

Sculpting in mud

Matt Leonard has been testing out Skymatter's 3D digital sculpting package, Mudbox. Here he explains you go about creating detailed figures.

Mudbox is a pioneering new brush-based sculpting package aimed at the high-end visual effects, games and design industries. Created and distributed by Skymatter, it was originally written by a group of artists from Weta Digital and Electronic Arts, and was used extensively on *Lord of the Rings* and *King Kong*. Since its release in December 2006, Mudbox has been used to produce digital models for movies such as *Xmen: The Last Stand* and *Eragon*. Currently, Cinesite in London is using Mudbox on a variety of features, including *His Dark Materials: The Golden Compass* (New Line Cinema), *Inkheart* (New Line) and *Fred Claus* (Warner Bros).

Mudbox is aimed squarely at digital modelers, texture painters, traditional sculptors and concept designers. The power of Mudbox is in its ability to

manipulate digital surfaces in an organic hands-on way. With its ability to handle five million polygons interactively and upwards of 100 million using its 'hard-drive streaming' technology, it enables you to add an enormous amount of detail to your digital models.

With Mudbox (\$299 for a non-commercial licence and \$649 for a full license) you can be up and running within a few hours of install. Although Mudbox contains a vast number of features, the learning curve is not at all steep. In fact, it's surprising, given the power of the software, quite how simple it is to use.

So let's get into the nitty-gritty of the software. First we'll look at the interface and general workings of Mudbox, and then move onto creating primitives or importing external models. Next we'll talk about cameras, image-planes, lights and materials, and from there go on to the all-important aspects of sculpting, stamps, stencils, selections and other important tools. Then we'll look at the layering system, along with object organization and tool properties. Finally, we'll cover outputting your finished model, along with baking out normal and displacement maps.

Interface and workings

One of the reasons Mudbox is so quick to learn is because of the clean and uncluttered user-interface (UI). The setup will be very familiar to users of other 3D packages, such as Maya or 3ds Max, with menus running along the top of the screen, a side bar on the right containing your layers and tool properties, and at the bottom of the UI you will find all the modelling tools plus

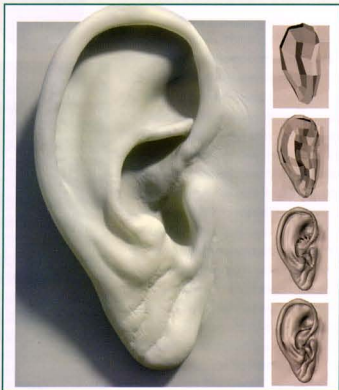
the status bar.

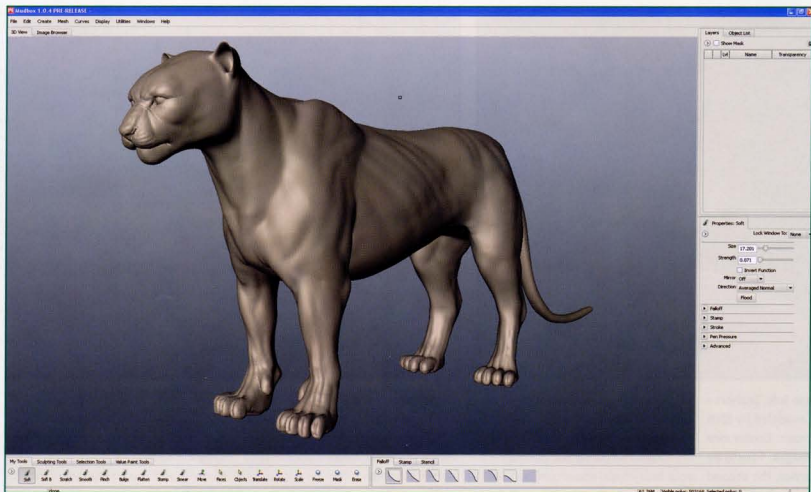
The menu bar at the top of the UI contains all the commands and tools organized into tasks, such as Create, Mesh and Display. These are quick to access and many of the commands have hotkeys already assigned to them. The custom hotkey menu allows you quickly and easily to assign hotkeys to other commands that haven't been predefined.

The main 3D Viewer window is the hub of your work. This is where you see and interact with your 3D sculpture. As you would expect from a high-end package, this display can be toggled to show your model in various states, such as textured, smooth shaded, wireframe or points. You can also affect the lighting setup and turn on and off elements, such as the display grid, curves and meshes. The controls for navigating around this 3D environment are taken directly from Autodesk's Maya using the ALT and mouse button combinations to pan, roll and zoom (although these can all be redefined if you prefer to work in a different way). The 3D Viewer can also be switched to display the Image Browser, which is used to view and organize images for use as image-planes, stencils, stamps, etc. The browser supports various file formats and color depths, including 8, 16 and 32-bit. Unfortunately, at the moment there is no support for openEXR (.exr) or High Dynamic Range Imaging (.hdr) files.

The trays located at the bottom of the UI contain all your tools for sculpting, selection, value paint, brush fall-offs, stamps and stencils. Similar to Maya shelves, you can add custom

**Ear created by artist
Jason Bickerstaff.**





trays, rearrange tools and generally customize things the way you want. The right side of the interface displays the managers and tool properties panels. This is where you control your 3D layers, organize your scene and control your brushes, etc.

Other important aspects of the user interface include the ability to switch to expert or full screen mode, hiding all your panels and maximizing the work space to fill the screen. Many of the panels can be torn off and moved. Other useful things to note include the speed review mode, which caches your model into your graphics card memory, enabling you to move around the model much faster once the poly count becomes really heavy, as well as draft mode, which drops your model's quality when moving in the UI once the polygon count has reached a specific size (1,000,000 by default). Finally, one very nice feature is the automatic save reminder that flashes up every x number of minutes, reminding you to save your work.

Primitives and imports

When starting off with Mudbox you need one of two things: either a

Mudbox primitive supplied as a cube, plane or sphere, or an imported low resolution model saved as either a Wavefront (.obj) or Binary Object (.bio) file. Mudbox can support faces that are triangle, quad and n-sided. During testing of the product, I was able to successfully import models from all the major 3D packages, including Maya, 3ds Max, XSI, Lightwave and Houdini. Also, you can import multiple objects into Mudbox if you need to work on numerous models at the same time. Finally, as each model is either created from within Mudbox as a primitive or imported from another package, the software automatically assigns it to a layer that can be used to control various aspects of the sculpture, including subdivision levels, visibility, layer locking and subdivision levels blending.

Views, lights and materials

The main working area of Mudbox is centred around the perspective view, but alongside this there are other camera views that can be used to help you build accurate models. Top, side and front camera view can be quickly switched to using the

Object List manager, giving you a true orthographic viewport to work from. If this isn't enough, any number of user defined new cameras setups can be created, although currently there is no quad view setup. Camera positions can be bookmarked, enabling you to quickly return to any given angle and previously defined view. Each camera also has a wealth of settings, including various positional and rotational locks, field of view and near/far clipping planes attributes. Mudbox also gives the artist the ability to add Image-Planes to any camera view. These can be transformed, rotated and scaled, as well as having their depth and opacity adjusted to fit the task at hand. Finally, you have the functionality to create multiple lights, alongside the default lights provided. These point/omni lights are extremely flexible, giving you the ability to change their position, color and intensity.

Sculpting

Finally, we arrive at the central hub of Mudbox's toolset, the sculpting tools; this is where it all happens. Mudbox without doubt is designed to be used with a pen and tablet. It does of course support a mouse, but you are going

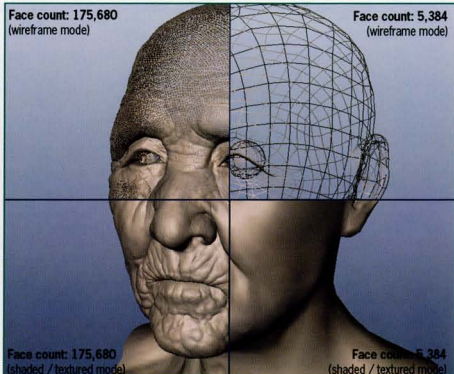
Slow Leopard created at Cinesite using Mudbox.



Above left: Seahorse modeled by Rich Diamant. Center two images: Fausto de Martini, the second showing the Mudbox user interface. Far right: modeled by David Cardwell.

to lose a huge amount of creative control operating that way. The main concept behind Mudbox is that models are formed by pulling and pushing your base model about using various brush tools. Both large and small scale changes can be made, so an entire character's head can be created simply out of the default cube. This is done by adding detail through subdividing the whole or selected parts of the mesh, and then sculpting detail onto it.

As you subdivide the object or selected faces, Mudbox remembers the history so that you can go back later and make adjustments. For instance, a model is created by painting detail, subdividing the mesh, painting more detail, subdividing the mesh again, and so on. Once the model is finished, you could step down the subdivisions to an earlier coarseness and make a gross change to the shape of the model without undoing fine detail put in at a much higher subdivision level. You can then step back up to a finer level of detail and continue adding features. A side effect of this is that you can effectively work with more polygons than your system can handle. For instance, you could model a character's head by slowly subdividing and adding more and more detail to the maximum your system can handle, then step back down to your original base subdivision level. Then you can begin to work on the rest of the body, subdividing



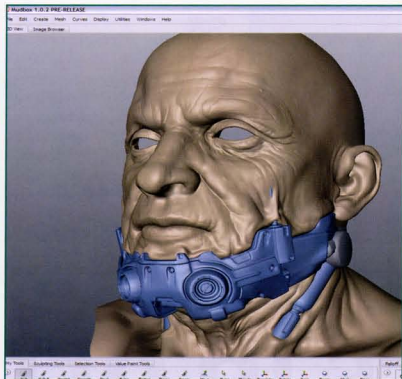
your mesh again to the maximum your system can work with. Using this workflow, you can sculpt models in sections, working beyond your normal system capacity.

The main tools for sculpting in Mudbox come in the form of a variety of brushes. These include a Soft brush which simply moves vertices in a particular direction, based on the average of the surface normals within the boundary of the brush size. It also builds up the deformation dependant on the pressure with which you use the pen. This brush is good for painting small detail into a model right through to adding largescale geometry changes. The Soft B brush works in a similar way to the first Soft brush, but is more geared to high resolution meshes. The Scratch brush, again similar to the Soft brush, differs by way of not supporting the stamp tools (we'll talk about this in a minute) and has no gradual build up. Because of these two differences, this brush is suited to working with very high face counts. The Smooth brush flattens out the surface by averaging the position of vertices on the face of the model. The Pinch brush sucks vertices into the center of the brush boundary and is good for creating such effects as skin wrinkles and folds. The Bulge brush is similar to the Soft brush, except that it moves the vertices in a particular direction based on the vertex normals as opposed to their average. The Flatten brush levels the

vertices by moving them towards a predefined plane. Finally, the Smear tool smudges or smears existing stocks on your mesh.

With all these brushes you can affect how they interact with your mesh via a set of falloff curves. Skymatter has provided nearly a dozen predefined curves to get you started, but you can very quickly and easily define your own. You also have the ability to mask off areas of your mesh to stop you sculpting on areas you want to leave untouched. In many situations, you will find yourself sculpting a model that contains some form of symmetry, such as a face, body, etc. Mudbox can greatly speed up workflow in these instances by allowing you to turn on brush mirroring in any of the X, Y or Z axes. Beyond this, Mudbox offers Tangent Space Symmetry, which enables mirroring over asymmetrical or posed models. This would enable you to sculpt the fingers on one side of the model while automatically adjusting the fingers on the other hand, regardless of how the mirrored fingers were posed.

Two other aspects of Mudbox's modeling arsenal are its stamp and stencil tools. Stamps enable you to add image detail directly into the mesh. These are grayscale bitmaps, which are attached to the end of a brush and used to define the shape of the brush as you sculpt. The stencil feature works in a very similar way to stencils



in the real world, in that they protect areas of the mesh from being sculpted on. For instance, you could use a grayscale image of elephant skin as a stencil – when you paint through it you paint the elephant skin texture directly onto the surface of your mesh. This of course is a very fast and effective way of adding high level detail to your models. Again, Mudbox ships with various stamps and stencils, but others can be added via the Image Browser very quickly. Finally, you are able to create and use curves to sculpt precise shapes and forms. The curves act like a railings system that your brush stroke will follow.

The Layer Manager

Along with the ability to step up and down through subdivisional levels, Mudbox also has a powerful Layer Manager at your disposal. This gives you the ability to sculpt in a non-destructive way. Brush changes can be assigned to specific layers (like in Photoshop) and these layers can then be turned on or off. This enables you to experiment while sculpting, knowing that you can simply hide or delete the layer if you're not happy with the result, but you are also able to create morph targets. For example, if you were modeling a character's face, you could start with a base expression and create new layers, each one being assigned to a different facial expression. These can then be separately exported

as individual .obj files and used as morphing shapes in your animation package. Layers can also be blended together through a percentage slider, enabling even finer control.

Object List

The object list is where you control all the elements of your scene. It works very similarly to the Outliner in Maya or the Scene Editor in XSI. Here you can select various scene elements including meshes, cameras, lights, curves, etc.

Property Manager

The property Manager window automatically updates depending on what tool or object you are using. When working with a brush you are able to control things such as the size and strength of the brush, mirroring, the brush falloff, stroke information, including jitter, which adds randomness, pen pressure attributes and various other advanced features. When working with Cameras, Image Planes, Lights or Materials, this is the area where you adjust those individual parameters.

Output and baking

Once your sculpture is finished, it can be exported out of Mudbox in a variety of ways. You can either export a specific layer (as mentioned in the morph target example) or an individual object. This again is done through

the .obj or .bio formats. The UVs are automatically assigned to your model as you work, and are exported with the mesh as part of the file format.

Your Mudbox model is going to have a far higher polygon count than your 3D application would be able to handle in normal circumstances. Because of this, you can export a model at a lower subdivision level and then bake out either Normal or Displacement maps, which you can use as part of your texture setup later. Mudbox outputs extremely high quality texture maps and can bake between multiple arbitrary meshes both for Normal and Displacement passes. These again can be output at a variety of color depths, including 8, 16 and 32-bit. During the export process, Mudbox gives you control over a range of options and the output result worked seamlessly in Maya when I ran my tests.

Conclusions

Mudbox has been extremely stable over the two days I have been testing it on my HP laptop. I have been able to successfully import .obj base models out of a variety of 3D packages without any problems, work on them, then export them back without any issues. I was working up to three million polygons and, yes, it was beginning to slow down, but it was still workable. What in the past could have taken hours modeling conventionally in Sub-division or NURBS takes just minutes in Mudbox.

Matt has worked in the animation and visual FX industry for over 16 years, producing work for feature films, commercials and corporate projects. He has operated as CG supervisor, head of post production and most recently director of his own company. Sphere VFX is a high-end training company specialising in 3D and visual effects work. Courses include Maya Unlimited, 3ds Max, Mudbox, Renderman, Fusion, Nuke, After Effects, Combustion, Boujou and PF Track. Clients include Soho post houses, design agencies, and various universities. www.spherevfx.com

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