Nathan Huseth | VSFX 721 | Winter 2022

Project 2 | Complex Scene

Kelp Forest | User Guide and Breakdown

Houdini Version 19.0.383

Render Statistics

• Renderer:	Mantra PBR
• Frame Count:	120
• Avg. Render Time:	32 min/frame (render farm)
• Image Resolution:	1920 x 1080
• Number of Lights:	5 (4 spotlights, 1 environment light)

Geometry Statistics

• Points:	6,578
• Primitives:	6,578
• Vertices:	6,578
• Volume:	1
• Packed Geos:	6,577

Sampling

• Noise Value:	0.01
• Min/Max Rays:	3/9
• Diffuse:	1
• Reflection:	1
• Global Quality:	1

Project Description

A scene featuring complex layered kelp stalks, a school of fish sweeping through the scene, a mossy rock and atmospheric falloff as the kelp recedes into the horizon.

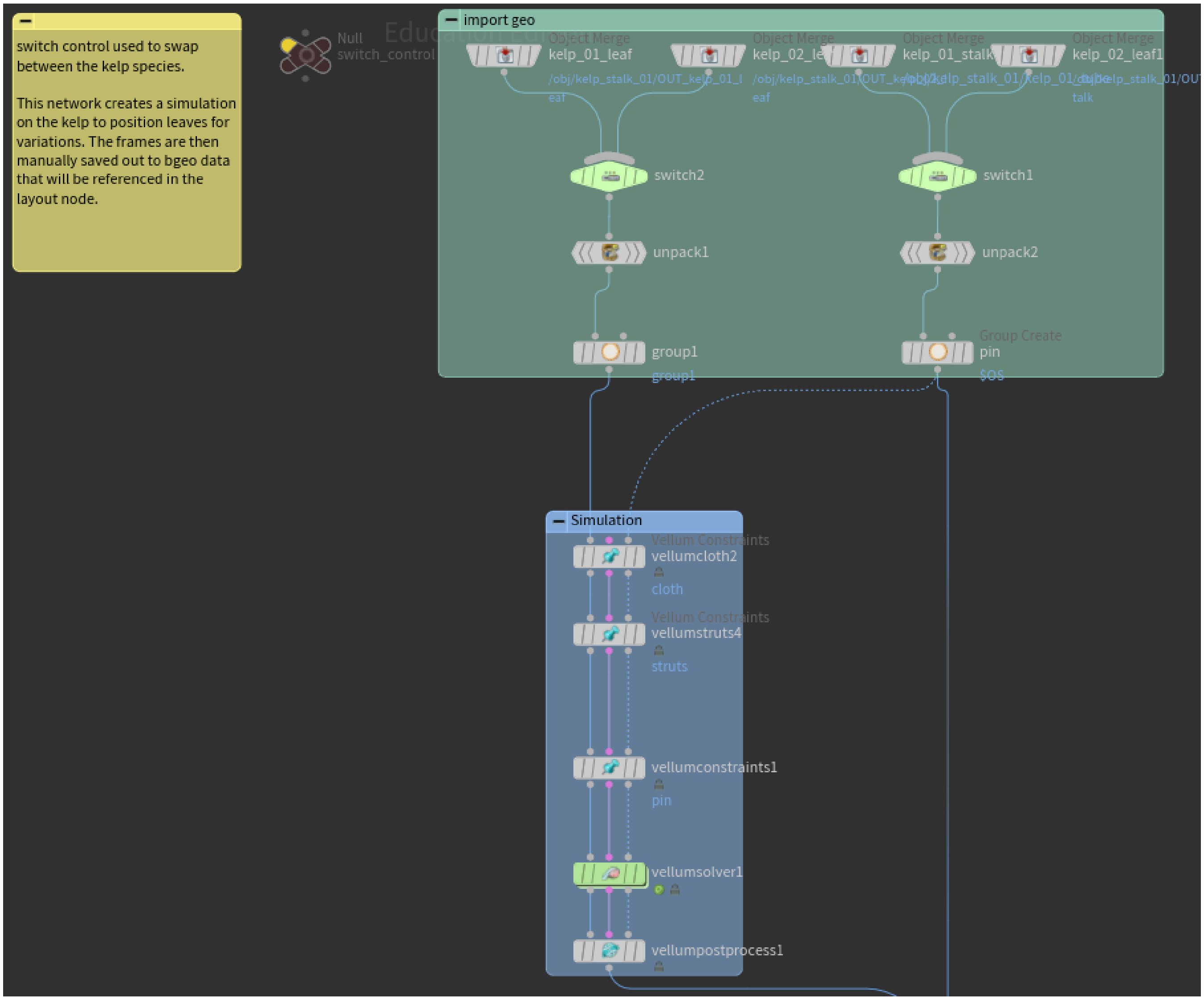
Left: Reference image. Right: Final render.

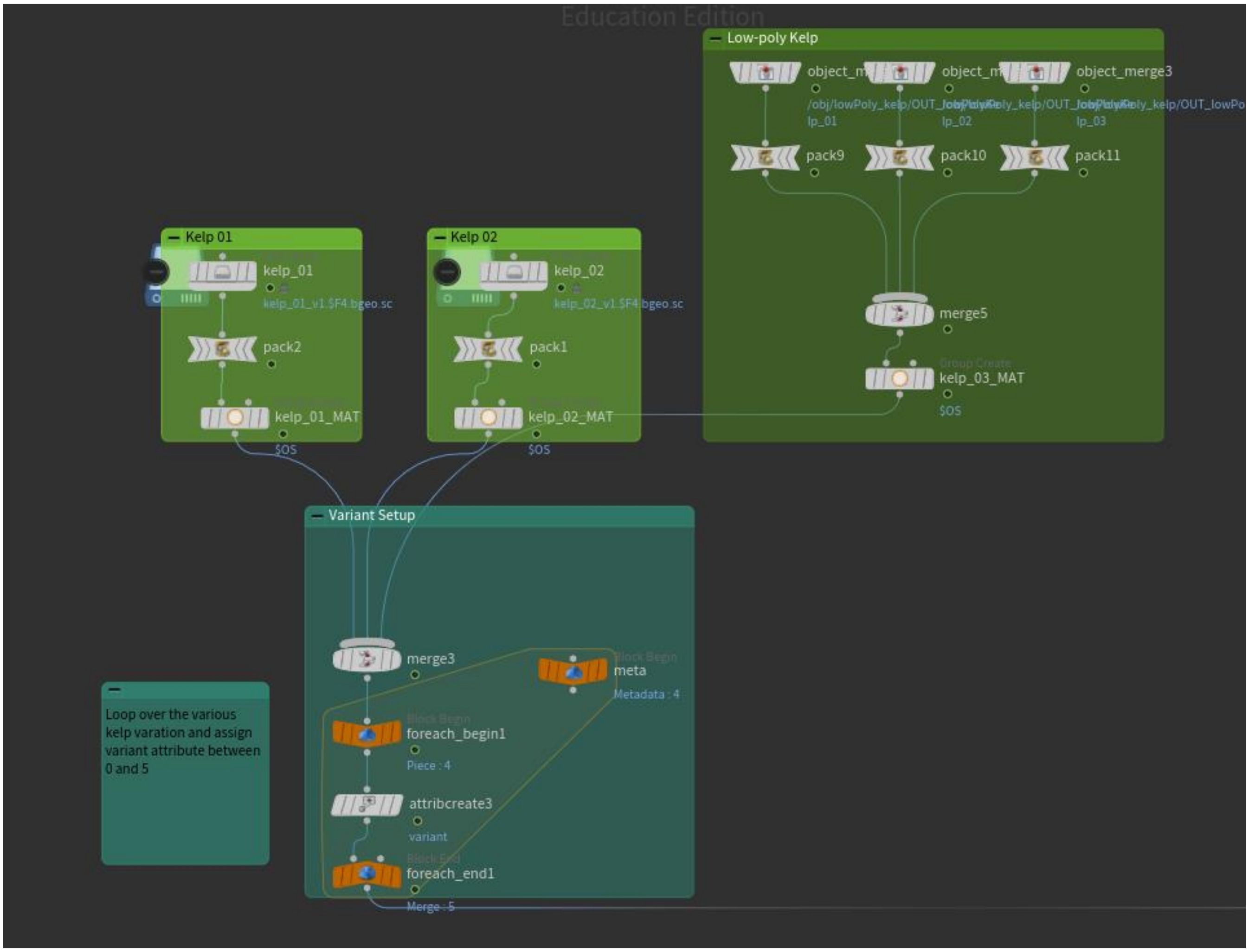
Technical Guide

Kelp

The kelp forest initially was created as a simple leaf geometry (a different leaf for each species) and with tube geo for the stalk. The kelp leaves were copied using a scatter node along the tube geo to generate the main stalk. Vellum cloth simulation was then used to position the leaves in a more natural way along the tube. The simulated geometry was exported at four different frames for each of the kelp species to create two animated variations of the kelp. The cached simulations are scattered through the scene with a copy to points node and composed in the scene using grouped points.

To reduce the number of detailed models, a single frame of each of the kelp stacks was rendered out to create an alpha matte in Photoshop. This matte was brought back in with a trace node to create low-poly versions of the kelp stalks that fill in the distant areas of the scene. To add animation to these low-poly geo, a bend node with randomized timing was added to the low-poly geo.


switch control used to swap between the kelp species.
This network creates a simulation on the kelp to position leaves for variations. The frames are then manually saved out to bgeo data that will be referenced in the layout node.
Null
switch_control
import geo
Object Merge
kelp_01_leaf
kelp_02_leaf1
kelp_01_stalk
switch2
switch1
unpack1
unpack2
group1
Group Create
pin
$OS
Simulation
Vellum Constraints
vellumcloth2
cloth
vellumstruts4
struts
vellumconstraints1
vellumsolver1
vellumpostprocess1

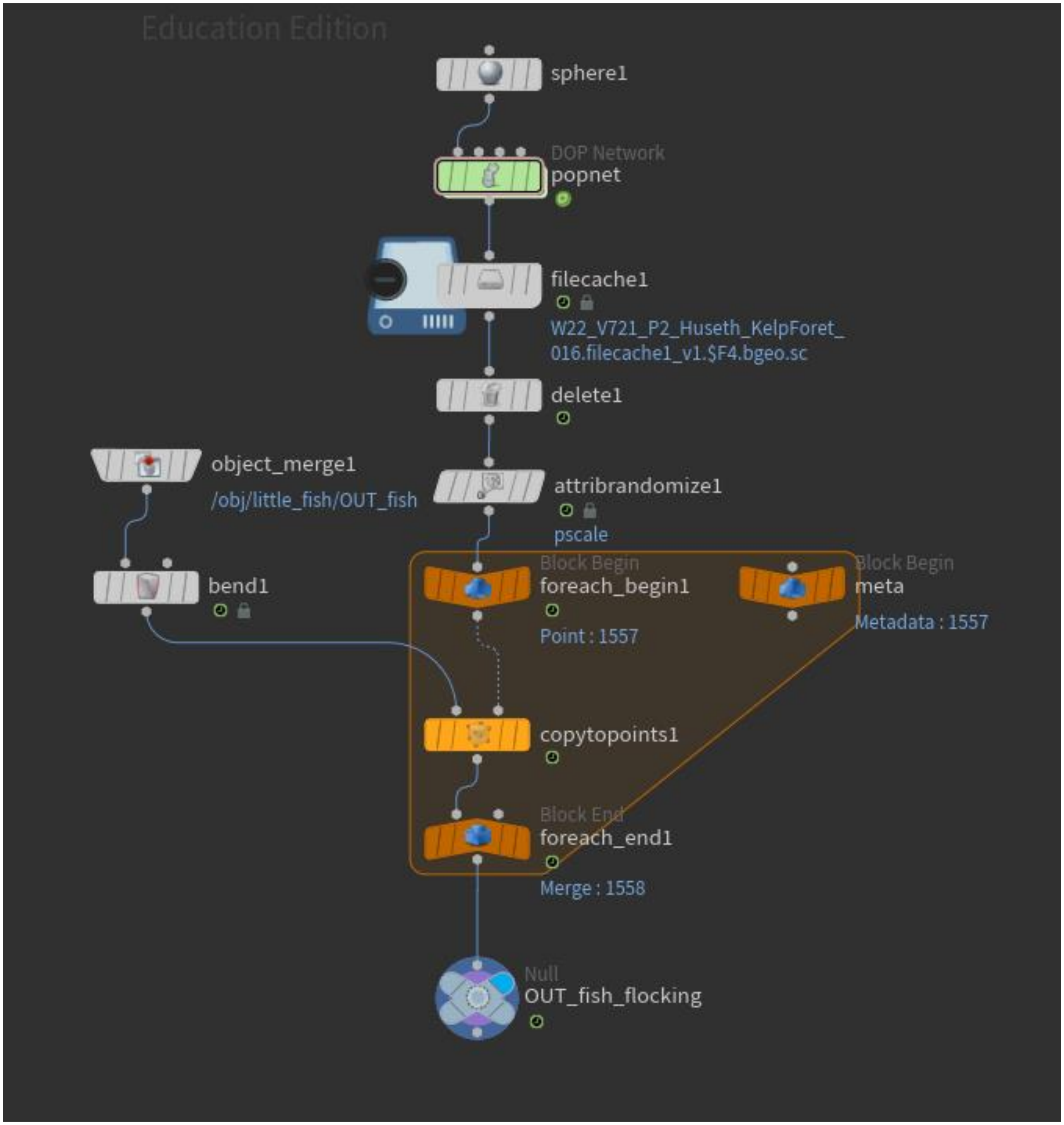


Fish

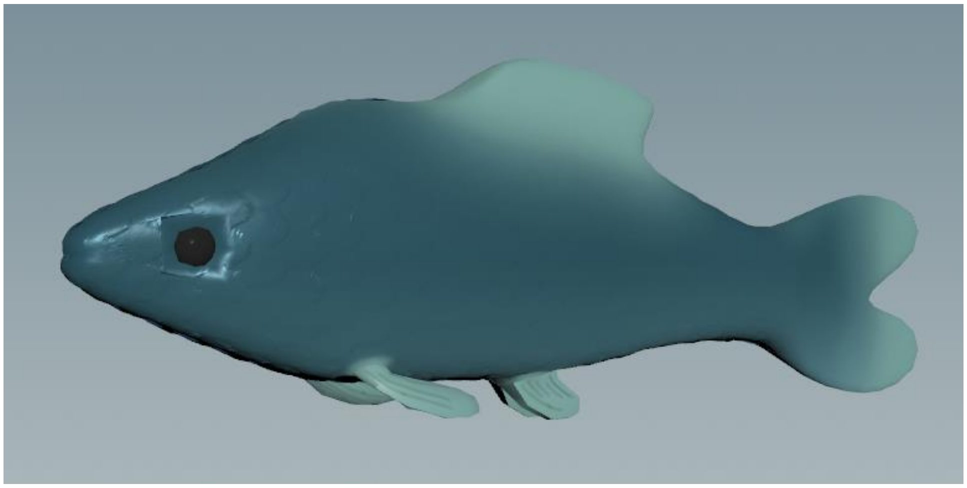
The main school of fish was created using a pop network with flocking behavior and follow curve forces to direct the overall movement of the fish. Simple fish geometry was then copied to the pop network points using a copy to point node.

A bend node was used to add swimming animation to the fish as well. Using a for-each loop, the iteration number is used to offset the timing of the bend animation on a fish-to-fish basis.

To render the animation effectively, the fish flocking behavior was cached before uploading to the farm.



As a modeling exercise, the big fish model was created through traditional modeling techniques in Houdini. The model was kept as simple as possible but with a more distinctive silhouette to ensure the model did was not too heavy in the scene. The fish are not close to the camera, but previous procedural models were too simplistic in form that the first were detracting from the scene's overall quality.

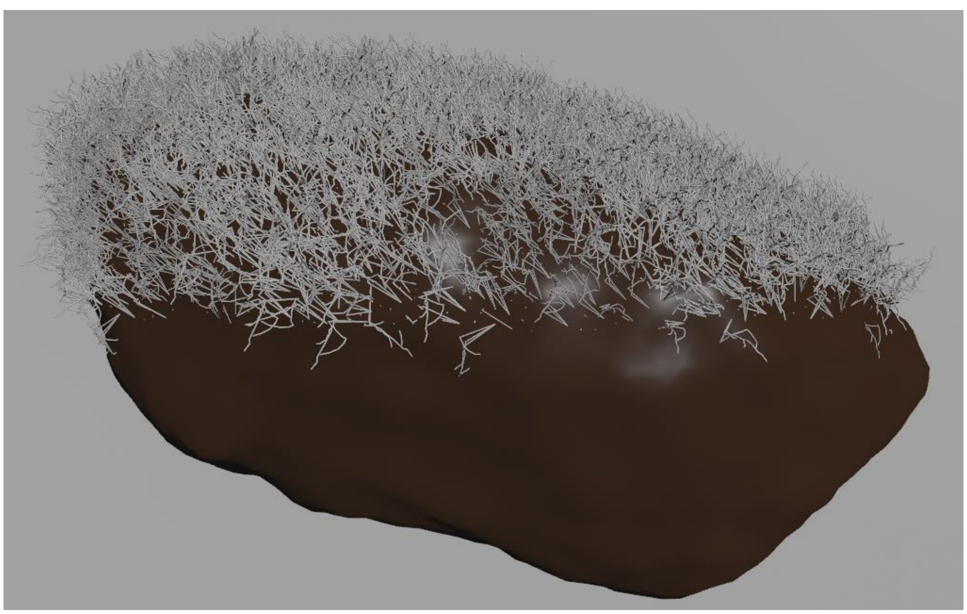


Mossy Rock

The mossy rock base geometry is comprised of a cube and sphere intersecting each other and then combined through a VDB conversion technique.

The moss on top of the rock was created by scattering lines across the surface of the rock geometry, applying noise attributes to the lines to create variation, and then skinning the lines with a poly wire node. The noise attributes are animated to create a subtle swaying movement within the scene.

To optimize the scene, any moss outside of the camera field of view was removed. Though the scene's geometry was culled, the moss fell inside the boundaries of the volume. A group with a bounding box was used to manually limit the moss location. This reduced the packed geometry from 11,580 down to its current count.



Atmosphere

Atmosphere was created using cube geometry that was converted to fog volumes using an isooffset node. The volume was varied using a volume VOP node and a unified noise element applied to the volume's density. Overall, the atmosphere contributed the most to the overall render time and generated a fair amount of noise in the render as well. Render settings were experimented to balance the noise level with the final render time.

Challenges

Creating the fish flocking behavior was straightforward, however, controlling the behavior and combining the flocking with the curve force was often time consuming to dial in the values. Often the fish would want to jitter or turn directions rapidly due to the competing curve and flocking forces and took some work to correct. The solution to the behavior was to overall force the fish to follow the curve force, removing the orbital force completely, and then applying the flocking behavior on a much smaller scale so it did not cause jittering.

The kelp simulation cache is large in storage requirements. The two kelp simulations easily push the project over 1 GB in size. I experimented with both alembic files and bgeo caches for the simulations. Overall, the alembic files were slightly smaller in size but presented an error on the farm that I have not had a chance to trouble shoot. Since the file sizes were not significantly different, bgeo file caches were used for the render.

Although all my geometry is packed and I utilized geometry culling, the render time for the scene is high. I will explore some options for render optimization in the future. Specifically, there is too much geometry that is hidden by the fog that could be removed or replaced with extremely simple versions of the kelp. It is my assumption that the volumetrics are also adding to the render time, but I will need to do some comparison tests to confirm this.