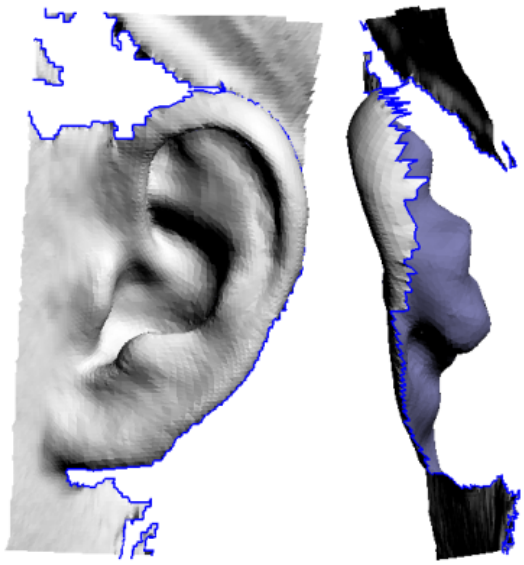

Fig 42. Missing Behind Ear

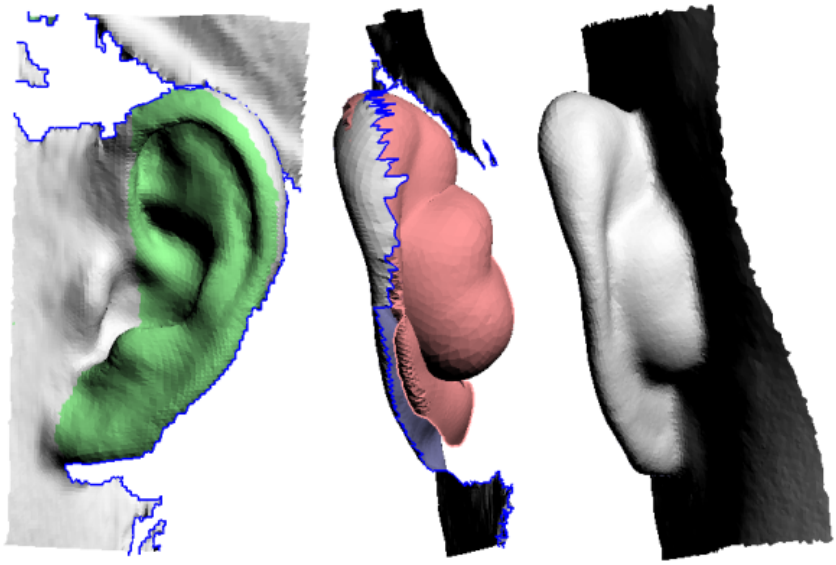

Fig 43. Offset Surface

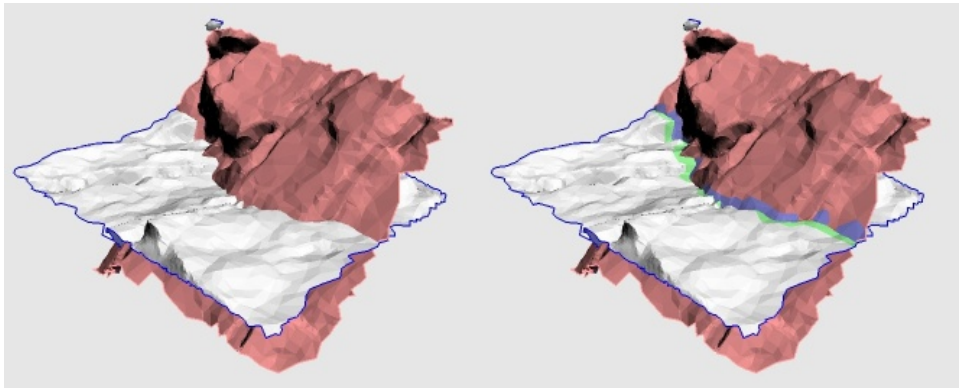

Fig 44. Before and After Mark

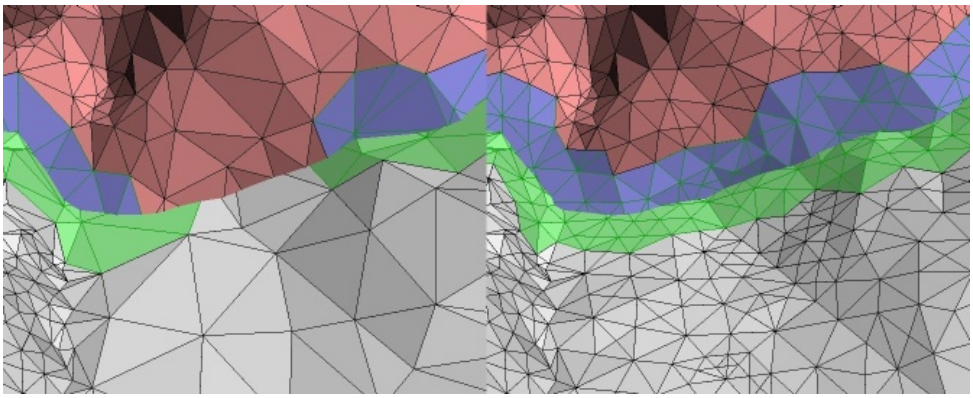

Fig 45. Fixing Gaps with x2

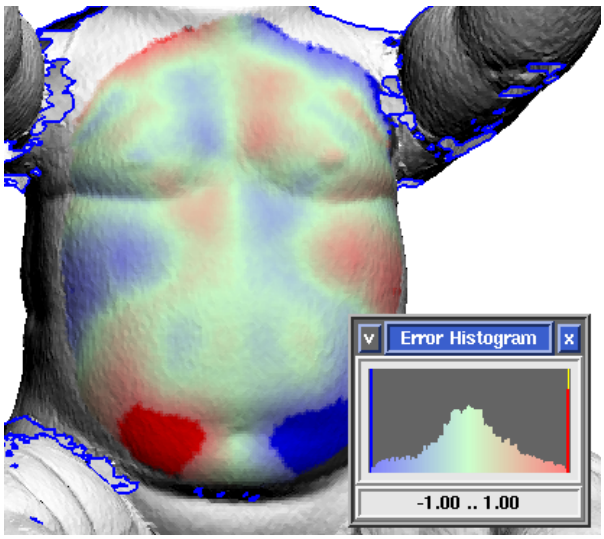

Fig 46. An Error Plot

Body Dewobble

The **Body Dewobble** tool is used to remove ripples caused by movement from 3D body scans. You can see these "wobbles" in the legs on the left side of Fig 47, and the dewobbled legs are to the right.

Most of the work is done using CyEdit, which is normally used to edit individual range grids (i.e. raw scans). What PlyEdit is doing here is extracting range grids from the 3D mesh data, sending them to CyEdit for processing, and then applies the changes back into the mesh data.

Reset View
: This orients the mesh ready for the first range grid extraction. The light is also moved above the mesh, which has the effect of making the wobbles easier to see.

Extract & Edit
: Extract 4 separate range grids, one every 90 degrees, and sends each of these in turn to CyEdit's **Dewobble** tool. Details on the usage of that tool are in the CyEdit User Guide.

1
: Or use this to extract and send just the one range grid from the current view.

Apply Dewobble
: Once you have processed the extracted range grids, click this to apply the changes back in to the 3D mesh.

Fig 47. Before and After

Fig 48. Body Dewobble

3D Paint

If your mesh contains CPV color, PlyEdit has a number of tools for touching up or completely replacing that color information.

Color Tools

Clear
: The color of all faces is set to white.

Mask
: The color of all *unmarked* faces is set to black.

Recolor
: Overlays a representation of the surface shading into the color itself.

Gamma
: Globally lighten (values less than 1) or darken (values greater than 1) the color information.

Smooth
: Smooths the color by the level indicated.

3D Paint

There is no painting within PlyEdit itself; what the 3D Paint tool does is provides an interface between PlyEdit and 2D paint programs. The only requirement is that the paint application can read and write TIFF formatted image files.

In this description GIMP, a free multi-platform application (see gimp.org), is used as the external 2D paintbox. Commercial products, such as Photoshop, would work just as well.

The painting process is quite simple:

1] Select View
: Select a view of the polymesh that you would like to paint.

  In this situation an Ortho projection may be better than Persp as parts of the polymesh further from the camera will be given the same pixel coverage as closer parts.

  Also consider hiding parts of the polymesh that you don't want to paint. Say you have a whole creature, but only wanted to paint the head, hide the rest of the body. This will speed up the color export and import process.

2] Extract Color
: Click the **Extract** button. This writes the color and surface shading into two separate files; by default, **out.p.tif** and **out.s.tif**.

To change the filename prefix edit the **Name** field. To change the save directory, click on the right arrow after the **Name** field.

Normally the extracted color images are the same resolution as the display window, but if the mesh being edited is very dense, some faces may be smaller than a pixel in size. To fix this, increase the resolution of the extracted images with the **Mult** value.

The left side of Fig 51 shows the extracted color, a blank canvas because Clear was used before painting, and the right side is the surface shading.

3] Load Images

If your paintbox supports layers then load the color file as the background plate, and the shading image as a multiplying overlay (see Fig 52). The shading information can then be switched on and off by showing or hiding the top layer.

If your paintbox doesn't support layers, then all you can do is load the color image. Consider using **Recolor** before you start painting to get some idea of the location of surface features.

4] Paint

Paint away, making sure that the background layer is selected, not the shading overlay (see Fig 53).

What you do here is only limited by what you can do in your paintbox. You could even import and overlay images from other sources, such as texture libraries or digital cameras. The only restriction is that you don't change the size or orientation of the background layer.

5] Check and Save

Turn off the shading overlay to check that the color you painted looks OK (see Fig 54). Of course, you can do this at any time during the painting stage.

Once you're happy with the painted color, delete the shading overlay and save the modified color image. Simply overwrite the original file, **out.p.tif** by default.

6] Project Color

Back in PlyEdit, click on **Project**. The original and modified color files are compared, and any differences (i.e. the pixels you painted) are projected onto the polymesh (see left side of Fig 55).

By default only visible and facing vertexes are updated. That is, you can only paint onto what you can see (see middle of Fig 55). If you want to paint all the way through the polymesh, disable **Facing Only** and **Visible Only** before projecting (see right side of Fig 55).

To paint some more, go back to step **1]**.

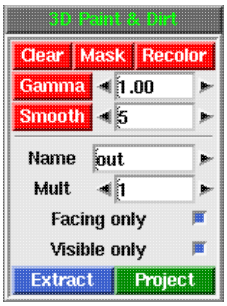

Fig 49. 3D Paint

Fig 50. Select View

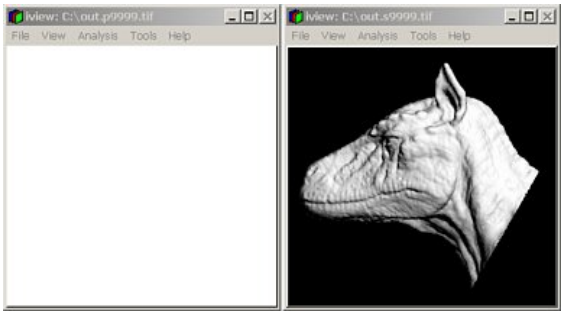

Fig 51. Extract Color

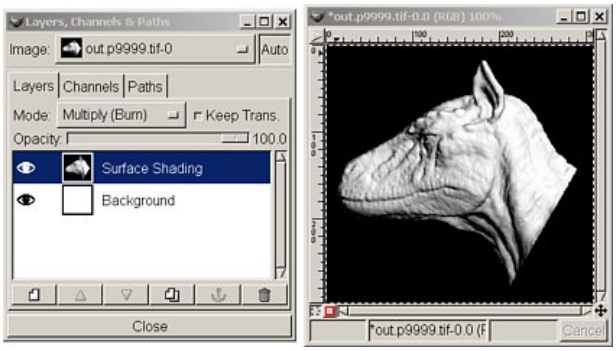

Fig 52. Load Images

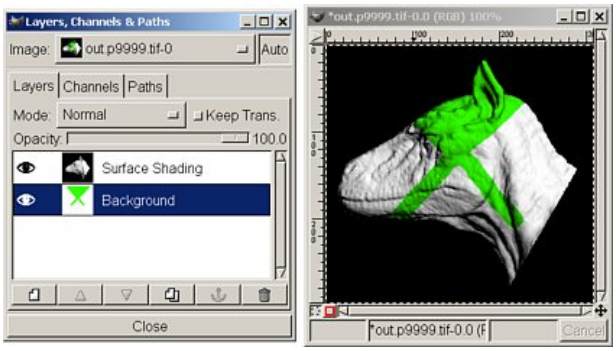

Fig 53. Paint

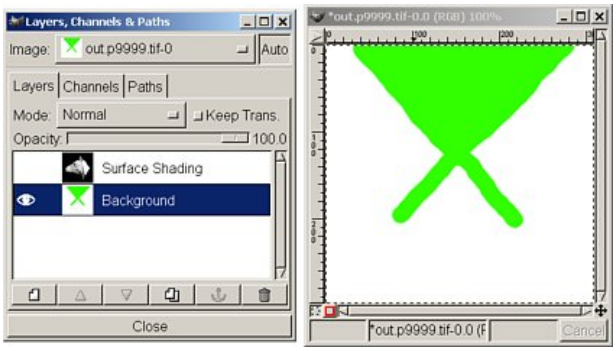

Fig 54. Check and Save

Fig 55. Project Color

Dirt

Often realism in computer graphics can be greatly enhanced by adding imperfections to color textures. These naturally occurring features, a result of an object's exposure to the physical environment, can include rain staining, scratches, scarring, bleaching, corrosion and the accumulation of dirt. With the Dirt tool you can automatically calculate the later; dirt (black) is added to the polymesh color in crevices (see right side of Fig 56).

The Dirt tool (see Fig 57) has three main parameters that control the dirt calculation process:

Radius
: One way to think of this is to cover your object completely with dirt, then get a felt covered ball of the defined Radius and rub it over the surface. If the ball is large, large areas of the polymesh will stay dirty because the felt won't be able to reach them. But if the ball is small, then only narrow crevices will retain dirt.

  As the Radius increases, so too does the calculation time.

Grain
: This controls the accuracy vs. speed of the dirt calculations. As you increase the Grain percentage, the speed increases but the accuracy drops. Reasonable values here are between 5% and 50%.

  If the Grain is very low there's a chance that the whole object gets colored black. This is a bug; increase the Grain until the problem disappears.

Smooth
: Increase the Smooth amount to blur the final result.

Fig 58 shows increasing Radius from bottom to top, and increasing Grain from left to right.

To calculate the dirt, click on the **Calc** button. It will turn into an **Abort** button, which you can use to stop the calculation before it would normally finish.

Once the calculation is complete, you can change the **Clean** and **Dirty** gray levels if you wish. This is a "free" operation; the dirt doesn't need to be recalculated just to adjust appearance levels. The left side of Fig 59 shows black dirt, and the middle image has grey dirt.

The polymesh on the right side of Fig 59 has inverted levels, where the **Clean** level is grey, and the **Dirty** level is white. This could simulate a clean object that's been handled by someone with dirty hands.

When you're happy with the dirt appearance, add it to the polymesh color by clicking on **Apply Dirt**.

If you wish you can now add more dirt at a different **Radius** setting. Each **Apply Dirt** is accumulative, adding more dirt to previous applications.

Note: Dirt calculation times on large polymeshes can take several minutes, even hours in extreme cases, but the calculation is only performed on visible faces. You can hide most of the polymesh, when fine tuning the dirt parameters, to speed up the initial trial-and-error process.

Also Note: Only levels of gray are defined for the dirt colors. In reality of course, dirt could be brown, or an odd shade of green, or a Purlin noise mixture of the two. Its beyond the scope of PlyEdit to provide all the possible appearances that dirt might take, but what you can do is use the gray dirt levels produced by PlyEdit as a parameter in a complex dirt shader.

In this case, its probably a good idea to have separate polymeshes, one for color and another for dirt information. Use the **3D Paint** tool to edit/create the diffuse color, save the polymesh out, then **Clear** the color and apply the dirt. You can then use the **3D Paint** tool again to edit the auto calculated dirt if required, adding more or cleaning other areas up.

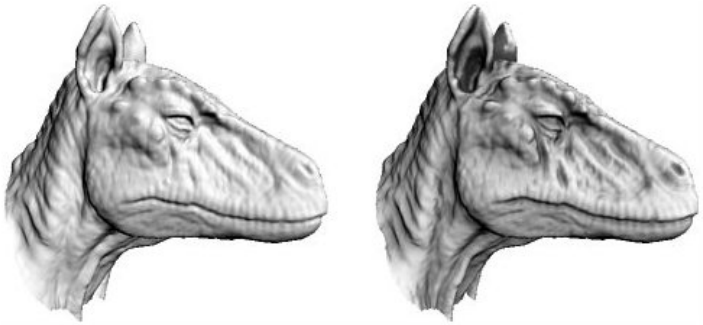

Fig 56. Clean and Dirty

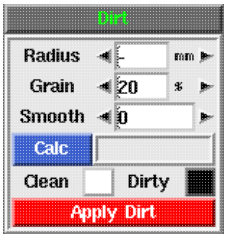

Fig 57. Dirt

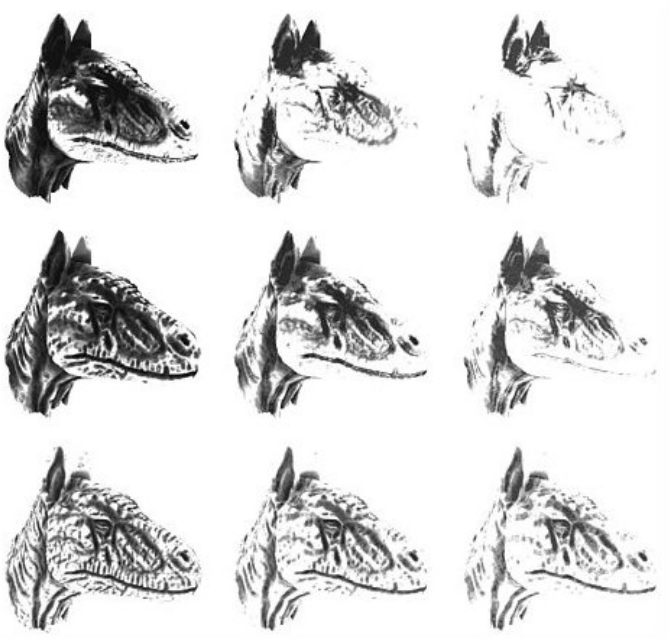

Fig 58. Radius vs Grain

Fig 59. Different Dirt Levels

Clean

The **Clean** tools are used to fix up a few different problems that can be found in 3D scan meshes.

Face

Finds and attempts to fix up "odd" faces. If you look at the top of Fig 61, everything looks fine. However, when viewed side on, you can see that the top faces are forming an archway over the faces beneath; this may have been created by the auto-fill tool. Click the **Clean Face** button, and all visible faces are checked and the problem areas are deleted and refilled.

Thin

3D scan data taken at a grazing angle can often generate long thin triangles. The left side of Fig 62 shows the shoulder area from a body scan, and you can see that the triangles there are stretched out in a particular direction. If there's some noise in the data, no matter how much you smooth it out, the long triangles will results in an obvious "grain" over the surface. Click the **Clean Thin** button, and all visible faces are checked and thin ones will be marked and multiplied to create more evenly proportioned triangles (see right side of Fig 62).

Edge

The **Clean Edge** tool attempts to clean up holes or boundaries by fitting a smoother line to the edges. It doesn't fill the holes, it just makes them look nicer by trimming off the jagged edges. This tool is still under development, so may not be enabled in all versions of PlyEdit.

Fig 60. Clean

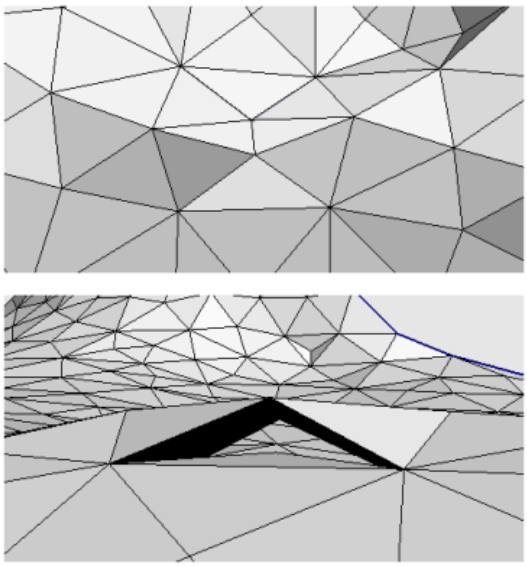

Fig 61. Odd Faces

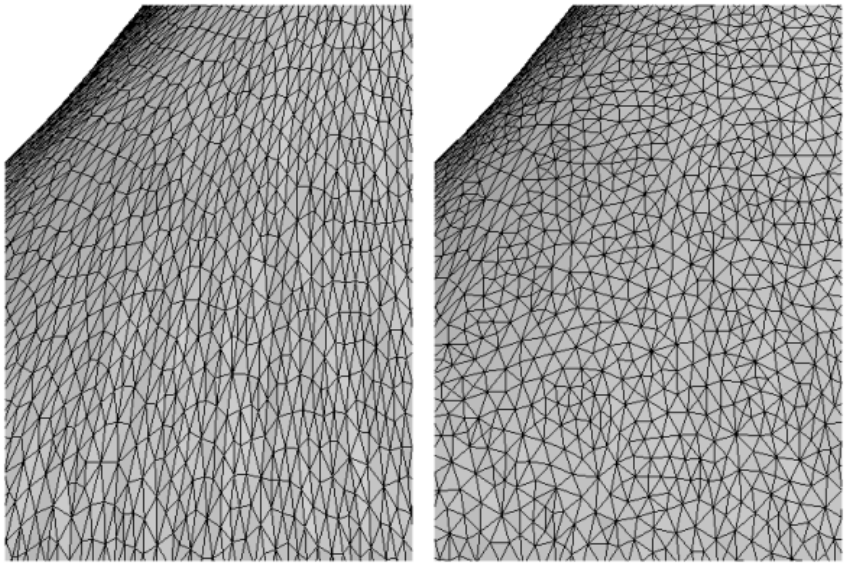

Fig 62. Before and After Thin

Saving Meshes

Its a good idea to save your work regularly. Plus you will need to know how to save out smaller parts of the mesh to cut'n'paste between PLY files.

Vis
: Save the visible faces into a PLY file. A file selection dialog will pop up where you type in the name of the new file.

Sel
: Save the selected (i.e. **<G>** key marked) faces.

All
: Save all faces.

Quads
: Even if the loaded PLY file is made up of quads (4 sided polygons), PlyEdit will turn them all into pairs of triangles for editing. If you tick this option, where possible, those triangles are joined back up together in the output file.

Post Process
: By default, whenever you save out a PLY file, it is post-processed to make it as compact as possible. This involves removing any unused points (i.e. points not connected to any faces) and welding together very close points. If you want to speed up the saves, you can untick this option, but the resulting files may be bigger. You may also want to untick this if the number and order of points in the file has to be preserved, for example, if you want to morph between an original PLY file and a sculpted one.

Tmp/E
: The **Tmp 1** to **5** buttons can be used to quickly save the current mesh into temporary files, named *tmp1.ply* to *tmp5.ply*, that can be loaded later on if something goes wrong. Regardless of the above **Post Process** setting, these temporary files are saved without any post processing.

  The buttons are color coded:

Red	- most recent save, can't be overwritten
Orange	- other saves
Greeny Orange	- oldest save
Green	- not yet used

  The **E** button also saves the current mesh, but into files named *edit01.ply*, *edit02.ply* etc, always creating the next unused filename in the sequence.

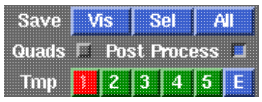

Fig 63. Saving Meshes

Undo

There is no Undo function as such, but there are ways to avoid disaster:

Void Undo

If you've used the **<V>** key to delete a section of the mesh and accidentally selected the wrong faces, type **<V><U>** right away; this will unvoid what was just voided. There is only one level of undo.

Fill Undo

If you've accidentally filled one or more holes that you didn't want to, use **<V><G>**. Holes are filled with green marked faces, so you can easily make them holes again by deleting marked faces.

Save Regularly

Use the **Tmp 1** to **5** buttons to quickly save the current mesh into temporary files. If you make a mistake that cant be fixed in other ways, you can then recover an earlier version of the mesh from one of the temp save files. Regular saving is a good idea anyway in case of a software or system crash.

Ghost Mesh

This technique is better than a normal undo because it allows you to select which parts of an earlier save you want to restore back into the current mesh.

Lets say for example that you filled and sculpted an ear, touched up the nose, started work on the other ear, but then realized your work on the first ear wasn't any good. A regular undo, to get the first ear back to its original state, would also undo your work on the second ear and the nose. By restoring an earlier save file you would also lose all of your recent work.

The solution is to load the earlier save file as the Ghost Mesh. Next, save the current mesh out; you don't want to lose your recent work if something goes wrong! Then view the ghost mesh and **<G>** key mark the section of mesh you want to restore; in our example, its the unedited first ear. Use the **Import Align Combine** tool's **Copy** button to make a copy of those faces, then go back to viewing the current mesh (the **<0>** key toggles the view between the current and ghost meshes). You will then see the replacement faces overlapping the current ones, so hide the 2nd "red" mesh and void the current faces, making sure you leave a bit of overlap with the replacement faces. Then finally, use the **Import Align Combine** tool's **Blend** button to merge the replacement faces into the current mesh.

By using this method, you can restore any part of your mesh back to an earlier state while retaining all of your other modifications.

Glossary

CPV
: The mesh color information is stored as an RGB value on each geometry point, hence "Color Per Vertex". Using this method the resolution of the color is only as good as the density of the geometry.

UV Color
: The mesh color information is stored in a separate image file (e.g. JPG or TIF), and each geometry point has an additional 2D UV coordinate that references a location in the image file. Using this method the color resolution is independent of the mesh density.

Notes