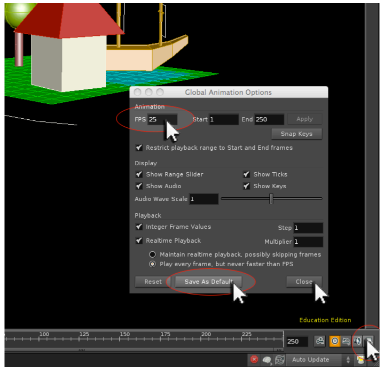
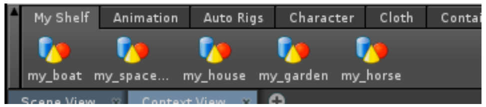
HOUDINI 12.1

Modelling #1

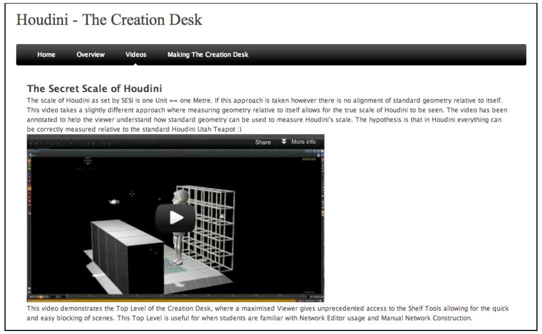
GLOBAL ANIMATION OPTIONS (PAGE 2)



SHELF FUNCTIONALITY (PAGE 2)

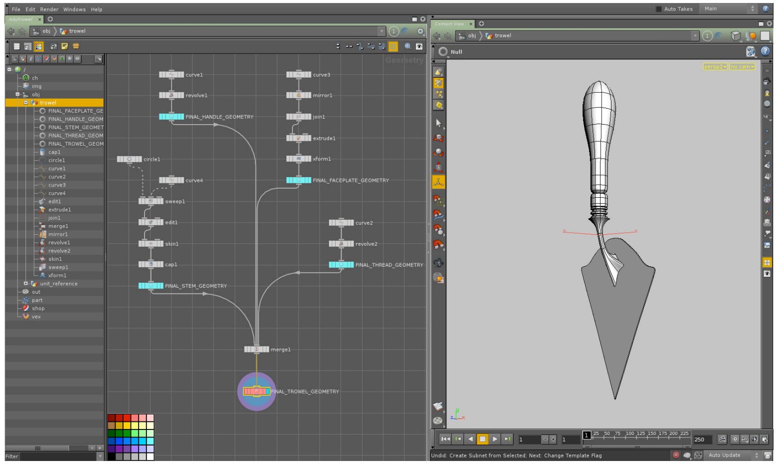


DEFINING UNITS IN HOUDINI (PAGE 3)

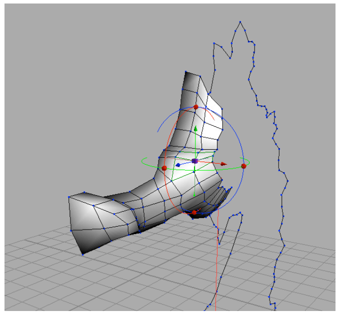


MODELLING A NURBS TROWEL (PAGE 6)

In this example, a trowel model is created as a single piece of geometry. This exercise will give an overview of the basic NURBS modelling techniques.



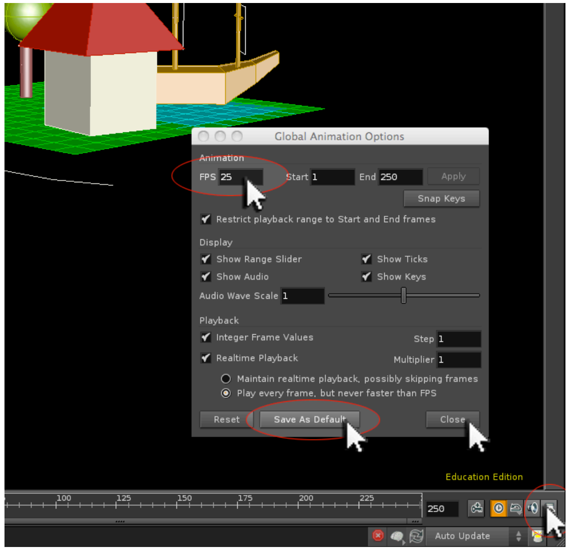
ORGANIC POLYGON MODELLING (PAGE 17)



HOUDINI GLOBAL ANIMATION OPTIONS

For **NCCA production work**, the **Global Animation options** of Houdini need to be configured to **25 Frames per Second** (by default this is set to 24FPS).

Open the simple scene developed for the first Houdini lecture and **Activate** the **Global Animation options button** found in the bottom right hand corner of the Viewer pane.

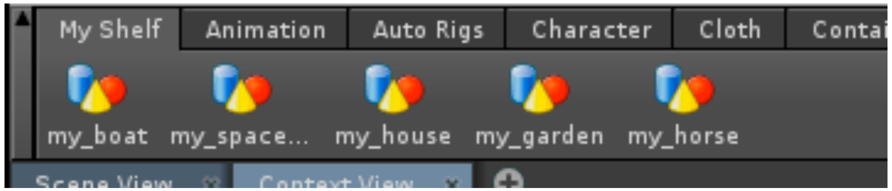


In the **Global Animation Options** window, set the **FPS** value to **25**, and press the **Save As Default** button. This window can now be closed. Whenever flipbook renders or full renders are generated they will by default output at 25 Frames per Second.

SHELF FUNCTIONALITY

The Houdini Shelves can be used as a way of storing developed assets that may be required for multiple usages. For example, Primitive Models can be developed and then stored on the Shelves for future access. **Activate the Shelves at the top of the Viewer Pane. By default, an empty Shelf called My Shelf is the first shelf in the Shelf Tabs.**

Objects can then be LMB dragged and dropped onto my Shelf for storage.



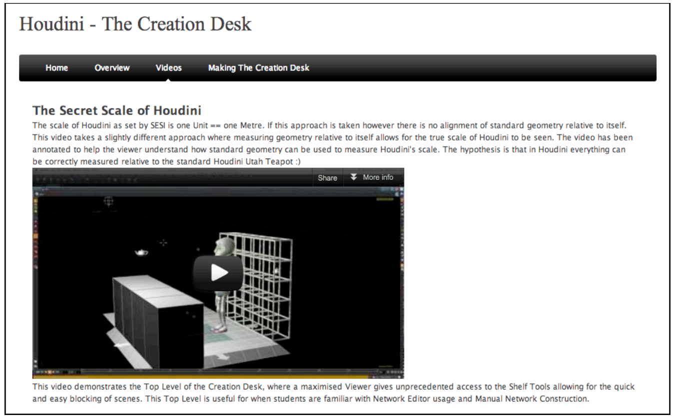
These assets can then be quickly activated in a new Houdini scene by pressing the Shelf button for the object. **NOTE:** The my_spaceship object has a reference to the flight_path object for animation purposes. If the flight_path oject is not stored on the shelf, it will need to be recreated and relinked to the my_spaceship object. **RMB** on a **Shelf Tool** will give options for removing it from the shelf; or editing its creation script.

DEFINING UNITS IN HOUDINI

The official measurement for Houdini is 1 Unit == 1 Metre. In real terms this means a standard box == 1 cubic metre. This however creates inconsistencies between a box and other objects (for example a standard teapot is larger than a standard box). A better approach to take is to see a standard box as representing 10 cubic cm. This in turn means that a standard grid becomes 1 square metre, and a standard teapot also becomes the correct scale relative to the grid and box.

A demonstration about how to think about Houdini's scale based upon a 10 cubic cm standard box scenario can be seen in the video '**The Secret Scale of Houdini**'.

http://houdinicreationdesk.ipage.com/videos.html



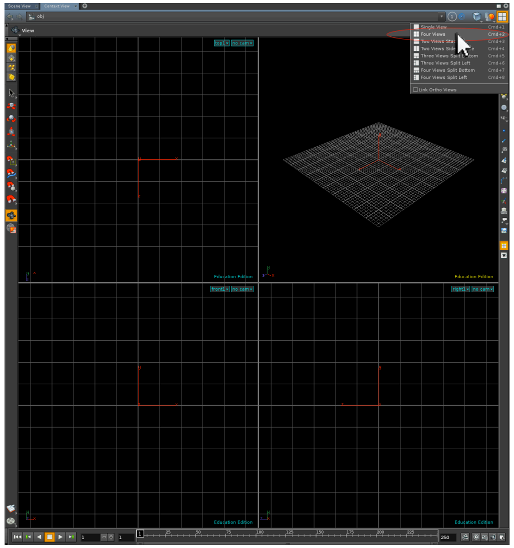
How Houdini internally perceives its scale can also be set in the main **Edit > Prefences > Hip File Options** menu. These settings have an effect on Dynamics calculations, but for the purposes of modelling, any scale can be worked at, as objects can always be resized later on in production to match the scale of other objects.

SETTING CONSTRUCTION PLANE PARAMETERS

The Construction Plane is a measuring grid displayed in the Viewer to assist with the alignment and construction of objects. With the Creation Desk UI, the Construction Plane has been configured so that each construction plane square matches a standard Houdini Unit, with 5 subdivisions per square. If further modification of the perspective view construction plane is required, its configuration parameters can be accessed from the **persp1** menu located in the top right hand corner of the **Viewer**. Simply select **Construction Plane Parameters…** from the persp1 menu.

THE ORTHOGRAPHIC VIEWS

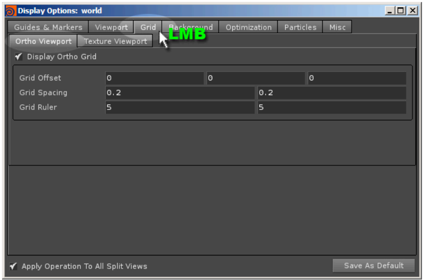
The scene Viewer can also display non-perspective based views of the scene. These are known as orthographic views. Each orthographic view (**top**, **front**, **right**) returns a flat 2D representation of the scene along each axis. Orthographic views can be accessed by **LMB** the **Viewport Layout Button** located at the top right hand corner of the **View Pane**.



A **Viewport Layout** of **Four Views** will return the three standard orthographic views, plus the perspective view. Pressing **SPACEBAR + b** over one of these four views will toggle the Viewer between the split Viewport Layout and the chosen Single View. **SPACEBAR + (1 – 4)** will scroll a single viewer between all the views (perspective and orthographic).

THE VIEWER'S DISPLAY OPTIONS

Orthographic views in Houdini have their own construction plane parameter controls separate from the ones associated with the perspective view. These can be found in the **Viewer Display Options**. Pressing **SPACEBAR + d** with the mouse over the **Viewer** will activate the Display Options.



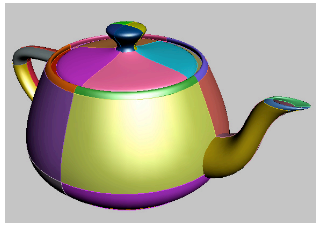
As with the Perspective Construction Plane; these parameters have already been configured within the Creation Desk UI, and this information is simply presented in these lecture notes for reference.

NOTE: Modifying the settings of the **Display Options** will simultaneously affect all orthographic views, **unless** the **Apply Operation to All Split Views toggle option** located in the bottom left hand corner of the **Display Options** is **deactivated**.

NOTE: Display Options for the Network Editor can be accessed by pressing SPACEBAR + d with the mouse over the Network Editor.

NURBS MODELLING

NURBS (non uniform rational b-splines) is a universal method of modelling in 3D animation systems. It is primarily used for recreating manufactured smooth surfaces. A NURBS surface is a single patch or square of geometry that can be shaped to create these surfaces. A NURBS model can be made up of varying combinations of patches collectively creating the final shape.

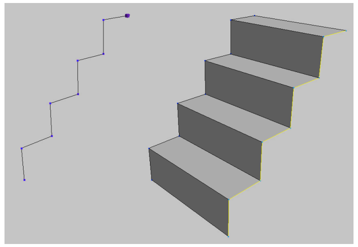


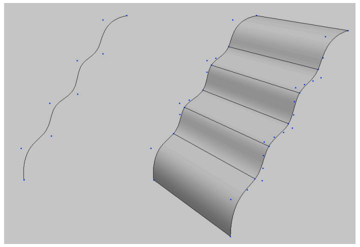
Although created from Bezier Patches rather than NURBS Patches, the Houdini teapot demonstrates how patches can be utilised to create a final model. The Houdini teapot consists of 33 patches (individually coloured for the purposes of illustration). The principles of modelling with NURBS and Bezier surfaces are identical.

GEOMETRY TYPES FOR MODELLING

In total, Houdini uses five Primitive Types for representing geometric shapes. These are:

Primitive	for basic geometric shapes (easy to calculate and quick to render)
Polygon	for hard-edged shapes constructed from one or more closed planar curves.
Mesh	for hard-edged shapes that have cubic topology (easy to calculate and quick to render)
NURBS	(**N**on **U**niform **R**ational **B**-**S**pline) a curved surface or curve
Bezier	An alternate curved surface or curve





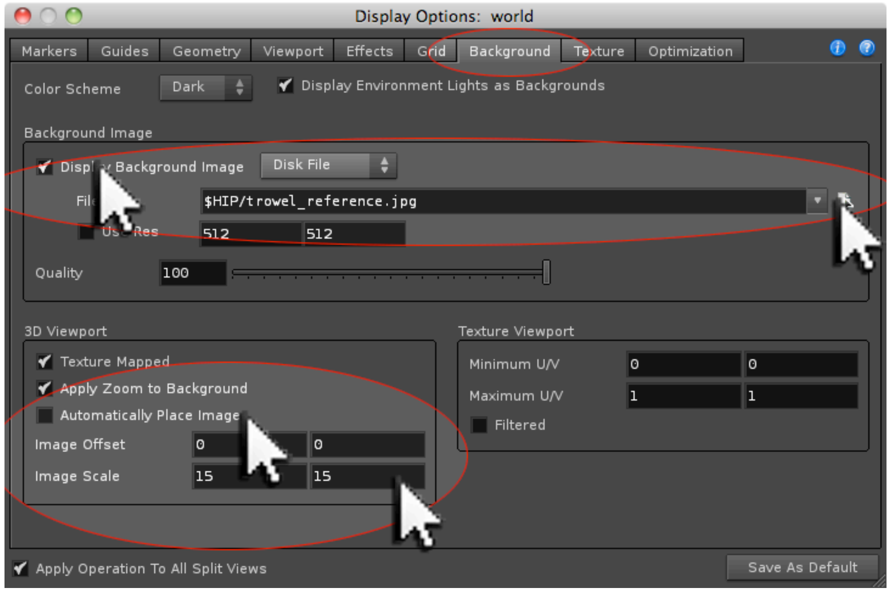
The above illustration shows the same extruded curve as both Polygon and NURBS types. A Polygon curve interpolates a hard-edged line by going **through** its points. Polygons can be utilised for both inorganic and organic objects, as they can be smoothed (or subdivided) to create curved surfaces. A NURBS or Bezier curve however draws a line by interpolating **between** the curve points. They are generally used for creating smooth shapes and contoured inorganic surfaces.

DISPLAYING REFERENCE IMAGE

Modelling objects is made simpler by having a reference image to model to. Reference images for each view can be activated through the **Viewer's Display Options** (**SPACEBAR + d** with the mouse over the **Viewer**).

In a **new Houdini Scene**, **activate** the **Display Options** for the **Viewer**. From the **Background** section of the **Display Options**, activate the **Display Background Images** option, and from the **Image Source** sub-section load in the **trowel_reference.jpg** using the **File Chooser button**. This will display the reference image simultaneously in each view. From the **3D Viewport sub-section**, **deactivate** the **Automatically Place Image** option, and specify and **Image Scale** parameter value of:

Image Scale **15** **15**



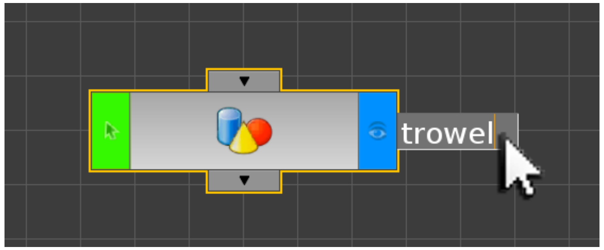
This will lock the image to viewport grids, and scale the image to an appropriate size. The Display Options can now be closed. Displayed images can also be activated or hidden by **LMB** pressing the **Display Background button** on the right hand side stow bar of the Viewer.

 Display Background

NOTE: A UV QuickShade SOP appended to a Grid SOP can also be utilised for creating custom image planes.

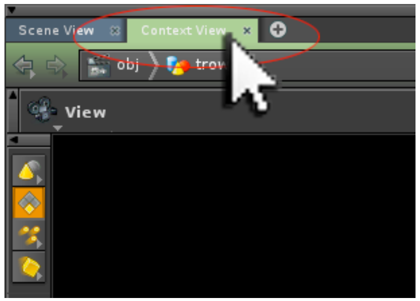
MODELLING THE TROWEL

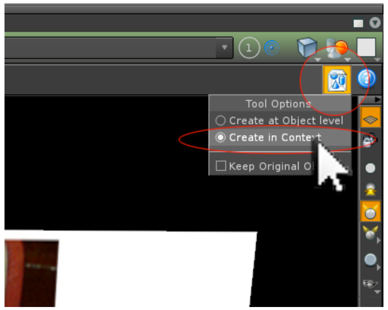
At Object Level, create a new Geometry Object, renaming it from **geo1** to **trowel**. **Double LMB click** the trowel object to go inside it, and **delete** the default **File SOP**.



WORKING IN CONTEXT

Ensure that the **Viewer** is set to the **Context View Tab** rather than the Scene View Tab. Set the **Tool Options** button in the right hand corner of the Viewer to **Create in Context**.

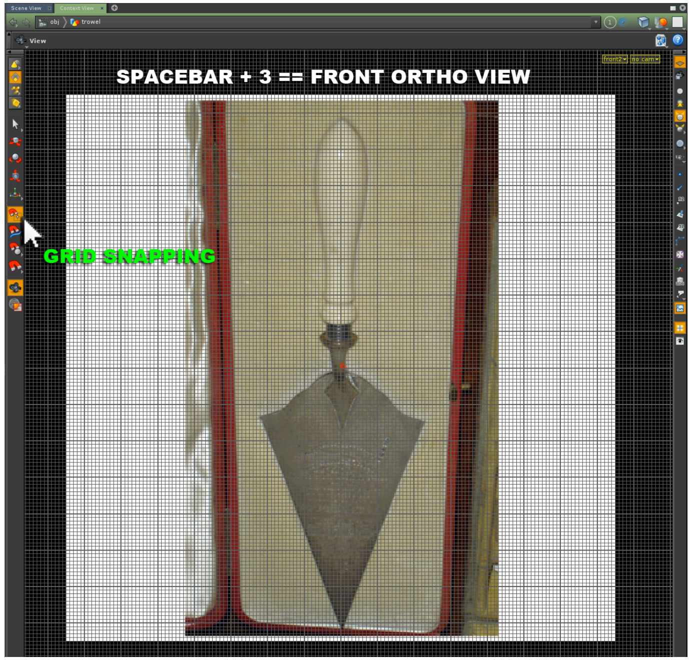




This will ensure that any base operators created directly inside the Viewer (such as spheres, grids and curves etc) are created within the current object rather than being created as a new scene object.

GRID SNAPPING

Activating the Grid Snapping button located on the left hand side Viewer Stow Bar can enhance modelling accuracy further. This will automatically lock any modelling activity to the points of the viewport grid.

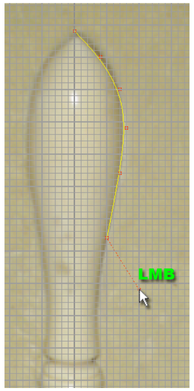


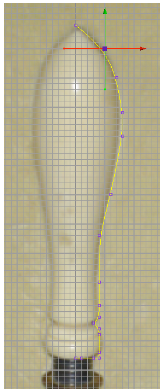
The View Pane can also be set to the **Front Orthographic View** (**SPACEBAR + 3**) in preparation for modelling.

CREATING THE TROWEL HANDLE

Examination of the **trowel_reference.jpg** reveals that the trowel is constructed from components which be recreated individually and then merged together to form the final trowel.

To model the trowel handle, activate a **Curve SOP** interactively using the **Viewer**. Pressing TAB with the mouse over the Viewer and typing curve can do this. In the **Parameters** for the **Curve SOP** specify a **Primitive Type** of **NURBS** to provide a smooth curve, and begin to draw around the edge of the handle. When a curve representing the profile of the handle has been created, press **ENTER** to confirm the curve's creation. Ensure the **first** and **last points** of the curve are **aligned** with the **central Y-axis**. Drawing the curve in an orthographic view also ensures that all points exist on the same plane.

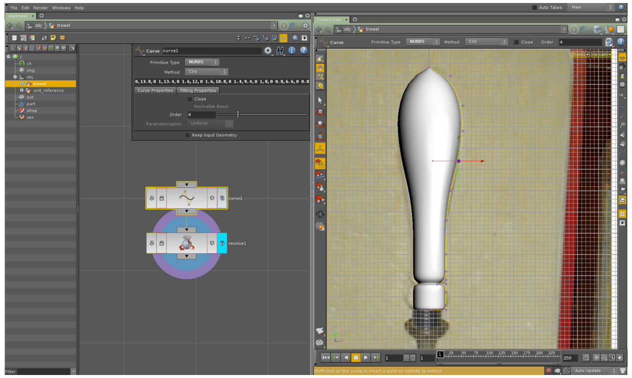




NOTE: Curve Points can be interactively edited after a curve has been created by pressing **ENTER** on the keyboard with the mouse over the Viewer. This will activate a single point-editing handle in the Viewer. Curve Points can also be inserted into an existing curve by **SHIFT + LMB** on the curve.

REVOLVING A CURVE

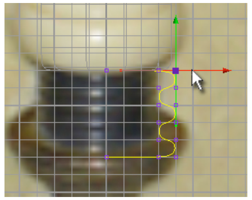
With the curve still selected, press **TAB** with the **mouse over the Viewer** and type **revolve**. This will revolve the curve to form the handle. The shape of the handle can be examined in the Perspective view and reedited if necessary by selecting the Curve SOP in the Network Editor and activating its Tool Mode in the Viewer.

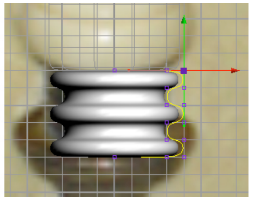


Note: This operation has automatically appended a Revolve SOP to the Curve SOP in the Network Editor.

CREATING THE HANDLE THREAD

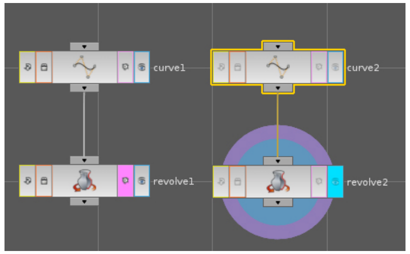
This curve revolve technique can also be utilised to create the trowel handle's thread component. Before attempting this second curve ensure Grid Snapping (not Point Snapping) is activated, and draw the thread curve using the front orthographic view.

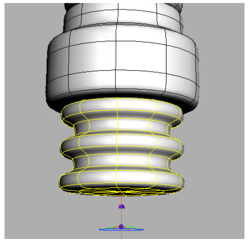




TEMPLATED GEOMETRY

If the second curve operation is interactively created in the Viewer, the existing revolved handle geometry will remain in view as an interactive Templated Display. The **Pink Template Flag** on each SOP has **two functions**. The first is to display geometry as a non-interactive light grey wire-frame outline; the second is to display geometry as a shaded object, which can be interacted with. When a new network is created, any previously displayed network is displayed as a shaded template. While this is visually clearer, it can cause construction errors if the shaded templated geometry is inadvertently interacted with.

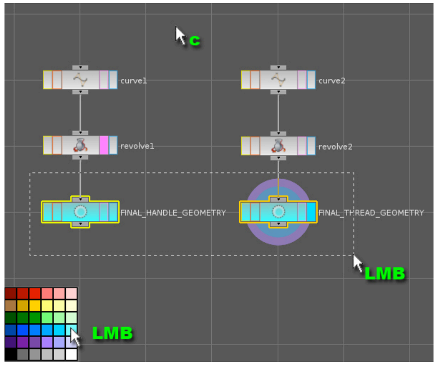




To set a piece of geometry to a **template wire-frame view**, **LMB** activate the pink Template Display Flag on the node. To set a piece of geometry to a **template shaded view**, use **Ctrl + LMB** to activate the pink Template Flag. In both cases holding down **SHIFT** will allow more than one piece of geometry to be templated.

ANNOTATING NETWORKS & COLOURING NODES

As all of the trowel components will exist in the same Geometry Object, it is good practice to label and define each section of the growing network. This can be done by appending a **Null SOP** to each network chain and renaming the Null SOP to describe each networks purpose.

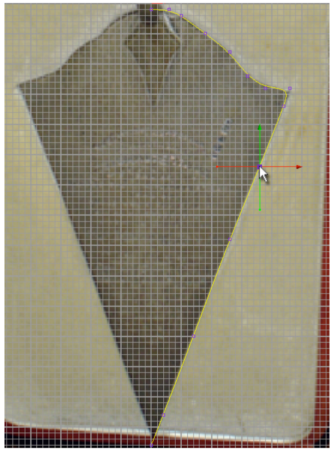


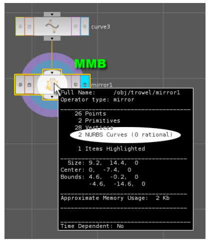
With the mouse over the **Network Editor** press **c**. This will activate the Network Editor's **Colour Swatch**. Select both **Null SOPs** and using the colour swatch; select a colour for the nodes that will help identify them. Pressing **c** once more with the mouse over the Network Editor will hide the colour swatch.

See **modelling_a_trowel_stage1.hipnc**

CREATING THE TROWEL FACEPLATE

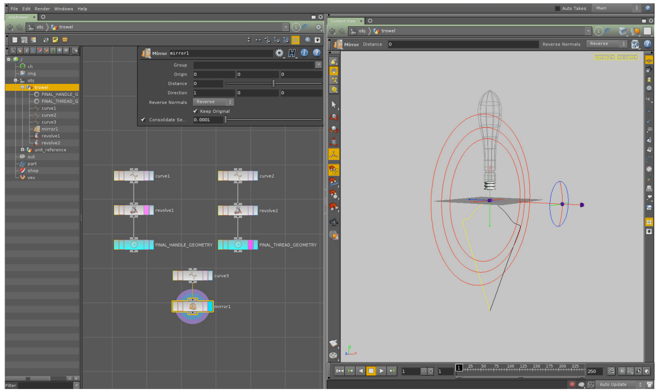
A slightly different modelling procedure can be utilised in order to generate the faceplate of the trowel. With the mouse over the **View Pane**, press **TAB** and type **curve**. This will activate a third **Curve SOP**. Draw the profile shape of the trowel faceplate as a **NURBS curve** and press **ENTER** to confirm the operation. **Edit** the curve appropriately so that it closely matches the shape of the faceplate reference. Again, ensure that the first and last points of this curve are located on the central Y Axis. Use **Grid Snapping** to help ensure this.



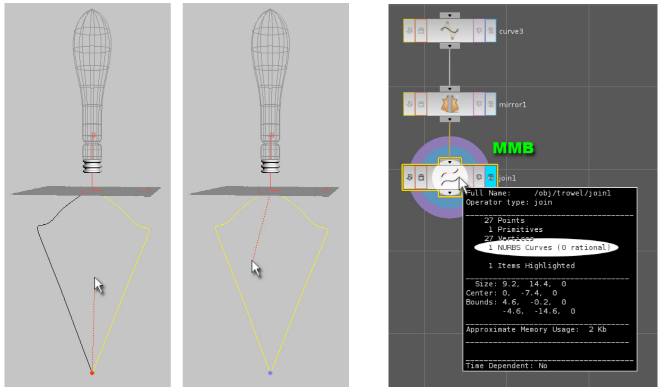


MMB on the **Mirror SOP** in the **Network Editor** will reveal the Information Card for this node. This states that there are two NURBS curves being processed (the first drawn by the Curve SOP, the second created by the Mirror SOP). These two curves will need to be joined together before the faceplate geometry can be created.

THE MIRROR SOP
Return back to the **Perspective View**, and with the curve still selected and the mouse over the Viewer, press **TAB** and **type mirror**. This will activate a **Mirror SOP** in the **Network Editor**, mirroring the faceplate profile curve to create a whole shape.



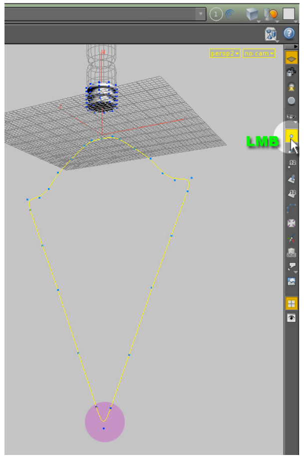
JOINING CURVES
With the mouse over the **View Pane**, press **TAB** and type **join**. This will activate a **Join SOP.**

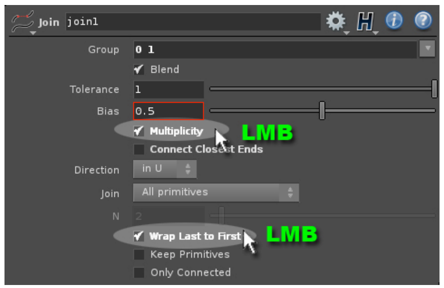


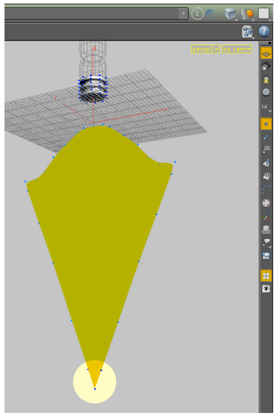
Select the **first curve**, **select** the **second curve** and press **ENTER** to confirm the operation. **MMB** on the **Join SOP** in the **Network Editor** will reveal that the two curves are now a single NURBS curve.

REFINING CURVES

Upon examination, the joined curve no longer quite reflects the shape of the original two curves that made it. This is most noticeable at the tip of the faceplate curve, which has become rounded, rather than remaining pointed. This discrepancy can be rectified by adjusting the **Parameters** of the **Join SOP**.



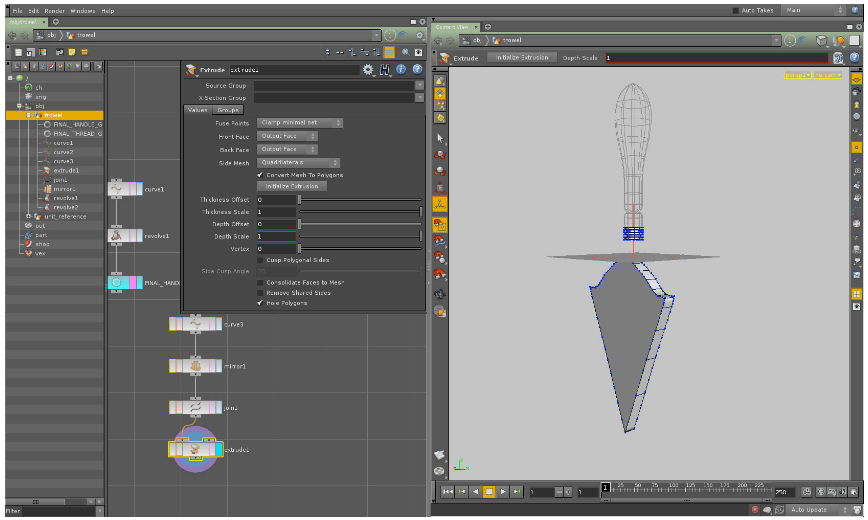




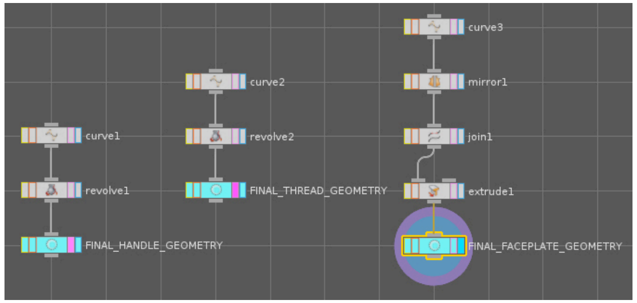
Activating the **Multiplicity** tick box in the **Parameters** of the **Join SOP** will restore the shape of the trowel. Activating the **Wrap Last to First** tick box in the **Parameters** of the **Join SOP** will turn the curve into a single NURBS surface.

EXTRUDING CURVES

A NURBS curve or surface can be extruded to create thickness. With the faceplate geometry still selected, press **TAB** with the mouse over the **Viewer** and **type extrude**. This will invoke an **Extrude SOP**. Press **ENTER** to confirm the extrusion.



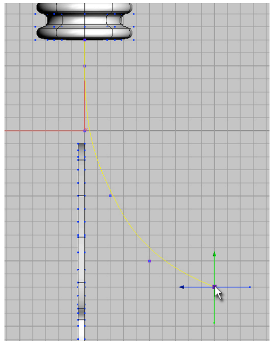
Modify the **Depth Scale** parameter of the **Extrude SOP** to reduce the thickness of the extrusion.

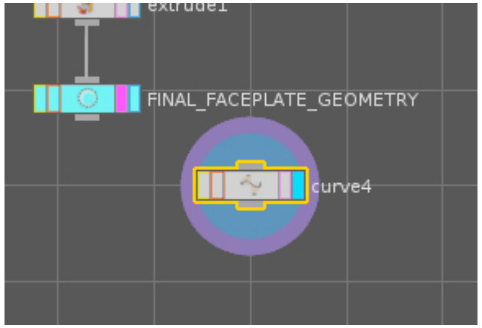


As a final step, append a **Null SOP** to the faceplate network to annotate it. It can be coloured to match the other network annotations in this object. See **modelling_a_trowel_stage2.hipnc**

CREATING THE TROWEL STEM

Switch the **View Pane** to the **Right Orthographic View** (**SPACEBAR + 4**) and with the mouse over the **View Pane** press **TAB** and type **curve**. This will activate another Curve SOP. Using **Grid Snapping**, draw a curve that will form the backbone of the trowel stem.



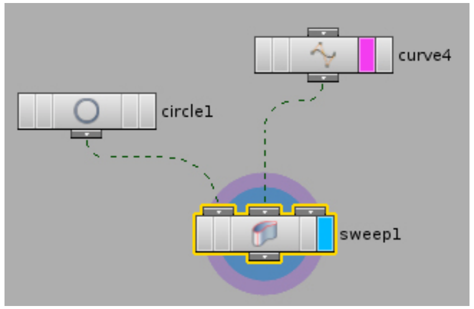


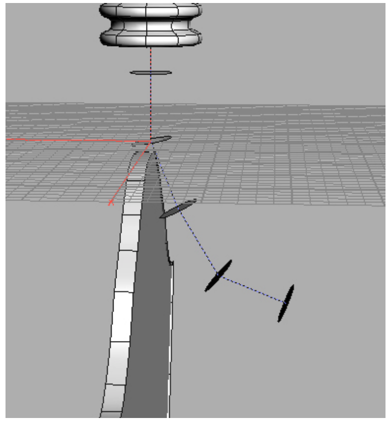
SWEEPING A CURVE

Manually in the Network Editor, create a **Circle SOP** alongside this newly created curve. In the **Parameters** for the **Circle SOP** specify:

Primitive Type	**NURBS Curve**	
Radius	**0.3**	**0.3**

This will create a small circle that can be assigned to each point on the stem curve by performing a sweep operation.

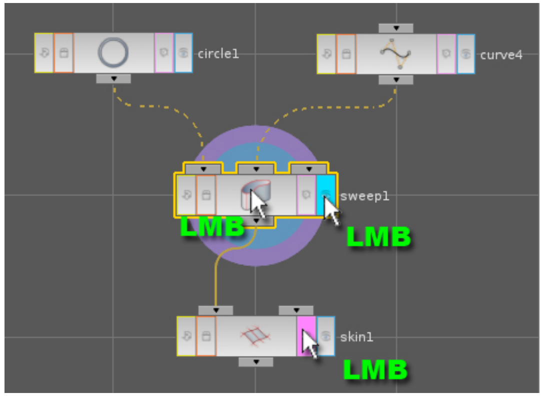


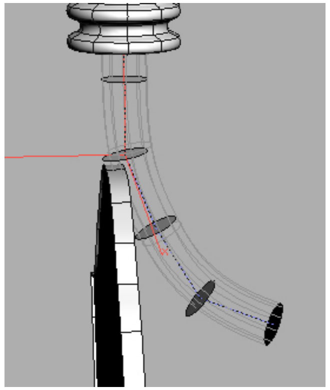


With the mouse over the **Network Editor**, press **TAB** and type **sweep**. This will create a **Sweep SOP**. Manually wire the output of the **Circle SOP** into the **first input** of the **Sweep SOP**. **Manually wire** the output of the **Curve SOP** into the **second input** of the **Sweep SOP**. This will copy an instance of the Circle SOP onto each point of the stem curve.

SKINNING A SWEPT CURVE

While the parameters of the **Sweep SOP** do allow for a skin to be created over the resulting shape, there is also an independent Skin SOP operation that will create the same effect. The advantage of assigning this separately is that it will allow for simpler editing of the shape.

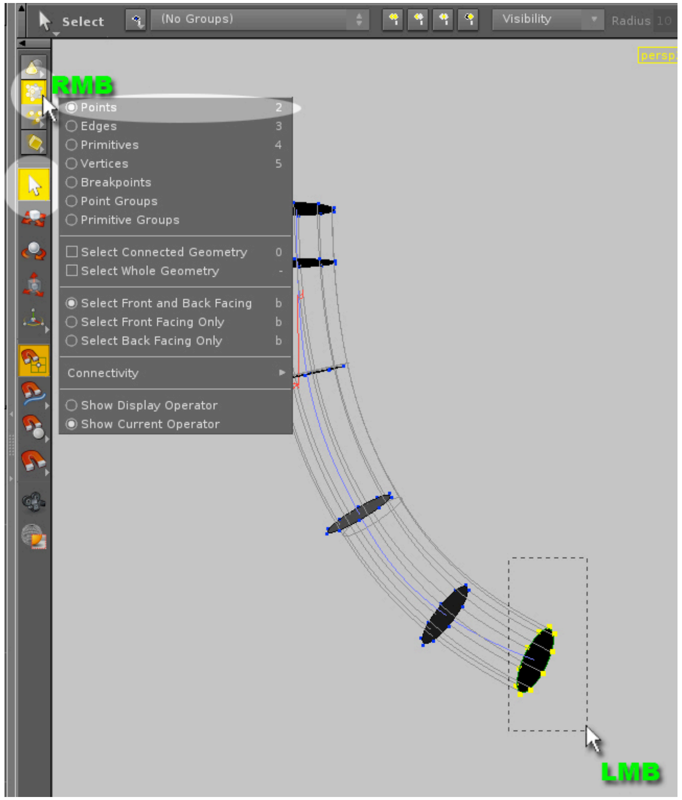




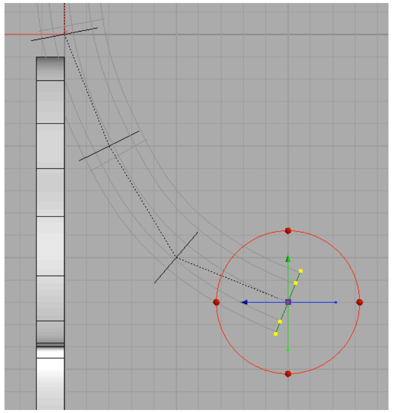
In the **Network View RMB** append a **Skin SOP** to the **Sweep SOP**. Holding down **SHIFT**, activate the **pink Template Flag** for the **Skin SOP** so that a preview of its effect can be seen in the **Viewer**.

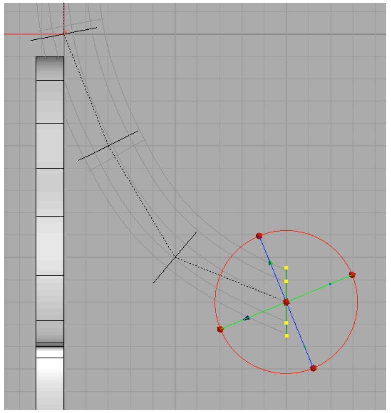
REFINING THE STEM SHAPE

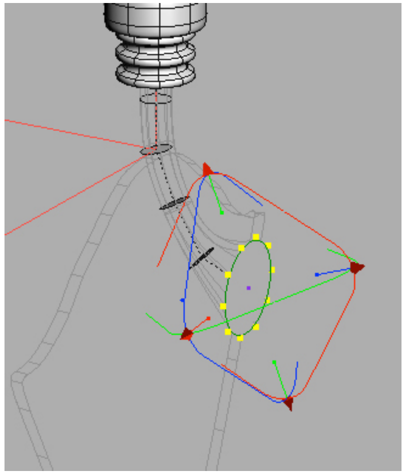
RMB on the **Geometry Selection** button and from the resulting menu choose **Points**. This will change the selection so that the points of the circle are selected. Activate the **Select tool** from the left hand side Viewer Stow Bar and select the end circle of the sweep operation.



Switch to a **Right Orthographic View** (**SPACEBAR + 4**) and using the Viewer's Rotate tool rotate the points to a vertical alignment. This will automatically insert an **Edit SOP** into the network (after the Sweep SOP and before the Skin SOP). An Edit SOP can also be created by pressing TAB and typing edit.



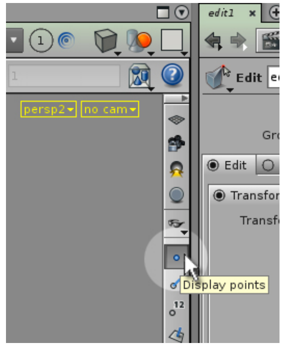


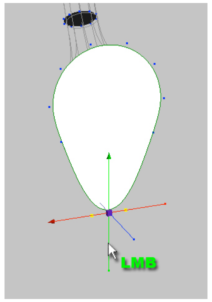


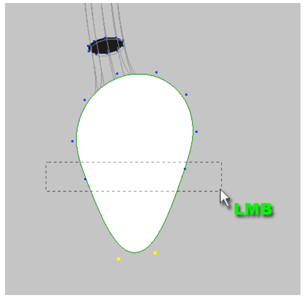
Switch the Viewer to a Perspective View (SPACEBAR +1) and uniformly scale the selected points using the Scale Tool (e). This scale-based modification of the points will be recorded as part of the existing Edit SOP until a new operation is activated. This means that Edit SOPs cannot be keyframe (use a Soft Transform SOP instead if this functionality is required).

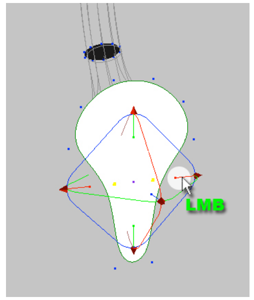
DISPLAYING POINTS

So that further editing of the stem shape can continue, it is useful to display all points in the Viewer. This can be done by activating the Display Points button from the right hand viewer side stow bar. It is also useful to set all other geometry to a non-interactive template wireframe display so that only the points associated with the Edit SOP are displayed.

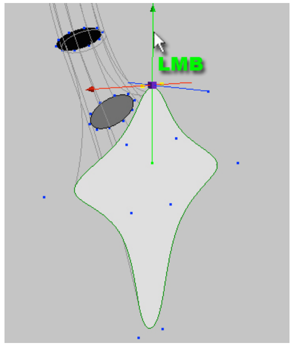






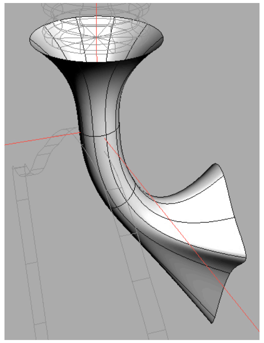


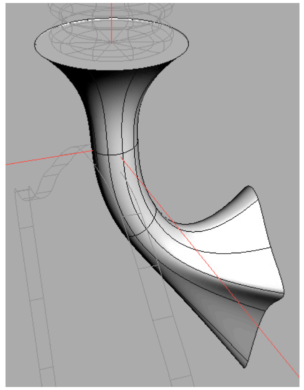
Continue editing the points of the end circle to create a diamond shape. Use the trowel reference image as a guide for creating and finalising the shape. When the editing of the stem is complete, activate the Display Flag on the Skin SOP to see the final stem geometry.



THE CAP SOP

At present the stem has hollow ends. While this is fine for the end that will align with the faceplate, a cap needs to be added to the end which aligns with the trowel thread.

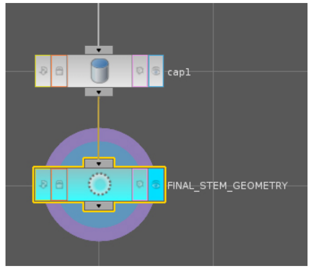




In the **Network Editor**, append a **Cap SOP** to the **Skin SOP**. By default this will cap both ends of the input geometry. In the **parameters** for the **Cap SOP** specify:

Last U Cap **No end cap**

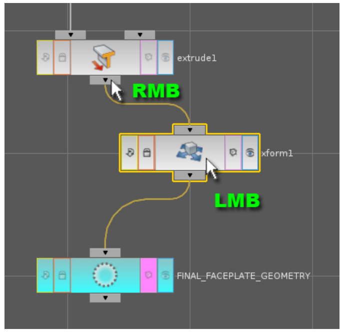
This will uncap the end of the stem that will align with the faceplate, making it more render efficient.



As before, a **Null SOP** can be appended to this network chain, annotating its purpose.

ALIGNING THE FACEPLATE

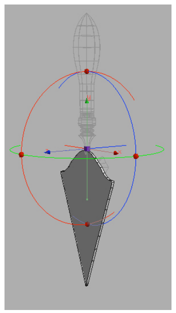
Template the final stem geometry and return back to the network chain responsible for creating the trowel faceplate. Before the final Null SOP **insert** a **Transform SOP**. This can be utilised to move the faceplate geometry into position relative to the other trowel components.

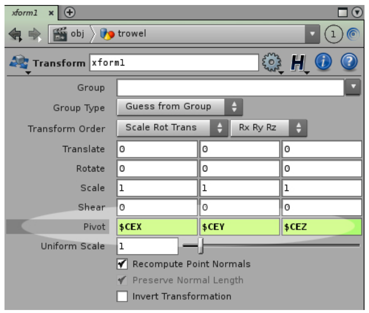


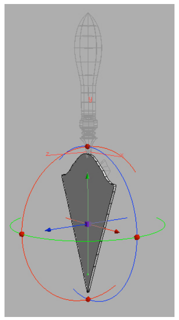
CENTERING TRANSFORM PIVOTS

At present, the pivot for the Transform SOP handle is located at the top of the trowel faceplate. A pivot can be centred by entering into the Pivot parameter of the Transform SOP the following variables:

Pivot **$CEY** **$CEY** **$CEZ**





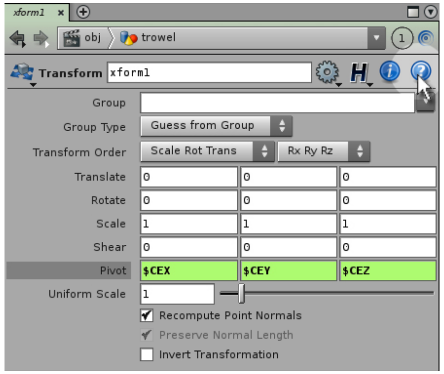


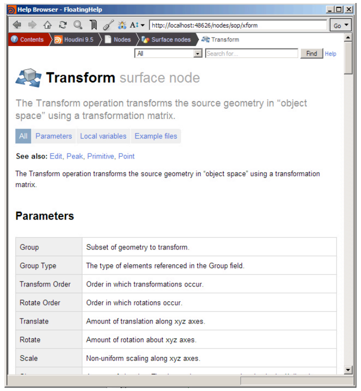
These variables will automatically compute the centre position of the input geometry for each axis. The advantage of utilising these variables rather than entering their numeric equivalents (which can be viewed by MMB on the Transform SOP), is that this pivot positioning will automatically re-evaluate itself should any further shape refinement happen to the faceplate. This procedural approach to data management is central to Houdini.

NOTE: These variables can be mathematically refined further. For example, entering **$CEY / 2** into the **Pivot Y** parameter will move the height of the pivot to exactly ¼ of the geometry length. These variables are also specific to the Transform SOP. **RMB** on the **transform handle** in the **Viewer** will also give options for pivot manipulation. **INSERT** can be pressed with the mouse over the Viewer to activate Pivot Placement handles. Pressing **INSERT** after the pivot has been moved will restore the regular transform handle.

OPERATOR HELP CARDS

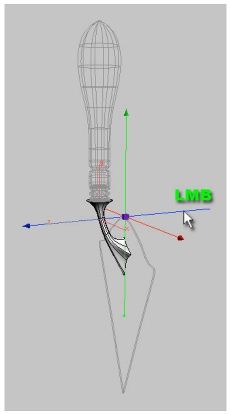
Each operator also has a help card assigned to it. When faced with a problem in Houdini it is always worth investigating the help of an operator before creating another node to solve it. These help cards explain the function of a node, list any local variables specific to that operator and give loadable network examples of the operator in use. A help card for an operator can be found by **LMB** pressing the  button located in the top right hand corner of the operator's parameters.

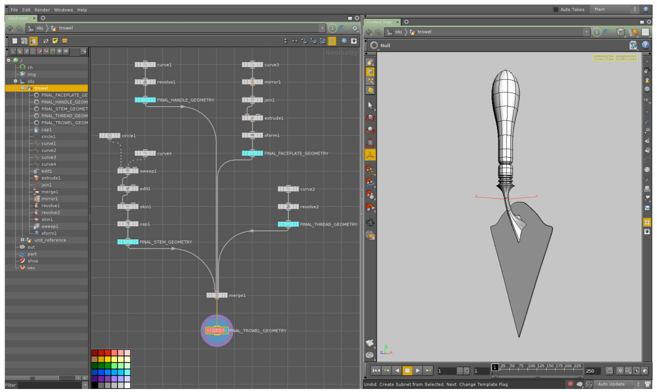




COMPLETING THE TROWEL

With the pivot of the Transform SOP centrally aligned, the trowel faceplate can be moved into position. If necessary turn off Grid Snapping and use the Right Orthographic View to ensure the faceplate is correctly aligned.



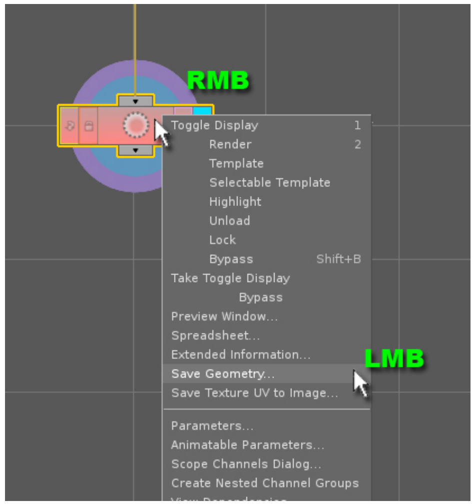


All of the components that create the trowel can now be merged together using a **Merge SOP**. As before, a **Null SOP** can be utilised to annotate the completed network. If at any point a trowel component requires further refinement (for example further editing of its shape, or the addition of textures), the network chain associated with it can be expanded upon further to incorporate other nodes.

See **modelling_a_trowel_end.hipnc**

SAVING GEOMETRY TO DISK

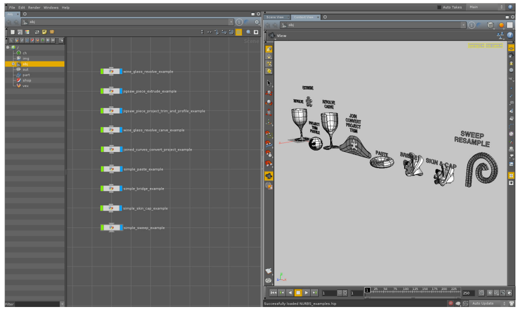
The trowel geometry can now be utilised in a new scene for animation purposes. Firstly however the trowel model should be saved out to disk as a geometry file. This will ensure that the network generated to model the trowel will not be evaluated when the animation is processed. It also means that the scene containing the trowel network does not inadvertently get modified.



RMB on the **final_trowel_geometry Null SOP** and from the resulting menu choose **Save Geometry…** This will activate a dialog window for saving the geometry to disk. Save the geometry as a file called **trowel.bgeo** to an appropriate location on disk. This **.bgeo** file can be read into any new scene by using a **File SOP**.

Note: A .bgeo file is Houdini's native geometry format. Other geometry formats such as .obj can also be created.

OTHER NURBS MODELLING TECHNIQUES

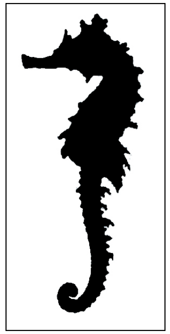


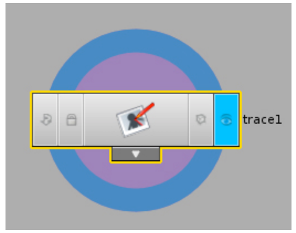
NURBS surfaces can be combined to produce other modelling functionality. These include creating holes in surfaces (**Trimming**), extracting projected curves from a surface (**Profiling**), parametrically reducing a surface area (**Carving**), copying one NURBS surface into another (**Pasting**), and creating a surface between two curves (**Bridging**).

See **NURBS_examples.hip**

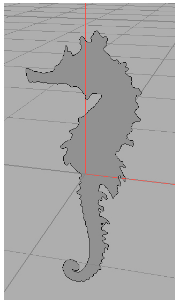
Organic Polygon Modelling

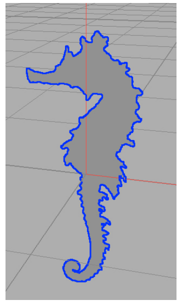
In a new Houdini, create a **Geometry Object** and rename it to **seahorse**. Inside the object, delete the default **File SOP** and in its place create a **Trace SOP**. This operator will automatically trace the outline of an image.

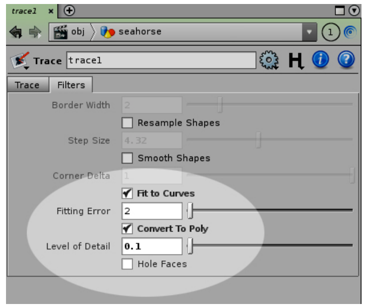




A paint package has been utilised to convert a reference image into a black and white mask specifically for creating an outline. This outlined image (**seahorse_outline.jpg**) can be read into **Houdini** using the **Trace SOP**.



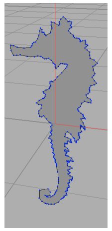




When **Point Display** is activated in the **View Pane**, there are many points generating the outline. This can be rectified by adjusting the **Filters** section of **Trace SOP Parameters**.

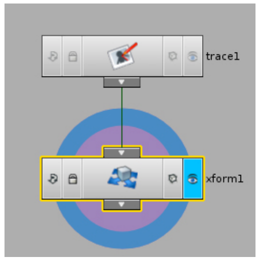
Activate the **Fit to Curves** option and the **Convert to Poly** option. In the Level of Detail Parameter associated with the Convert to Poly option specify:

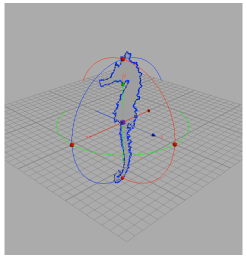
Level of Detail	**0.1**



This will produce a single polygon with a manageable number of points from which a model can be generated. Append to the **Trace SOP** a **Transform SOP**. In the **Parameters** for the Transform SOP specify:

Rotate	**0**	**90**	**0**
Uniform Scale	**10**		

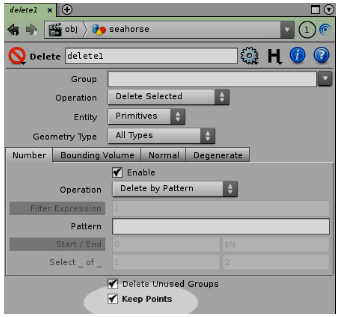


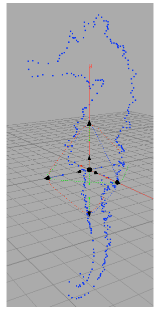


This will enlarge the seahorse shape and orientate it correctly for modelling.

Creating an Outline from a Shape

At present the seahorse shape has a primitive face created by the closed polygon curve created by the Trace SOP. This face will cause problems when modelling. The face can be removed by selecting it in the View Pane and with the mouse over the **View Pane** press **TAB** and typing **Delete (Attribute)**. This will create a **Delete SOP** in the **Network Editor**.

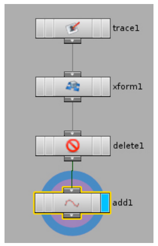


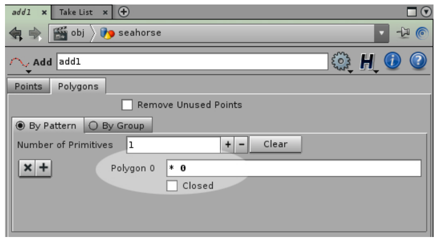


When this operation is applied, the seahorse shape will disappear. **Activating** the **Keep Points** option in the **Parameters** for the **Delete SOP** will restore only the point information for the seahorse shape.

Joining the Dots

To the output of the **Delete SOP**, append an **Add SOP**. This node can be utilised to redraw the seahorse curve.

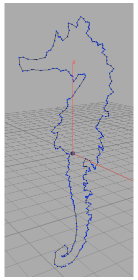




In the **Polygons** section of the **Parameters** specify:

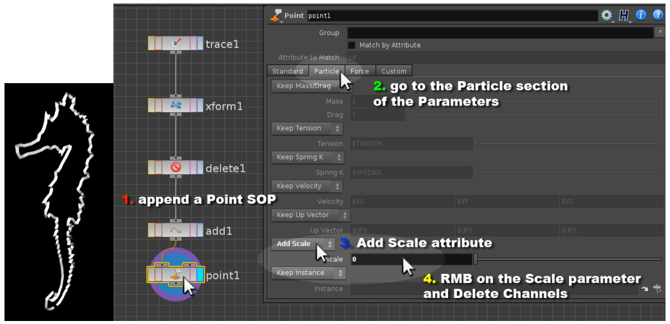
Polygon 0 *** 0**

This will draw a curve using all (the wildcard *) of the points. Appending 0 at the end of this * will join the last point back to the first point (0) without closing the curve to create a face.



CURVES AND RENDERING

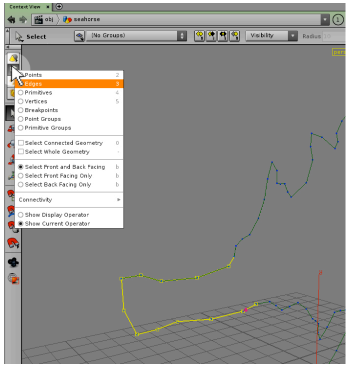
By default Houdini will render curves. A Render Region Preview reveals the outline curve of the seahorse. Even after modelling of the seahorse is complete, this curve will still appear.

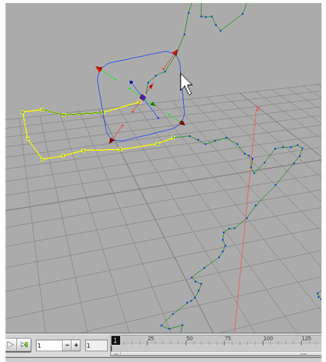


This can be fixed by appending a Point SOP, and adding a Scale Parameter of 0 to the curve.

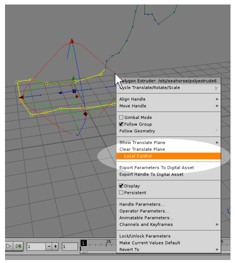
Creating the Muzzle

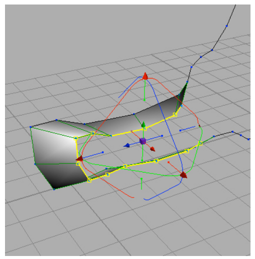
RMB on the **Geometry Select Mode** button and specify a selection type of **Edges**. In the **Viewer**, select all of the edges which make up the muzzle of the sea horse.

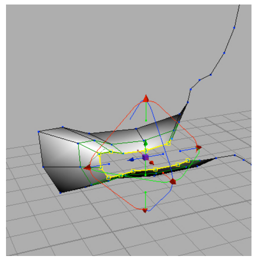




Activate a **PolyExtrude** operation by pressing **TAB** and typing **polyextrude** with the mouse over the **Viewer**. The **PolyExtrude Operation** has **two modes** in which in can function. The **default** mode is **Local Control**. This means that the transformation handle is orientated to one of the edges being extruded. **RMB** holding on the **transformation handle** and **decactivating** the **Local Control** option will orient the handle to Object Space. This second mode function is known as **Global Control**. With the **PolyExtrude** operation set to **Global Control**, extrude the edges in the positive X Axis, whilst scaling them down slightly.



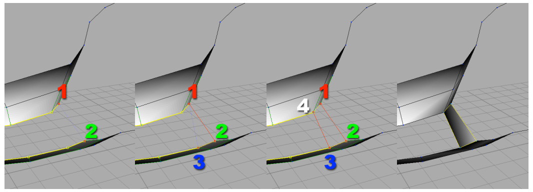




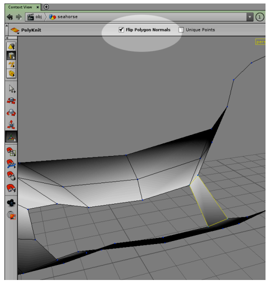
With the mouse over the **Viewer**, press **q** to repeat the current operation. Ensure that **Global Control** is activated for this second **PolyExtrude** operation, and once more extrude the edges in the positive X Axis, whilst scaling them down slightly.

Creating Additional Polygons

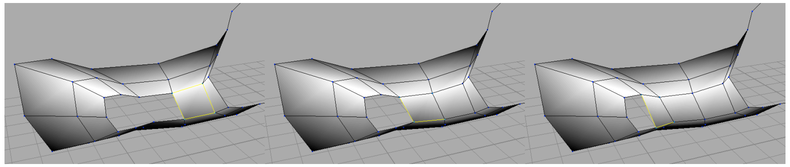
Ensure the **Shading Mode** of the **Viewer** is set to **Smooth Wire Shaded**, and with the mouse over the **Viewer**, press **TAB** and type **polyknit**. This will activate an operation to draw polygons between the extruded faces.



Individually select the points to be knitted and press **ENTER** to confirm the operation. A new polygon face will be created.

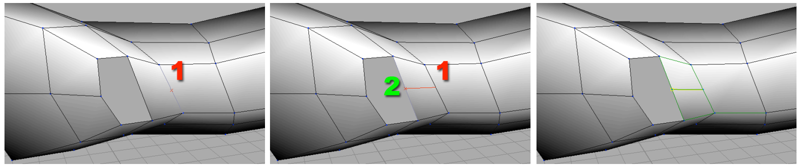


The point order selection of the Poly Knit determines how the new face will be orientated. Sometimes is it necessary to activate the **Flip Polygon Normals** parameter so that the new face responds correctly to lighting calculations. Press **q** on the keyboard to repeat the operation, creating individual faces for the remainder of the gap.

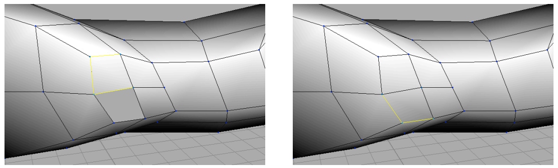


Splitting Polygons

In order to knit the final part of the gap, it is necessary to split a polygon in order to give the correct topology for the knit. With the mouse over the **Viewer** press **TAB** and type **polysplit**. This will activate a **PolySplit** operation.

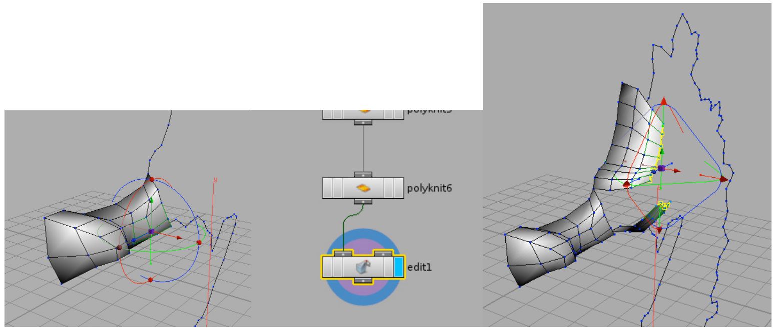


LMB select a start point and an end point for the split, and press **ENTER** to confirm the operation. This will divide the polygon face. With the PolySplit operation complete, the remainder of the gap can be filled using PolyKnit operations.



NOTE: Splitting polygons can be done over numerous faces simultaneously. This is a PolySplit option called **Quad Strip** which if a start point for the split is selected, will automatically split a complete ring of faces.

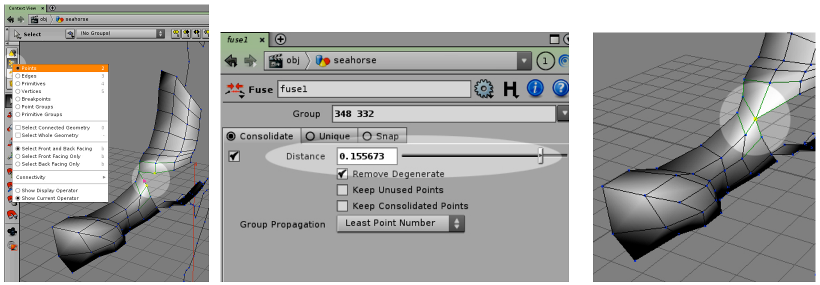
When creating this type of model, it is necessary to ensure all faces being created are square rather than triangular. This will ensure clean geometry topology for aiding deformation based animation. The shape of the seahorse muzzle can be further refined by an **Edit** operation.



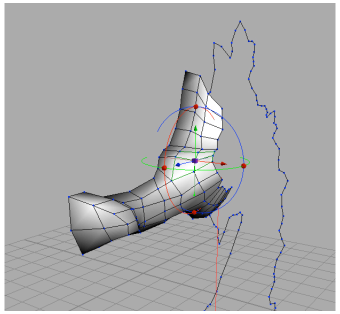
The process extruding edges can be repeated for the forehead of the seahorse by utilising the PolyExtrude operation once more.

Fusing Points

After creating the rough geometry for the forehead, it can be joined to the muzzle by using a Fuse SOP. In the Viewer, press **s** to enter selection mode, and **RMB** on the **Geometry Select Mode** button to set the selection type to **points**. Select the two points to be fused, and with the mouse over the Viewer press **TAB** and type **fuse**. This will activate a Fuse operation.



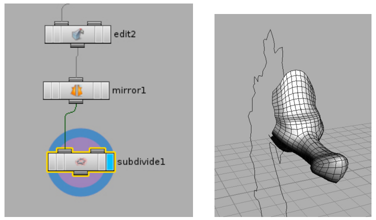
In the **Parameters** for the **Fuse SOP**, increase the **Distance** Parameter until the two points to snap together as one. A combination of PolyExtrudes and Fuses can be utilised to complete the rest of the seahorse forehead and its attachment to the muzzle.



Another Edit operation can be utilised to refine the shape further. Wherever possible, the geometry edges should follow the natural muscle or feature lines of the shape being created. This will allow for extra detail to be modelled around these areas, as well as aiding deformation based animation.

Checking the Model

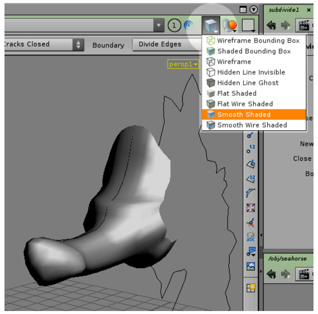
To the output of the current **Edit SOP**, append a **Mirror SOP**. This will mirror the current progress of the modelling to give a better understanding of how the model will look when it is completed.



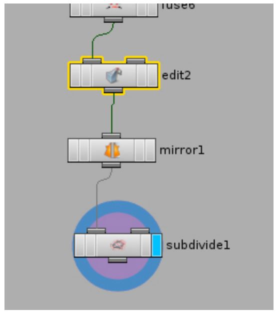
A **Subdivide SOP** can also be appended to the **Mirror SOP** in order to smooth the geometry further. Again, at this stage, this is for visualisation purposes only.

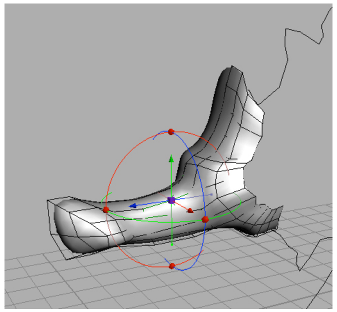
Refining the Shape

Set the **Viewer** to display **Smooth Shaded** geometry.



In the **Network Editor**, set the **Display Flag** to the **Subdivide SOP** and **select** the **Edit SOP** that was utilised to refine the shape before it was mirrored.



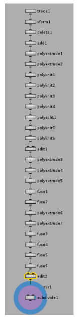


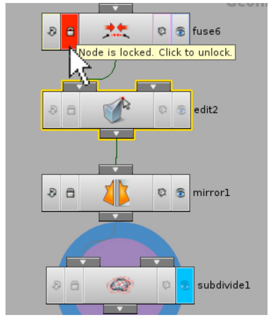
This will display the Edit SOP as a cage around the subdivided geometry, allowing for both editing of the low resolution mesh as well as a view of how these edits will effect the final geometry. See **seahorse_stage1.hipnc**

Locking Nodes (Deleting the Construction History)

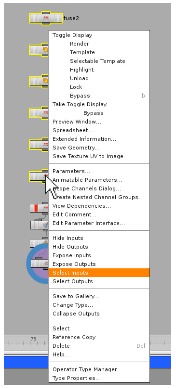
When viewed in its entirety using the Network Editor, there is a long list of nodes creating the seahorse muzzle and forehead. This is known as the construction history; and for this type of modelling these nodes can be deleted or ignored. Other operators such as the Delete SOP (for completely removing geometry elements) or the Dissolve SOP (for dissolving geometry elements without creating holes in the geometry) could be utilised to return the geometry back to a more primitive state if necessary. This means the construction network can be removed from the scene.

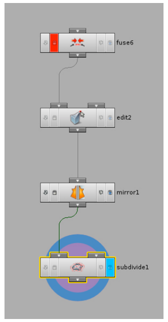
In the **Network Editor** locate the node before the final **Edit SOP**, and **LMB** click on its **Lock Flag**. This will lock all of the information generated by the construction history into this node.





Select the **previous node** to the one that is now locked, and **RMB** on it. From the resulting menu choose **Select Inputs**. This will select every preceding node in the chain.





These nodes can either be unloaded from memory by selecting **Unload** from the same **RMB menu** or they can be deleted. The model can now be developed further using the same techniques described earlier.

NOTE: if a network is deleted and the locked SOP is then unlocked, the information locked into the node will be lost and an error returned.