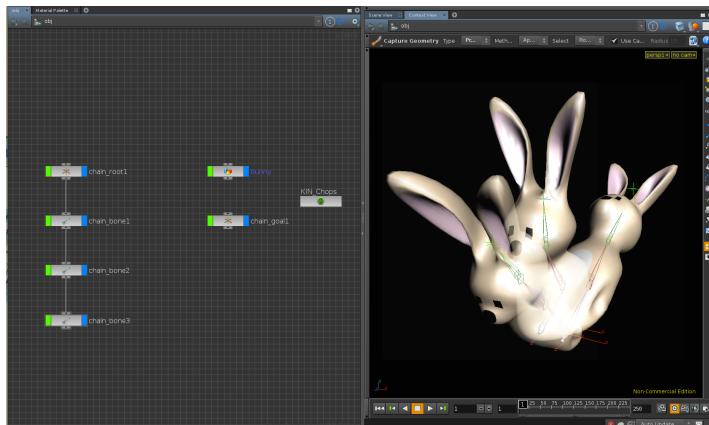


DYNAMIC EARS

Bones from a Curve can also be used in conjunction with dynamics to provide automated deformation responses to a character's movements. [Open the scene](#) `bunny_ears_begin.hipnc`.



This is a similar scene to before; however a simple IK bone chain has been added to animate the bunny body. This example will look at assigning ear curves in order procedurally deform the ears relative to the movement of the bunny animation. When **PLAY** is pressed, the bunny rocks back and forward.

NOTE: Character Tools such as IK bones will be covered in an upcoming lecture.

ATTACHING THE CURVES

Stop playback and go inside `chain_bone3`. This is the bone associated with the head region, and a useful point where dynamic curves can be attached to the bunny character rig. To the **BoneLink SOP** append a **Fuse SOP** followed by a **Point SOP**.

In the **parameters** of the **Point SOP**, specify:

Standard >

Add Normal

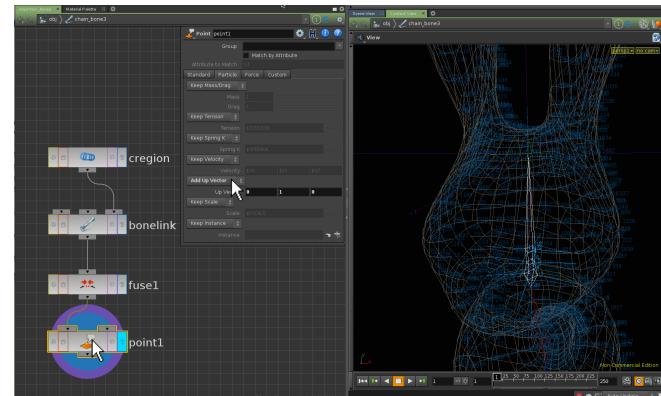
| | | | | |
|--------|------|------|------|------------------------|
| Normal | \$NX | \$NY | \$NZ | (not @N.x, @N.y, @N.z) |
|--------|------|------|------|------------------------|

Particle >

Add Up Vector

| | | | |
|-----------|---|---|---|
| Up Vector | 0 | 1 | 0 |
|-----------|---|---|---|

This will allow point number 13 of the bone geometry to have a Rivet Object assigned and aligned to it, that the ear curves can be then be copied onto.

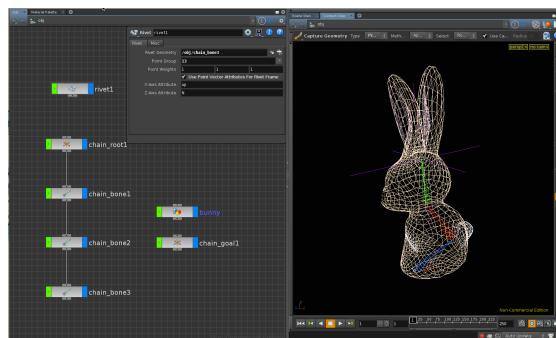


NOTE: H15 Change – the new `@N.x`, `@N.y`, and `@N.z` declarations do not automatically reveal the (hidden) normal information of any incoming geometry, but instead assign a value of 0 instead. `$NX`, `$NY`, `$NZ` will however pick up the (hidden) normal information of any incoming geometry. If the `@N.x`, `@N.y` and `@N.z` declarations are used, then a **Normal SOP** should be inserted before the **Point SOP** to activate the (hidden) normal information of any incoming geometry so it can then be stored in `@N.x`, `@N.y` and `@N.z`.

Houdini 15 – Deformers Homework

Return to **Object Level** and create a **Rivet Object**. In the **parameters** specify:

Rivet Geometry /obj/chain_bone3
Point Group 13
 Use Point Vector Attributes for Point Frame



When **PLAY** is pressed, the Rivet Object is attached and aligned to the tip of the head bone. Under the **Misc** section of the **Parameters** adjust the scale of the Rivet geometry to **0.4**. This will align the tips rivet geometry to the base of the bunny ears.

See file **bunny_ears_stage1.hipnc**

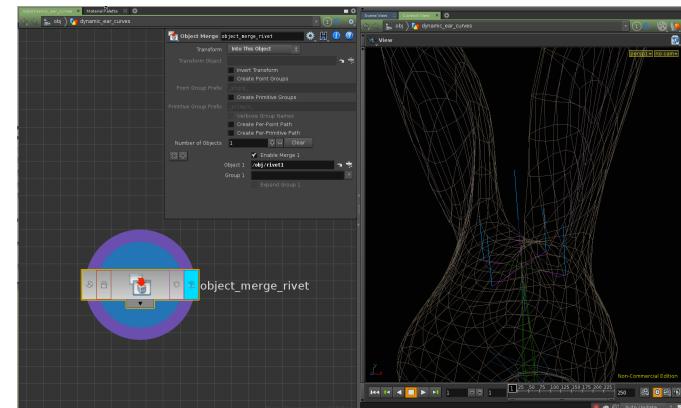
CREATING THE EAR CURVES

Inside the **Rivet Object**, append a **Point SOP** to the **Control SOP**, and specify:

Add Normals
Normal 0 0 1

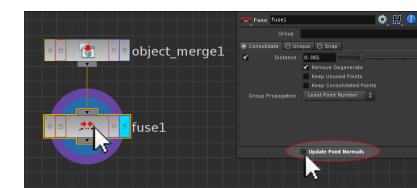
This will assign Normals to the Rivet Geometry, allowing for dynamic curves to aligned to it.

At **Object Level** create a **new Geometry Object** called **dynamic_ear_curves**, and at its **SOP Level** replace the **default File SOP** with an **Object Merge SOP**. Use the **Object Merge SOP** to read in the **Rivet Object**, specifying **Transform into the Object** to ensure its animation is also read in.



Append a **Fuse SOP** to the **Object Merge SOP**. In the **parameters** for the **Fuse SOP** specify:

Update Point Normals



Houdini 15 – Deformers Homework

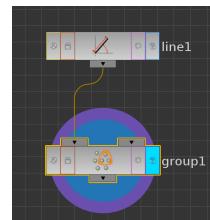
Alongside the Fuse SOP create a Line SOP. In the **Parameters** specify:

| | | | |
|-----------------------|-------|---|---|
| Primitive Type | NURBS | | |
| Direction | 0 | 0 | 1 |
| Points | 5 | | |

To The Line SOP append a Group Geometry SOP. In the **parameters** specify:

| | |
|----------------|--------|
| Entity | Points |
| Pattern | 0 1 |

This will group the first two points of the Line SOP, allowing them to be anchored when dynamics are assigned.



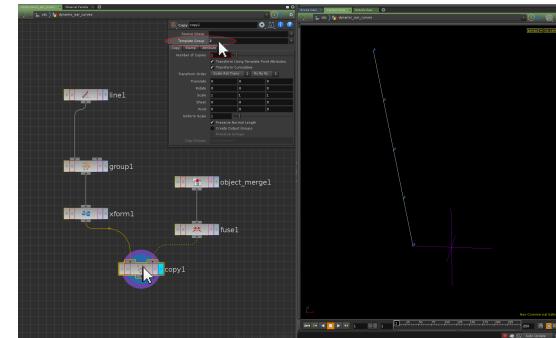
To the Group Geometry SOP append a Transform SOP. In the **parameters** specify:

| | | | |
|---------------|---|-----|---|
| Rotate | 0 | -10 | 0 |
|---------------|---|-----|---|

Append a Copy SOP to the Transform SOP and wire the **output** of the Fuse SOP as the **second input**. In the **parameters** of the Copy SOP specify:

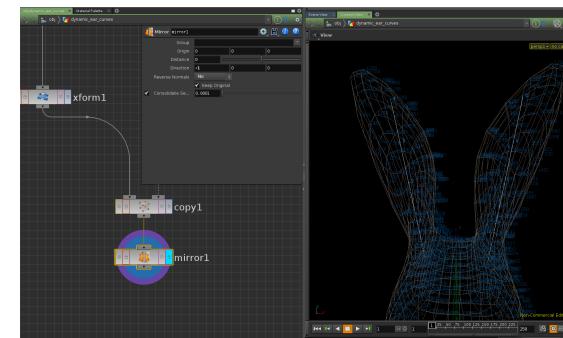
| | |
|-----------------------|---|
| Template Group | 2 |
|-----------------------|---|

This will copy the line onto the right hand side of the rivet geometry, aligning it with the right ear geometry of the bunny object.



To the Copy SOP append a Mirror SOP. In the **parameters** for the Mirror SOP specify:

| | |
|------------------------|----|
| Reverse Normals | No |
|------------------------|----|



This will duplicate the first curve to create a pair of ear curves. Specifying No to the reversal of normals will ensure any bones generated along this second curve will orient as expected.

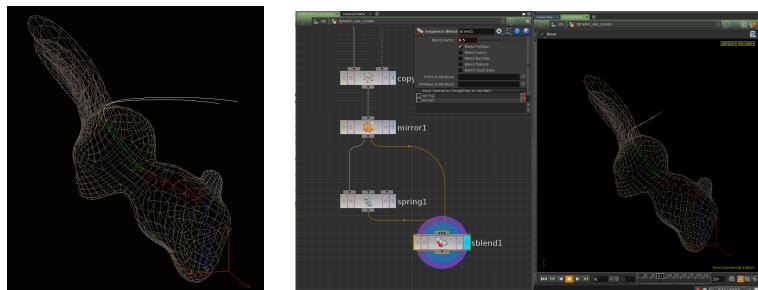
Houdini 15 – Deformers Homework

ADDING DYNAMICS

In this example, a Spring SOP will be used to add simple dynamics to the ear curves. It should be noted however that Wire DOP Object could also be used for this stage. To the **Mirror SOP** append a **Spring SOP**. In the **parameters** specify:

| Forces | | | |
|----------------|--------|------|---|
| External Force | 0 | -0.5 | 0 |
| Nodes | | | |
| Fixed Points | group1 | | |
| Mass | 0.1 | | |

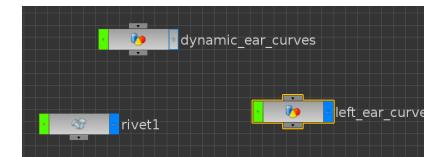
When **PLAY** is pressed, the curves respond dynamically to the movement of the bunny geometry.



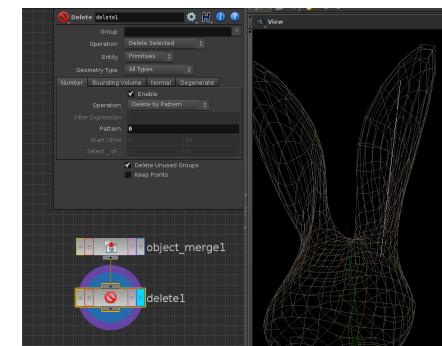
To the output of the **Spring SOP** append a **Sequence Blend SOP**. This can be used to help control the extent of the dynamics affecting the curve. Wire the output of the **Mirror SOP** as the **second input** of the Sequence Blend SOP, and in its **parameters** specify a **Blend Factor of 0.5**. The curves will now take half of their position information from the dynamics of the spring SOP and half their position information from the static curves of the Mirror SOP. The visual result is a stiffening of the ear curves that can be controlled by the artist. See file [bunny_ears_stage2.hipnc](#)

GENERATING THE EAR BONES

As the Bones from a Curve Tool can only accept one curve at a time, each dynamic ear curve will need to be split into their own separate object.



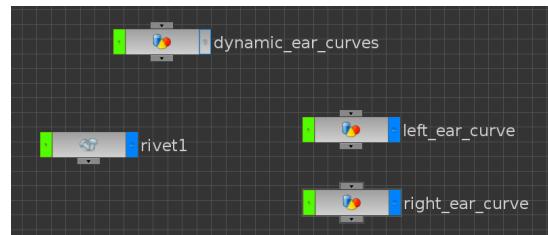
At **Object Level**, turn off the **Display Flag** for the **dynamic_ear_curves** object, and create a **new Geometry Object** called **left_ear_curve**. Inside this new object, replace the default File SOP with an **Object Merge SOP**. Use this Object Merge SOP to read in the **dynamic_ear_curves** object.



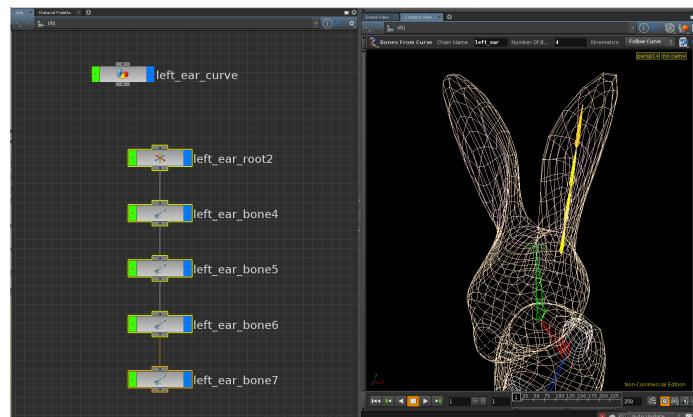
To the **output** of the **Object Merge SOP** append a **Delete SOP**. In the **parameters** specify a **Pattern value of 0**. This will delete the right ear curve leaving only the left one remaining (primitive number 0).

Houdini 15 – Deformers Homework

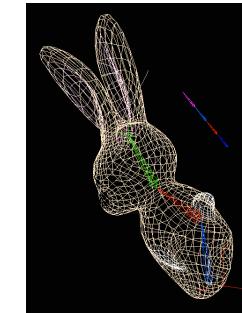
Repeat these steps to create a second new object containing only the **right ear curve** (primitive number 1). For simplicity, the **left_ear_curve** object can be (CTRL+c) copied and (CTRL+v) pasted and modified accordingly.



In the **Network Editor**, select the **left_ear_curve** and with the mouse over the **Viewer** activate the **Bones from Curve Tool**.

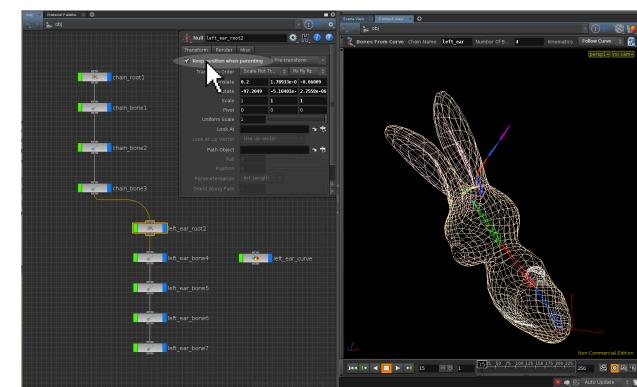


From the **Tool Options** stow bar of the **Viewer** specify a **Chain Name** of **left_ear**; **Number of Bones** – 4; **Kinematics – Follow Curve**.



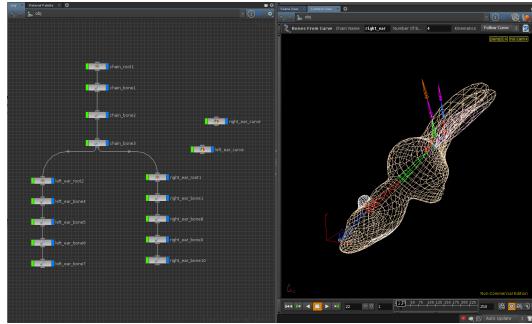
When **PLAY** is pressed, the **bones follow the left_ear_curve**; however are rooted to their original location resulting in the bunny object leaving the bones behind. This can be fixed, by parenting this bone chain to the bones controlling the animation of the bunny.

Rewind the scene, and in the Network Editor, activate the **Keep Position When Parenting** option on the **left_ear_root2** object. With this option specified, the left ear bone chain can now be parented to **chain_bone3**.



Houdini 15 – Deformers Homework

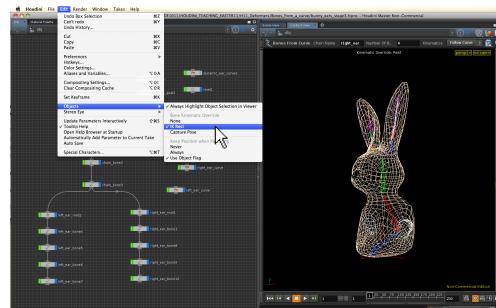
When **PLAY** is pressed, the root of the ear bone is now locked to the same position as the base of the left ear curve, allowing for the left ear bones to remain on the curve as it deforms.



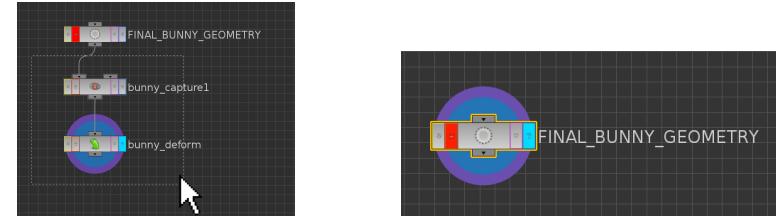
These steps can be repeated to **generate bones** for the **right_ear_curve** object.

RE-ASSIGNING THE GEOMETRY CAPTURE

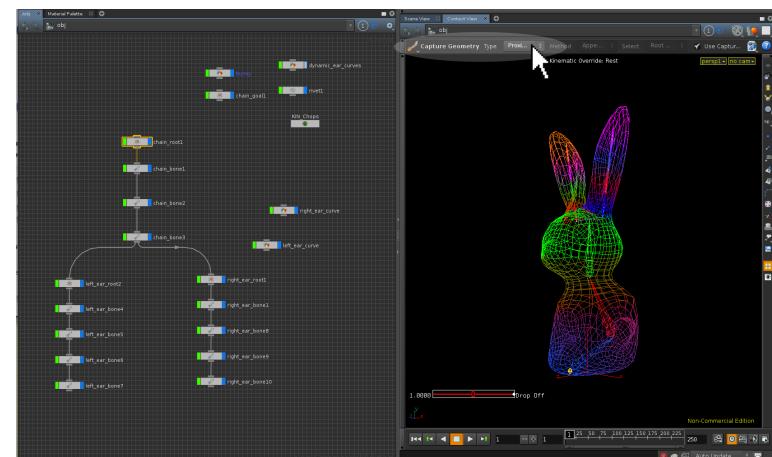
When **PLAY** is pressed, both sets of ear bone chains follow their respective curves. At present however they do not affect the bunny geometry. Re-capturing the bunny geometry using this new bone rig configuration can rectify this. **Rewind** the scene, and from the main **Edit Menu**, select **Objects > IK Rest** to disable the animation assigned to the bone rig.



Go **inside the bunny object**, and delete both the **bunny_capture1** node and the **bunny_deform** node.



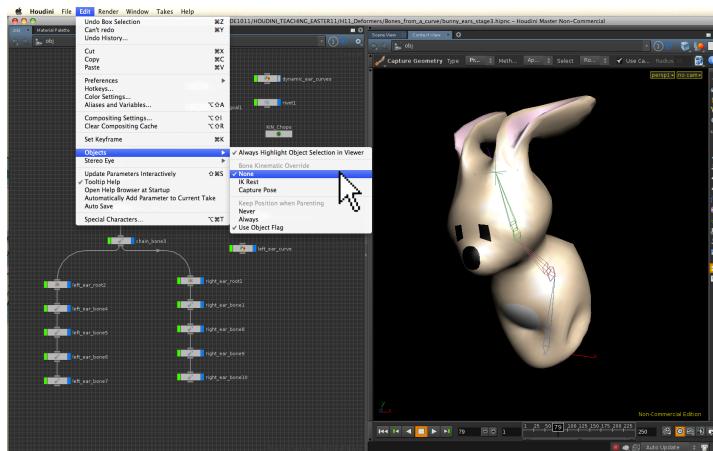
Return back up to **Object Level**, and **select the bunny object**. With the **mouse over the Viewer** press **TAB** and activate the **Capture Geometry** tool.



When prompted, select the **root of the bone chain (chain_root1)**, and press **ENTER** with the mouse over the Viewer to confirm the operation. Ensure the **Capture Type** is set to **Proximity**.

Houdini 15 – Deformers Homework

From the **Edit Menu**, choose **Objects > None** to reactivate the animation on the character rig. When **PLAY** is pressed, the bunny animates as before however now the Bones from Curve dynamic setup procedurally drives the ears.



As with the first Bones from Curves example, the smoothness of deformation can be improved by going to the **Geometry Level** of the **bunny** Object and locating the **Capture Proximity SOP** automatically generated by the Capture Geometry process. Increasing the **Max. Influences** parameter to **10** will increase the number of bones influencing the deformation of the geometry giving a smoother result.

See file **bunny_ears_done.hipnc**