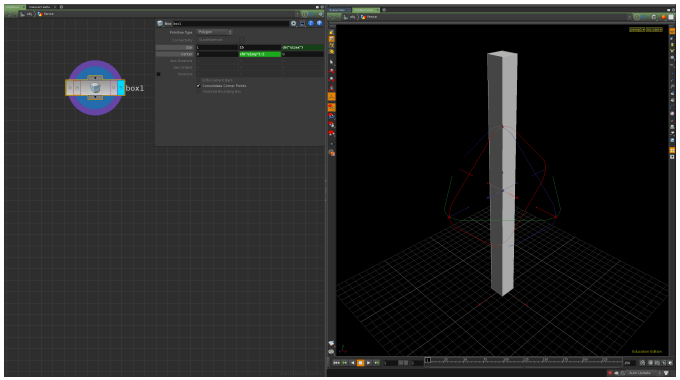
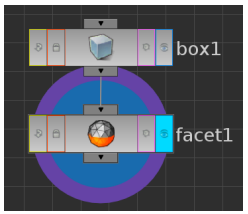
PROCEDURAL MODELLING OF A FENCE

This example will procedurally build a fence, allowing for the geometric configuration of the fence to be kept as live as possible. In a new scene create a Box Object and rename it to fence. At Geometry Level specify in the **parameters** for the **Box SOP**:

Size	**1**	**15**	**ch(“sizex”)**
Centre	**0**	**ch(“sizey”)/2**	**0**



This will create a fence post, whose size in both x and y will determine its shape and placement relative to the origin point.



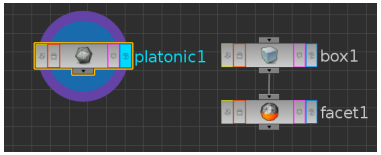
To the Box SOP append a Facet SOP. In the **parameters** for the **Facet SOP** specify:

☑ **Unique Points**

This will create a hard surface render for the fence post.

CREATING THE FENCE POST FINIAL

As a new network, create a **Platonic Solid SOP**. In the **parameters** specify:

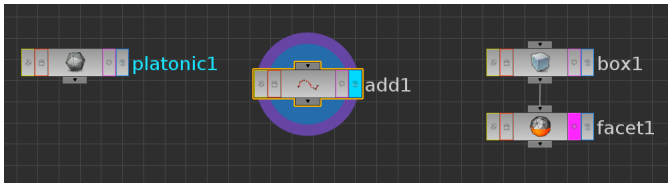


Solid Type	**Utah Teapot**		
Position	**0.1**	**0.46**	**0**

This will create a proxy finial for the fence post.

COPYING GEOMETRY ONTO PRIMITIVE FACES

As the finial will need to sit on the top of the fence post, a point for copying must be added to the top of the fence post. This can be done either by modifying the fence post geometry, or by procedurally assigning a point to the centre of the top face.



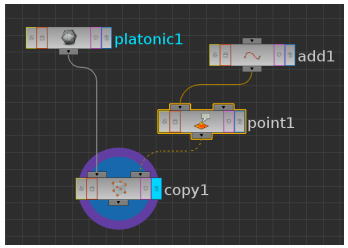
As a new network, create an **Add SOP**. In the **parameters** specify:

☑ **Point 0** **prim(“../box1”,5,”P”,0)** **prim(“../box1”,5,”P”,1)** **prim(“../box1”,5,”P”,1)**

This will create a single point, and procedurally position it at the centre of the top face of the fence post.

ORIENTATING THE FINIAL

Using a Copy SOP, copy the Platonic Solid SOP onto the Add SOP. In order to get better positioning control of the teapot placement, the point created by the Add SOP should have a Point Normal assigned to it.



Between the Add SOP and the Copy SOP insert a **Point SOP**. In the parameters of the Point SOP specify:

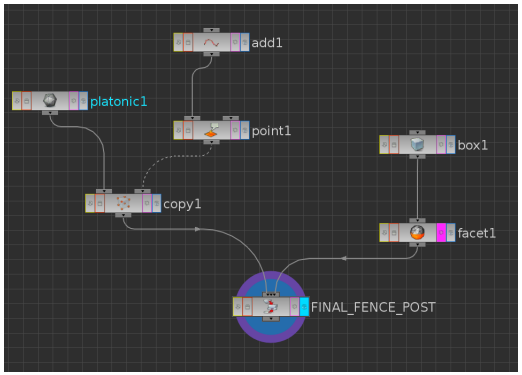
Standard >

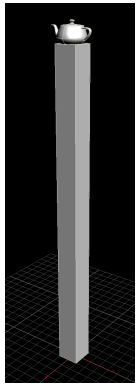
Add Normal **0** **0** **-1**

Particle >

Add Up Vector **0** **1** **0**

These settings will allow for orientation control for the placement of the teapot copied onto the point, defining which way to face and which way is up.

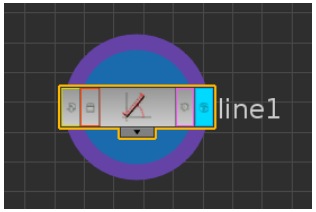




The components of the fence post can now be merged together.

CREATING FENCE RUNGS

As a new network chain, create a Line SOP. In the parameters specify:



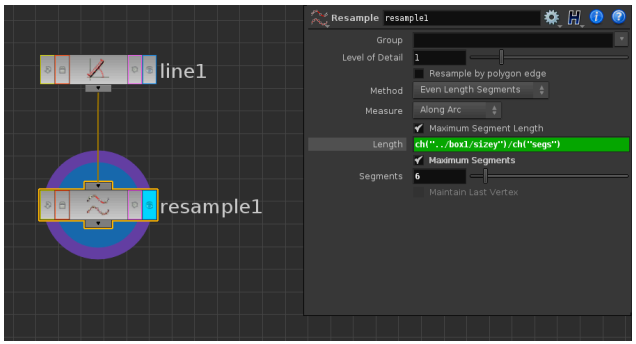
In the parameters specify:

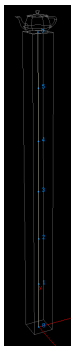
Distance ch("../box1/sizey")

This will automatically set the height of the line to the same height as the fence post.

To the Line SOP append a Resample SOP. This operator will define the number of rungs to be created between each fence post. In the parameters for the Resample SOP specify:

☑	Maximum Segment Length
Length	ch("../box1/sizey") / ch("segs")
☑	Maximum Segments
Segments	6



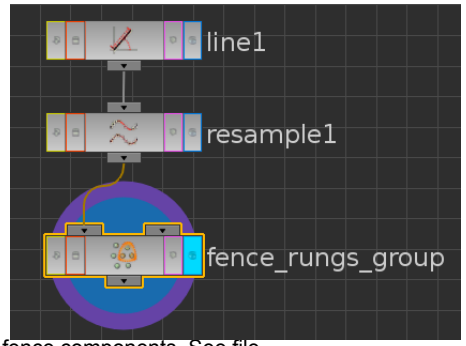


This will create a procedural gap between the rungs based upon the height of the fence post and the number of rungs (Segments) specified by the end user.

The points created as a result of the Resample SOP can be procedurally grouped to exclude the first and last point. This is so when the rungs are created, they do not align with the top or bottom of the fence post, but remain in-between.

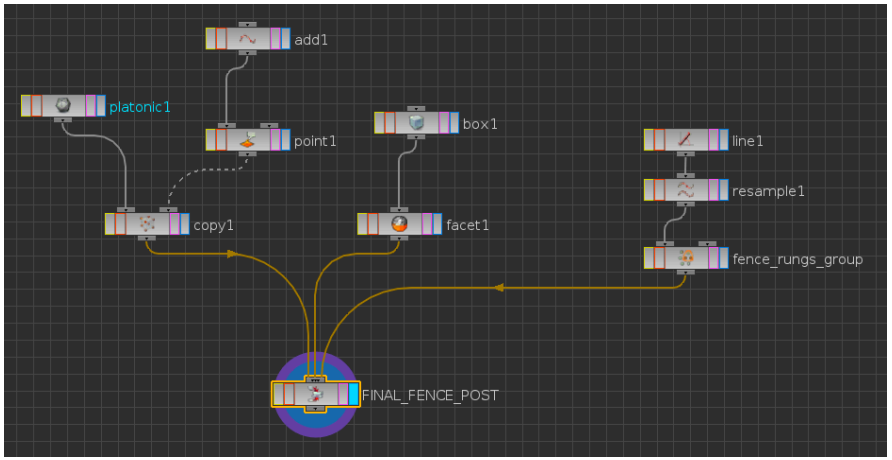
To the Resample SOP append a Group SOP. In the parameters specify:

Group Name **fence_rungs**
Entity **Points**
Number >
Pattern *** ^0 ^$N**



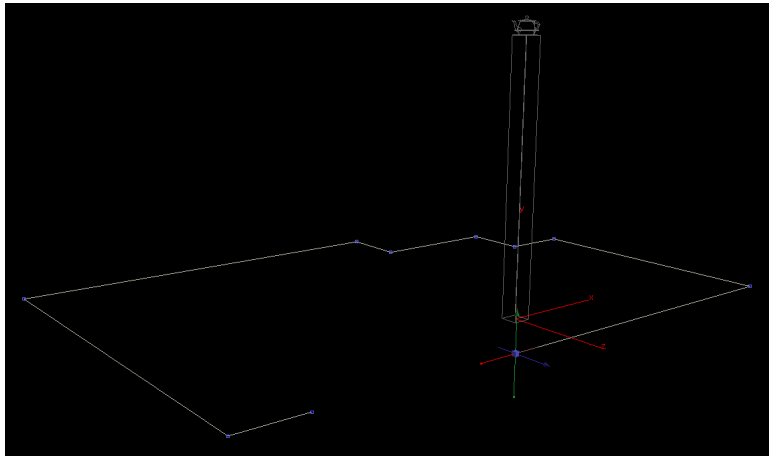
This will group all of the points apart from the first and last point.

This network can now be merged with the other fence components. See file **procedural_fence_stage1.hipnc**



CREATING THE FENCE OUTLINE CURVE

As a new network chain create a Curve SOP. Using the Top Orthographic View and Grid Snapping, draw a Polygon Curve defining the outline of the fence.

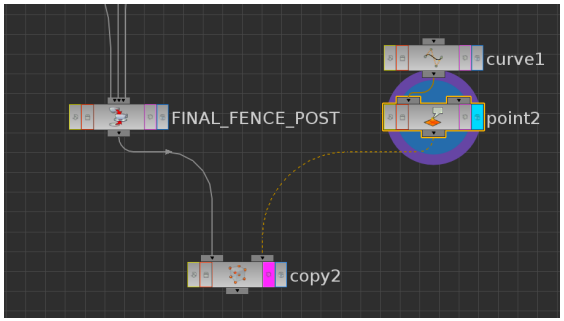


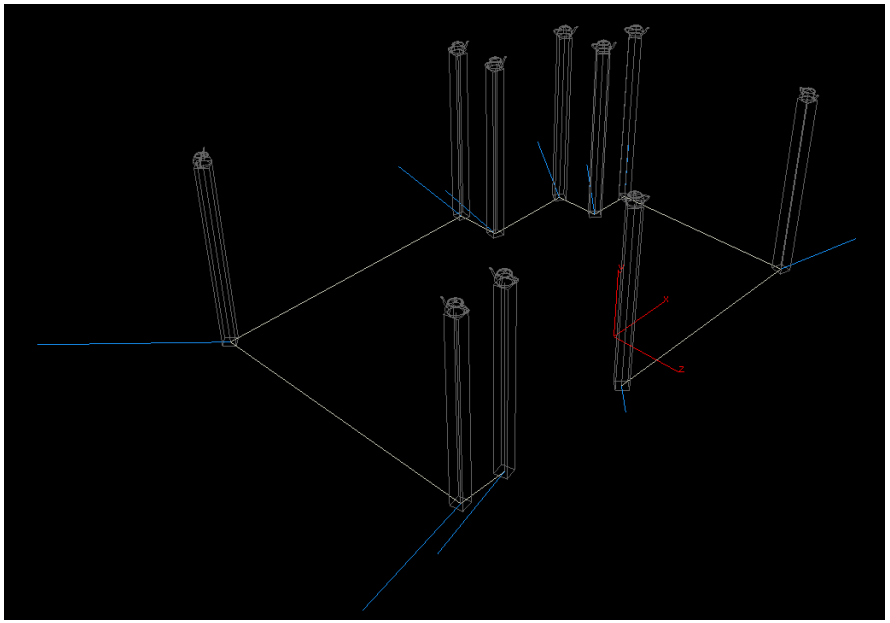
When the fence post is copied onto the curve, all the fence posts lie flat on the ground. Custom normals must therefore be created for the outline curve which takes into consideration both the orientation of the geometry to be copied and also the direction each fence post will eventually face.

To the Curve SOP append a Point SOP. In the parameters of the Point SOP specify:

Standard >
Add Normal $TX $TY $TZ

This will create normals for the curve which radiate out from each point.





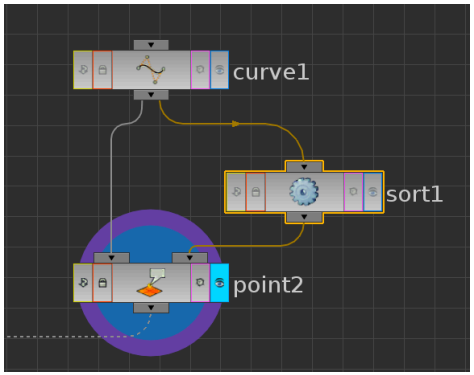
This fixes the orientation of the fence posts relative to the curve; however does not control their direction. To fix the direction of each fence post, each point normal can be pointed towards the next point of the curve. This will create fence posts which face outward from the fence outline curve.

To the Curve SOP MMB append a Sort SOP. In the parameters for the Sort specify:

Point >

Point Sort	Shift
Offset	1

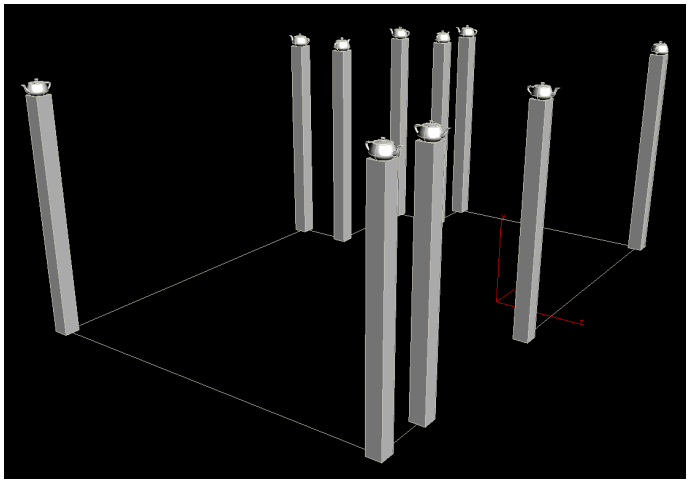
Wire the output of the Sort SOP as the second input to the Point SOP.



Modify the expression in the Point SOP from:

Normals	$TX	$TY	$TZ
to			
Normals	$TX2-$TX	$TY2-$TY	$TZ2-$TZ

This will subtract the point position derived from the second input of the Point SOP from the first, creating normals which point towards the next point along the curve. **NOTE:** an optional Delete SOP can be used to remove the curve geometry making the direction of the normals easier to see. A Facet SOP can also be used to explicitly set a unit length for the normals.



When the Display Flag for the Copy SOP is activated, each fence post now faces outward, but perpendicular to the edge of the fence outline curve.

BUILDING THE FENCE RUNGS

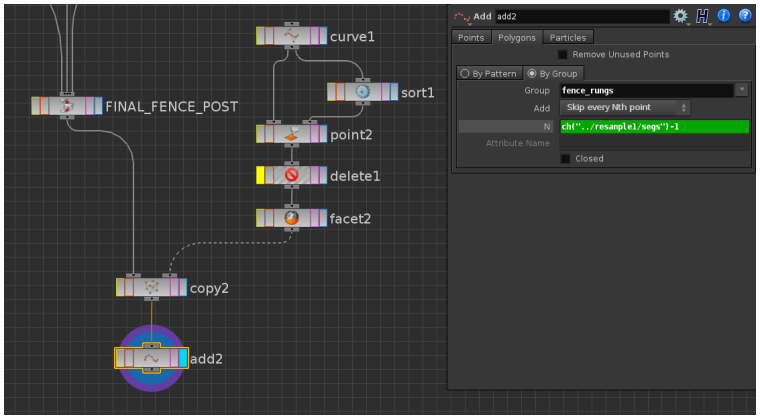
To the Copy SOP append an Add SOP. In the parameters specify:

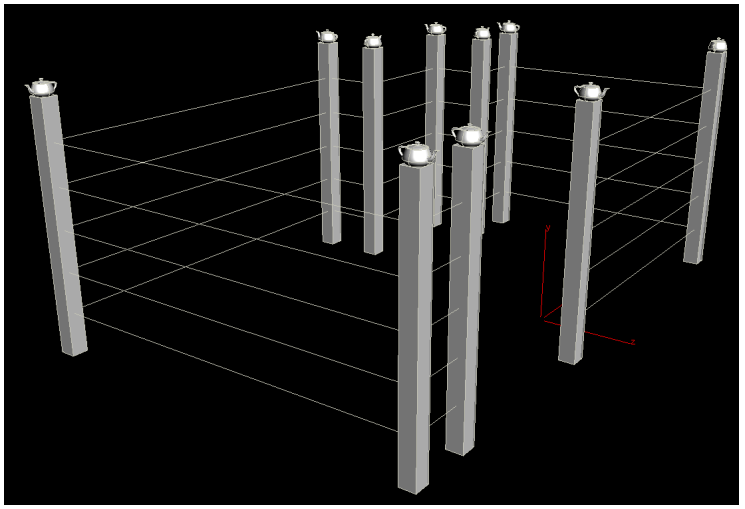
Polygons >

By Group >

Group	fence_rungs
Add	Skip Every Nth point
N	ch(“../resample1/segs”) -1

This will procedurally draw curves on all the points created in the fence_rungs group without joining the beginning and end of each rung. The linking of the N parameter to the Resample SOP will ensure that if more rungs are specified, the curves drawn by the Add SOP will remain consistent to the construction of the fence.





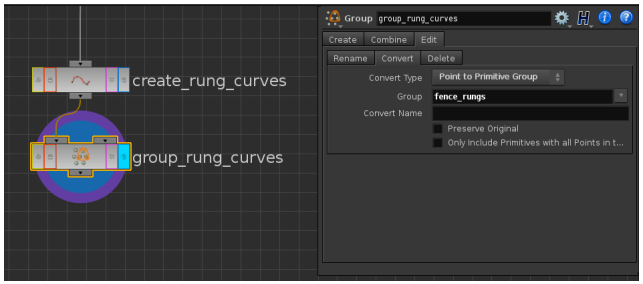
CREATING RUNG GEOMETRY

The fence_rungs group can also be used to build geometry onto the rung curves. The group must however be converted from a Point Group to a Primitive Group in order to facilitate this. To the output of the Add SOP append a Group Geometry SOP. In the parameters specify:

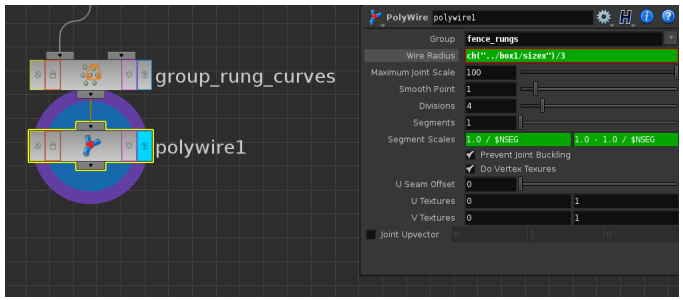
Edit >

Convert >

Convert Type	Point to Primitive Group
Group	fence_rungs



A PolyWire SOP can now be appended to the network to create the fence rung geometry.

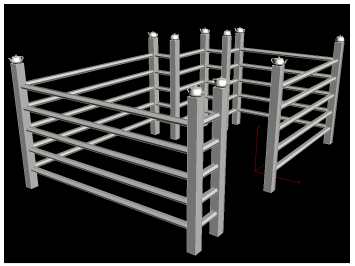


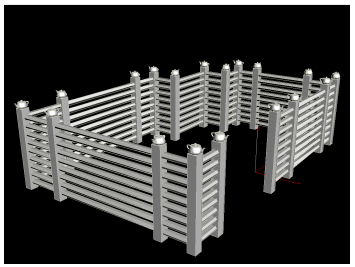
In the parameters for the PolyWire SOP specify:

Group	fence_rungs
Wire Radius	ch("../box1/sizex")/3

The expression assigned to the Wire Radius parameter will procedurally control the radius of the rungs relative to the size of the fence post.

With the network now complete, points can be inserted into the outline fence curve in order to procedurally create more fence posts (**curve1**). The number of fence rungs can also be set (**resample1**), as to the height and width of the fence post itself (**box1**). All adjustments to these controls will result in the fence procedurally updating.





See file **procedural_fence_complete.hipnc**