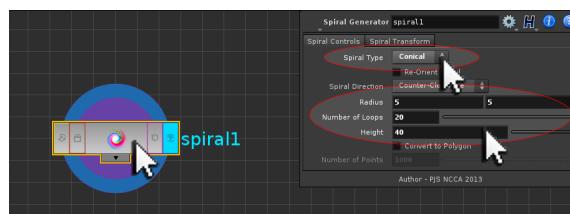


Houdini 14 – Spiral Tornado

In a new Houdini scene, create a **Geometry Object**, and inside it replace the default **File SOP** with a **Spiral Generator SOP**. In the **parameters** for the **Spiral Generator SOP** specify:

Spiral Controls >		
Spiral Type	Conical	
Radius	5	5
Number of Loops 20		
Height	40	
Spiral Transform >		
Rotate	0	-\$F*10
		0



This will create a large conical spiral that rotates when **PLAY** is pressed.

To the Spiral Generator SOP append a **Group SOP** and **rename** it to **group_top**. In its **parameters** specify:

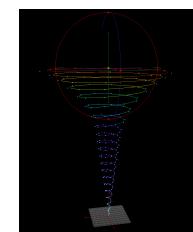
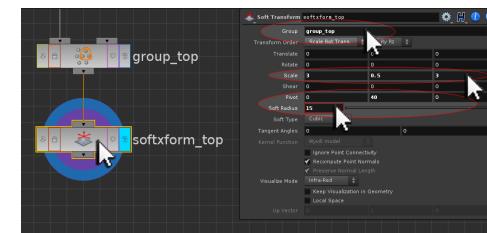
Entity	Points
Bounding >	
<input checked="" type="checkbox"/> Enable	
Bounding Type	Bounding Sphere
Size	20 5 20
Center	0 40 0



This will create a squashed Bounding Sphere at the top of the spiral, grouping any points inside it.

Append to the Group SOP a **Soft Transform SOP**. This can be used to reshape the top part of the spiral curve to create a more natural tornado shape. In the **parameters** for the **Soft Transform SOP** specify:

Group	group_top
Scale	3 0.5 3
Pivot	0 40 0
Soft Radius	15

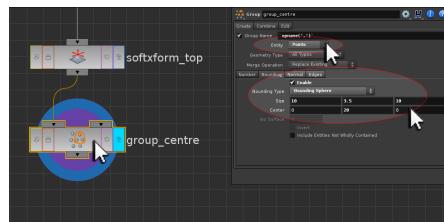


This will scale only the points grouped at the top of the spiral curve, and increase its overall scale. The **Soft Radius** parameter controls a **falloff of influence** for this transformation, creating a **tapering effect** into the shape of the original spiral curve.

Houdini 14 – Spiral Tornado

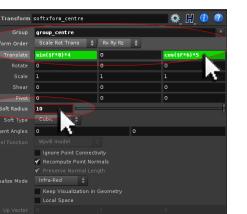
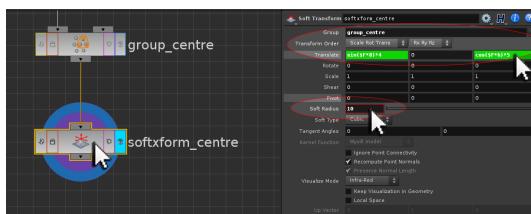
To the output of the **Soft Transform SOP** append a **Group SOP**. Rename it to **group_centre**, and in its **parameters** specify:

Entity	Points		
Bounding >			
<input checked="" type="checkbox"/> Enable			
Bounding Type	Bounding Sphere		
Size	10	3.5	10
Center	0	20	0

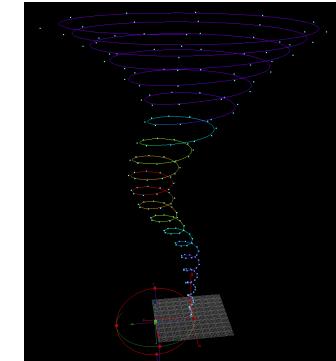


As before **append a Soft Transform SOP** to this new Group SOP and specify in its **parameters**:

Group	group_centre		
Translate	sin(\$F*8)*4	0	cos(\$F*6)*5
Soft Radius	10		



When **PLAY** is pressed, this will transform the grouped centre points of the tornado curve in an animated circular motion on the X and Z axis creating the central bend of the tornado shape.



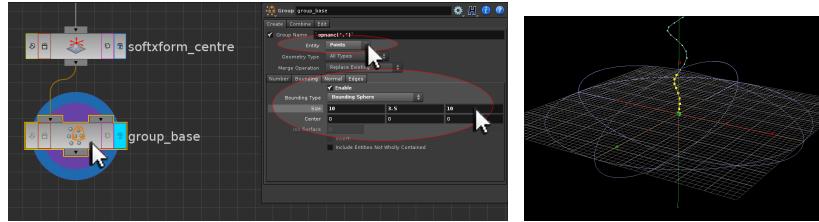
NOTE: The functions **sin()** and **cos()** are simple expressions for generating sin and cosine waves. These are internally animated using \$F. More about this type of expression based animation will be given in an upcoming lecture.

This method of using a Bounding Sphere for grouping points can also be assigned to the bottom of the tornado curve in order to warp and animate its placement on the ground. To the output of the **Soft Transform SOP** affecting the centre of the tornado curve, append a **Group SOP** and rename it to **group_base**. In its **parameters** specify:

Entity	Points		
Bounding >			
<input checked="" type="checkbox"/> Enable			
Bounding Type	Bounding Sphere		
Size	10	3.5	10

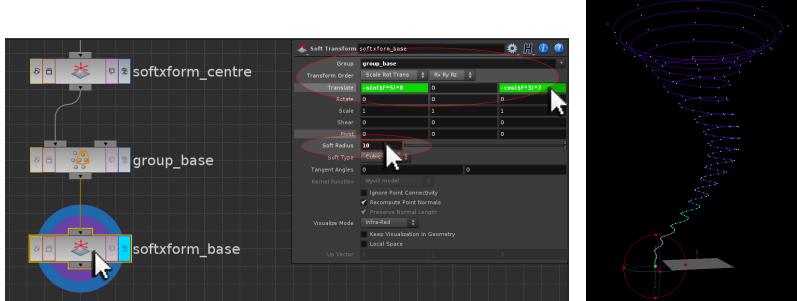
Houdini 14 – Spiral Tornado

This will group the points at the base of the tornado curve.



As before **append a Soft Transform SOP** to this new Group SOP and specify in its **parameters**:

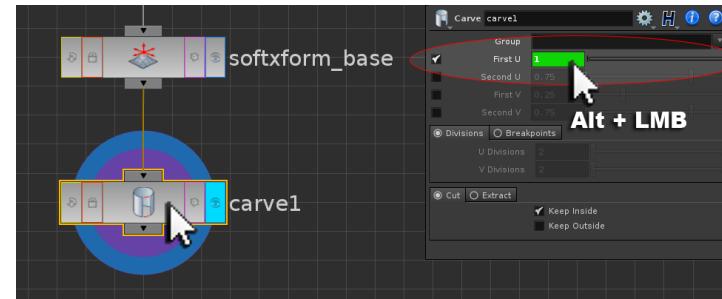
Group	group_base		
Translate	-sin(\$F*5)*8	0	-cos(\$F*3)*7
Soft Radius	10		



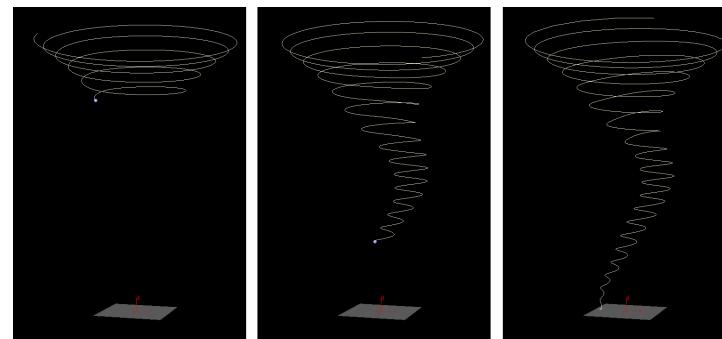
When **PLAY** is pressed, this will transform the grouped base points of the tornado curve in an animated circular motion on the X and Z axis creating a searching tip for the tornado over the ground.

ANIMATING THE TORNADO CURVE GROWTH

As the tornado curve is a NURBS curve, a Carve SOP can be used to animate its growth, creating the illusion of the tornado formation. Append a **Carve SOP** to the network, and **set a keyframe (Alt + LMB)** value of **1** to the **First U** parameter at **Frame 1** on the timeline.



Increase the **timeline** to **Frame 150**, and create a **new keyframe** for the **First U** parameter with a value of **0**. When **PLAY** is pressed, the tornado curve grows downwards from the sky until it touches the ground.



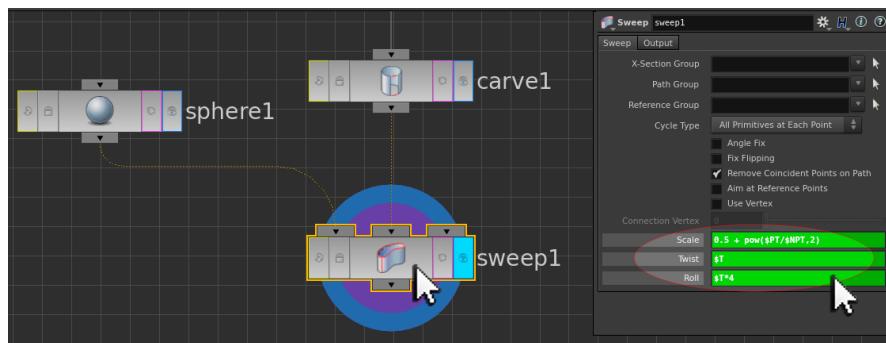
Houdini 14 – Spiral Tornado

CREATING TORNADO GEOMETRY

With the base curve of the tornado created, some simple geometry can be assigned to it to create the tornado itself. As a **new node** create a **Sphere SOP**, and specify in its parameters:

Radius	3	3	3
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Append to the Sphere SOP a Sweep SOP, connecting the **tornado curve** as its **second input**. This will sweep the sphere along the animated curve.

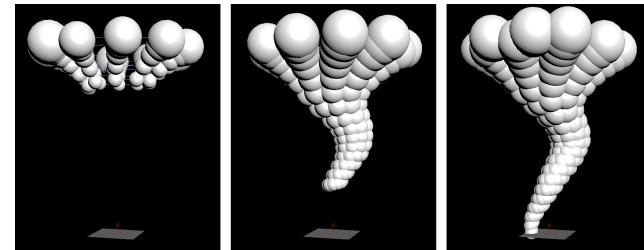


In the **parameters** for the **Sweep SOP** specify:

Scale	0.5 + pow(\$PT/\$NPT,2)
Twist	\$T
Roll	\$T*4

NOTE: The function **pow()** allows for a **curved tapering scale** to be assigned to the swept spheres based upon the point number the sphere is being swept onto. More about this type of expression based control will be given in an upcoming lecture.

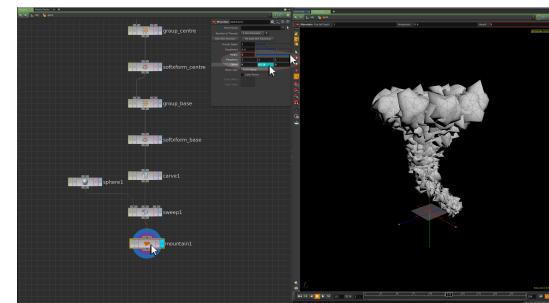
When **PLAY** is pressed, the swept spheres appear on the tornado curve in accordance to its growth animation.



CREATING A VOLUME

Set the **Primitive Type** parameter of the **Sphere SOP** to **Polygon**, and **append a Mountain SOP** to the **output** of the **Sweep SOP**. In the **parameters** of the **Mountain SOP** specify:

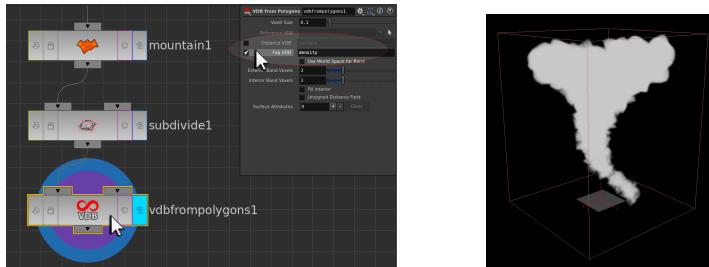
Height	5		
Offset	0	\$T/10	0



This will create **animated displacement** for the tornado geometry. The **spikiness** of the geometry can then be **softened further** by appending a **Subdivide SOP** to the network.

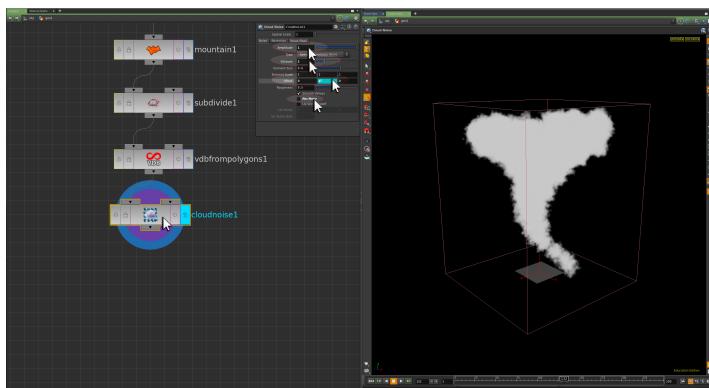
Houdini 14 – Spiral Tornado

To the output of the **Subdivide SOP** append a **VDB from Polygons SOP**. In its parameters deactivate the **Distance VBD** option, and activate the **Fog VDB** option instead.

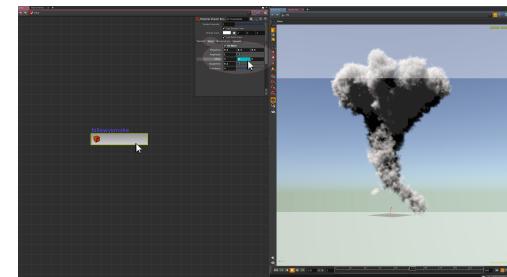


This will create a **Fog Volume** from the tornado geometry, in the **correct format** for the addition of a **Cloud Noise SOP**. In the parameters of the Cloud Noise SOP specify:

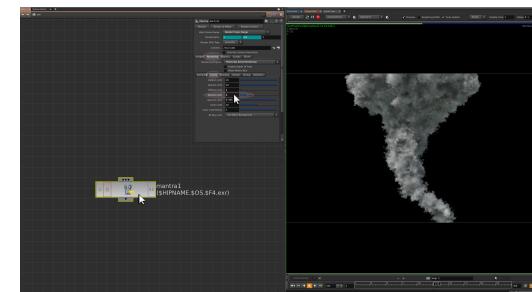
Amplitude	1
Octaves	2
Offset	0
Abs Noise	\$T 0



A **Billowy Smoke Material** can also be **created** from the **Material Palette** and assigned to the **tornado**. **Noise** can be **activated** and **animated** in its **parameters** to further enhance the emerging aesthetic.



A **simple camera** and **Sky Light setup** can also be **added** to the **scene** to start testing the render aesthetic.



The **Rendering > Limits > Volume Limit** parameter of a **Mantra PBR** node can also be **increased** to allow for **light to internally bounce** around the tornado volume. This can give a **greater sense of internal illumination** to the tornado.

See file [H14_spiral_tornado.hipnc](#)