TPF || Research & Development

Introduction to Shadow

James Roberts

union

Simulating a shadow

Stages of production

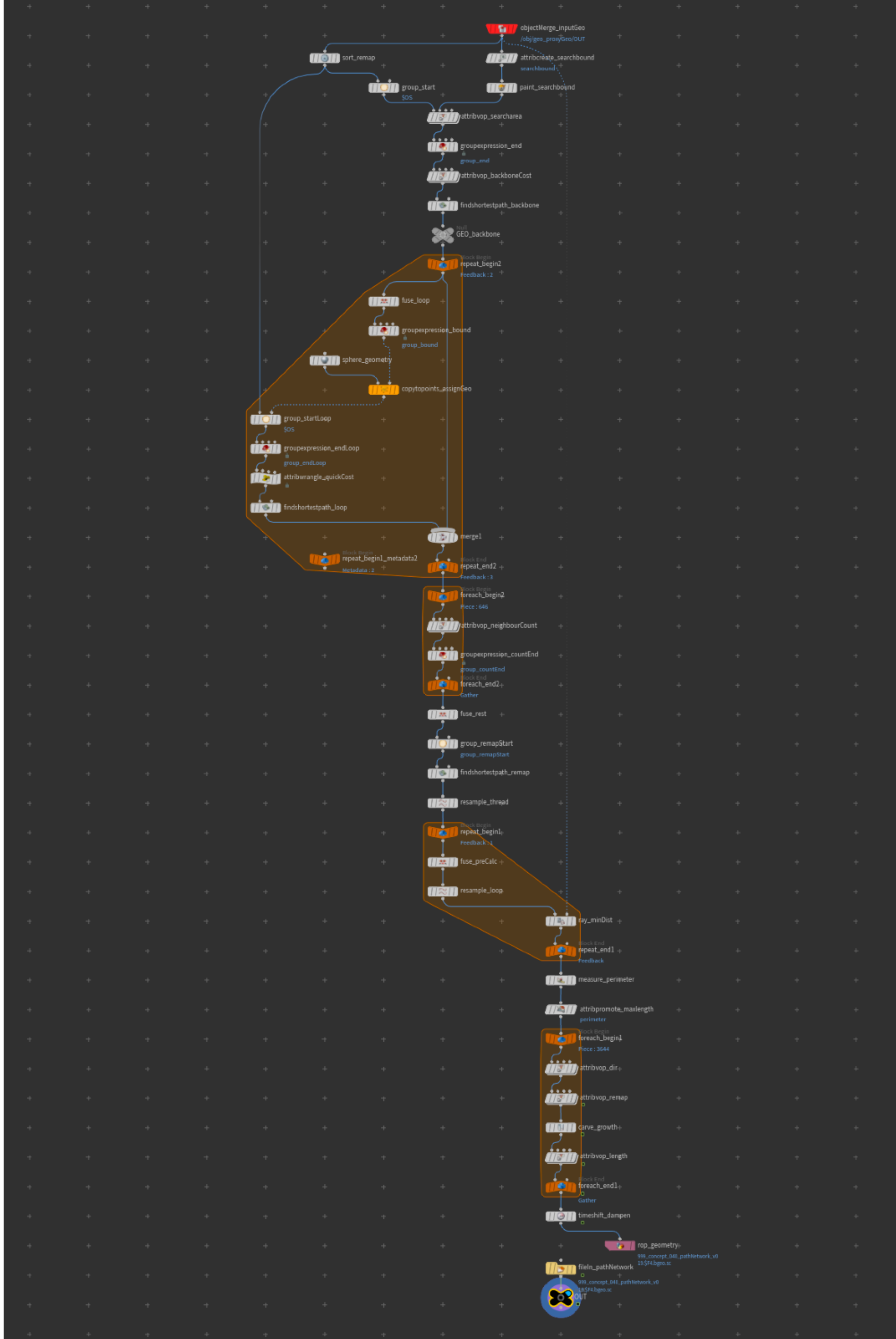
Fractal Path Network

Aggregation

Diffusion Solver

Topology & Rendering

Scene files: /Volumes/projects/tpf/sandbox/james/hip



Approved Concept Render

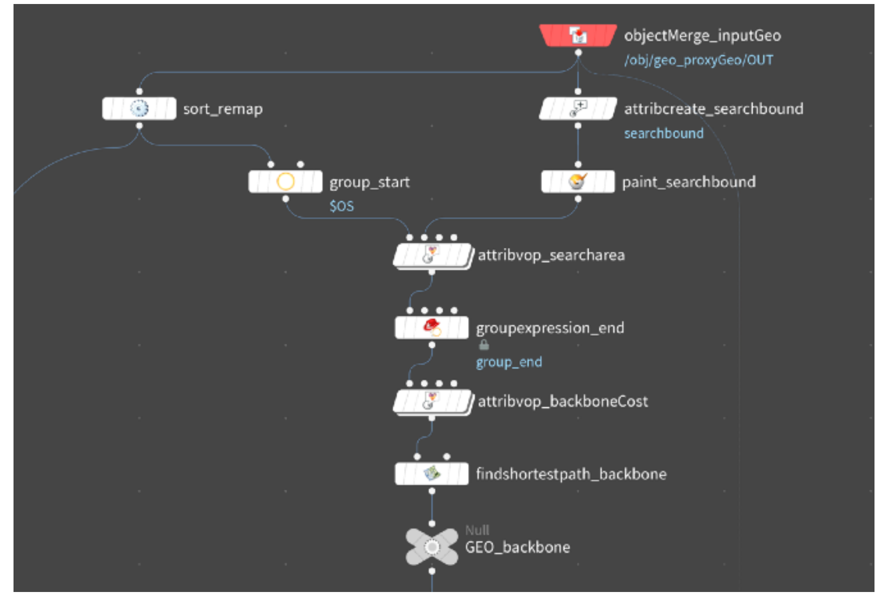
Aggregation Mesh || Diffusion Simulation || Contact Shadows

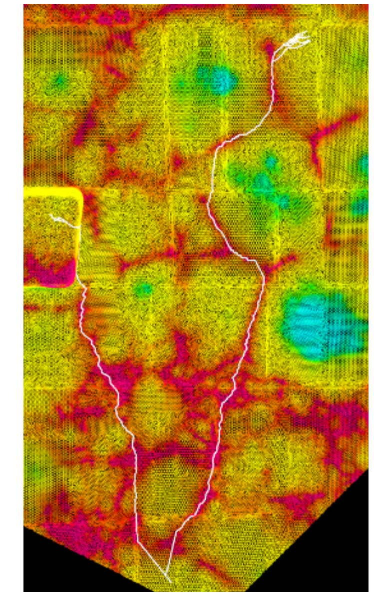
Stage 1

FRACTAL PATH NETWORK

- Procedural fractal system
- Vegetation | Mycelium | Anemones
- Backbone architecture which drives the simulation
- Simple input > Complex output
- Controllable & Optimised
- Ability to retime post-sim

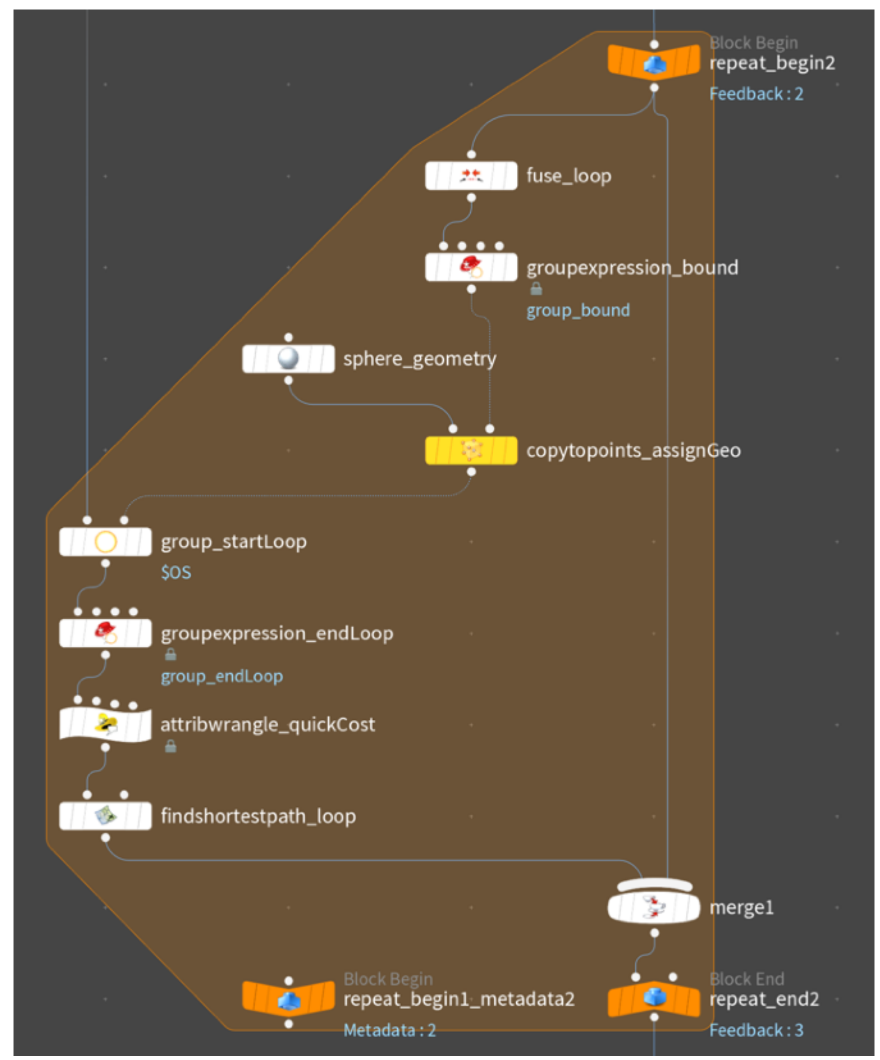
1

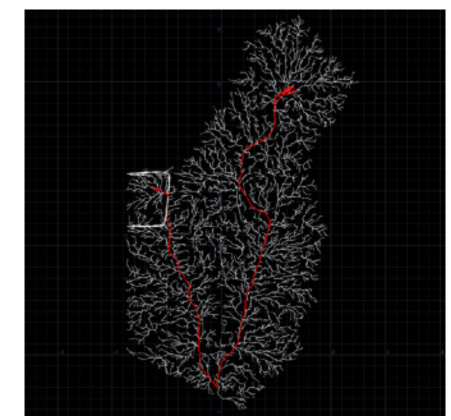


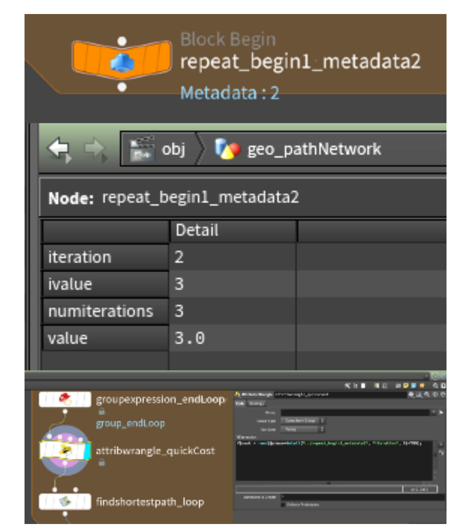


Define the goal locations using the paint SOP and calculate the shortest path through the environment based on pre-defined cost attributes.

2







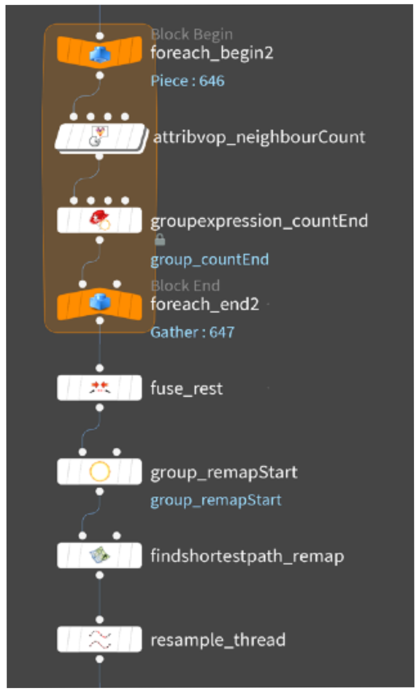
Accessing the "iteration" value from the metadata SOP allows manipulation at every step of the loop.

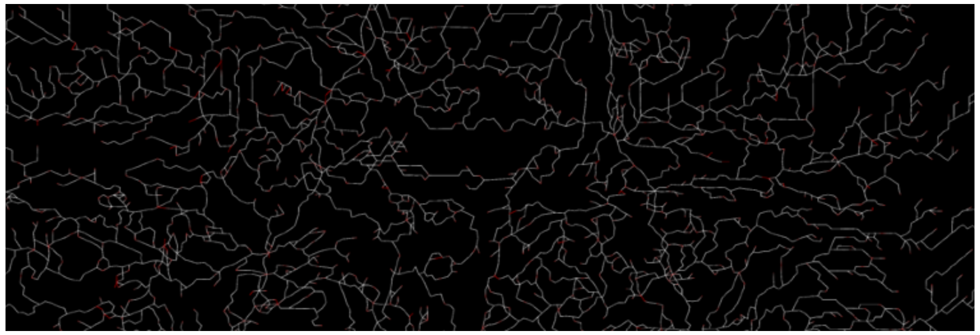
Iterate through a count-based loop to generate fractal branches off the backbone curve.

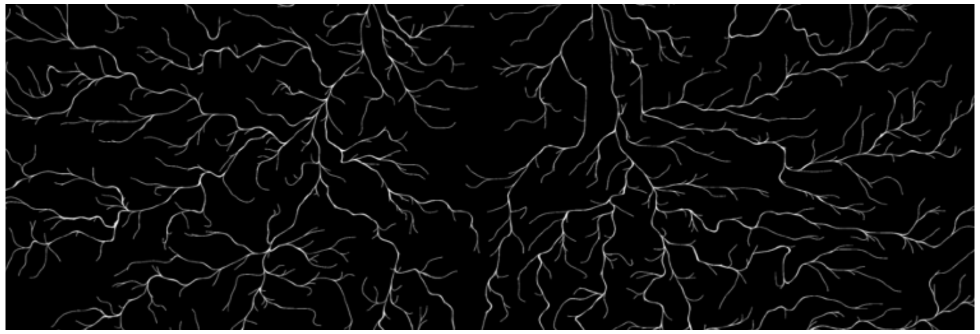
FRACTAL PATH NETWORK

Continued…

3



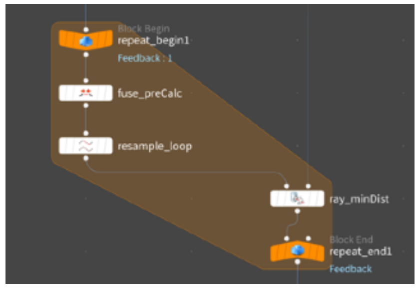




Using the neighbour count VOP; calculate the end point of each curve. Then create new paths through the existing network from the origin to the updated end points.

Note: The "resample_thread" SOP will relax the curves and produce a more organic look in the next step.

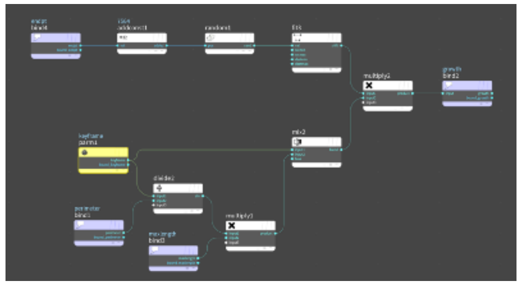
4



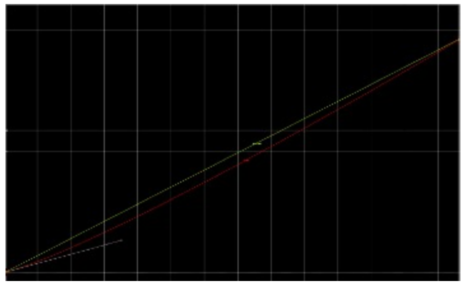
To ensure the paths are within the bounds of the simulation; we iterate a number of projections onto the proxy geometry, resampling by a factor of 2 each step.

Note: The "resample_loop" SOP is set to be a SubD curve; this will ease the angular nature caused by the resampling in the previous step.

5



Carve SOP expression



By promoting the perimeter measurement to a detail class (*maxlength*); we can equalise the growth of the keyframe animation in the attribvop_remap SOP.

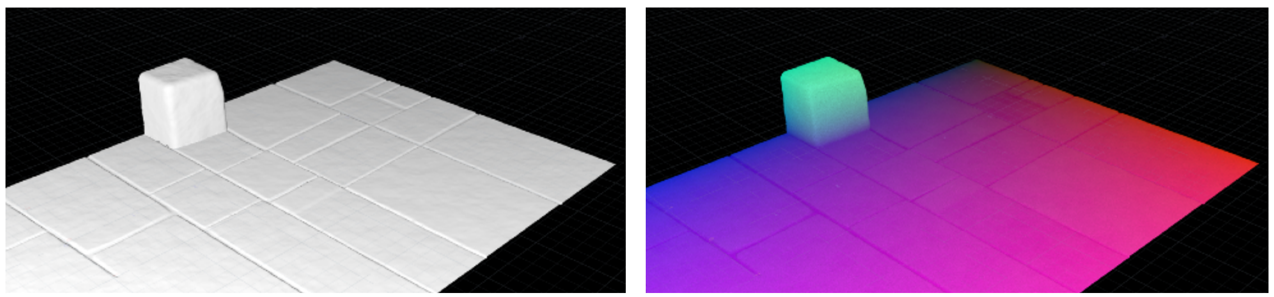
Note: As the input curve is linear, a timeshift SOP will allow post-processing of the animation.

Stage 2

AGGREGATION

- Simulated growth / clustering
- Based on virus replication
- Point cloud export
- Source geometry defines simulation detail
- Easy to iterate, scale and review

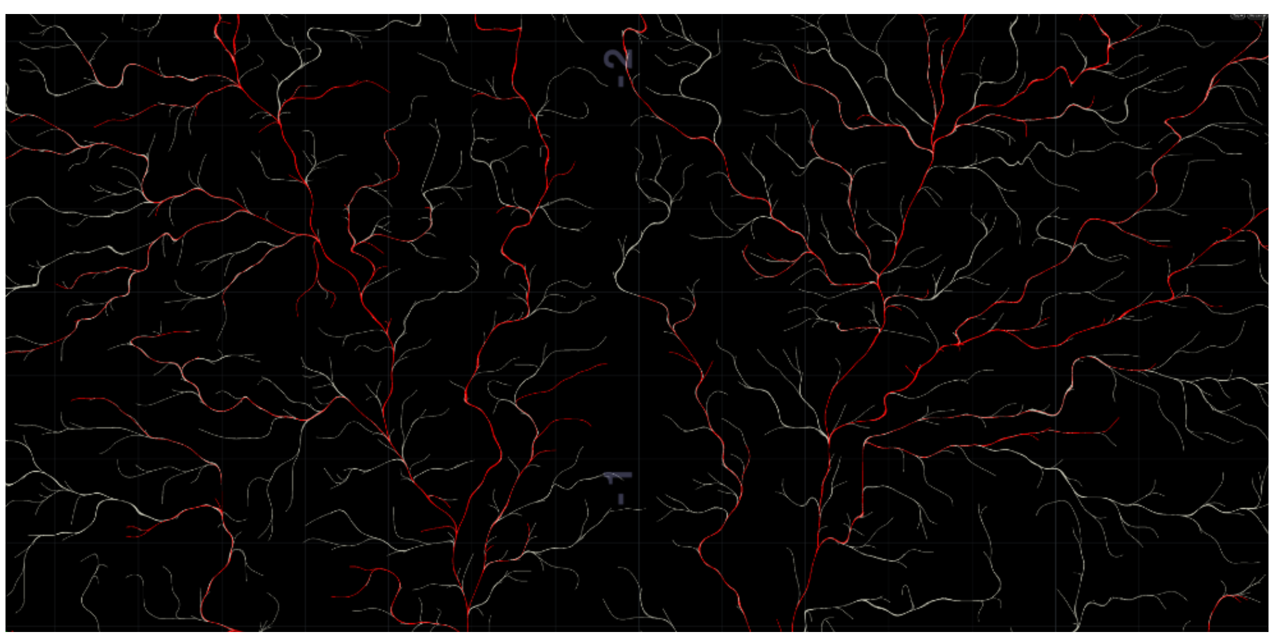
1 Create point cloud and define attributes.



The primary input is a point cloud generated from a scatter SOP. A high density of points will ensure coverage for the search radius of the PCOpen VOP inside the solver.

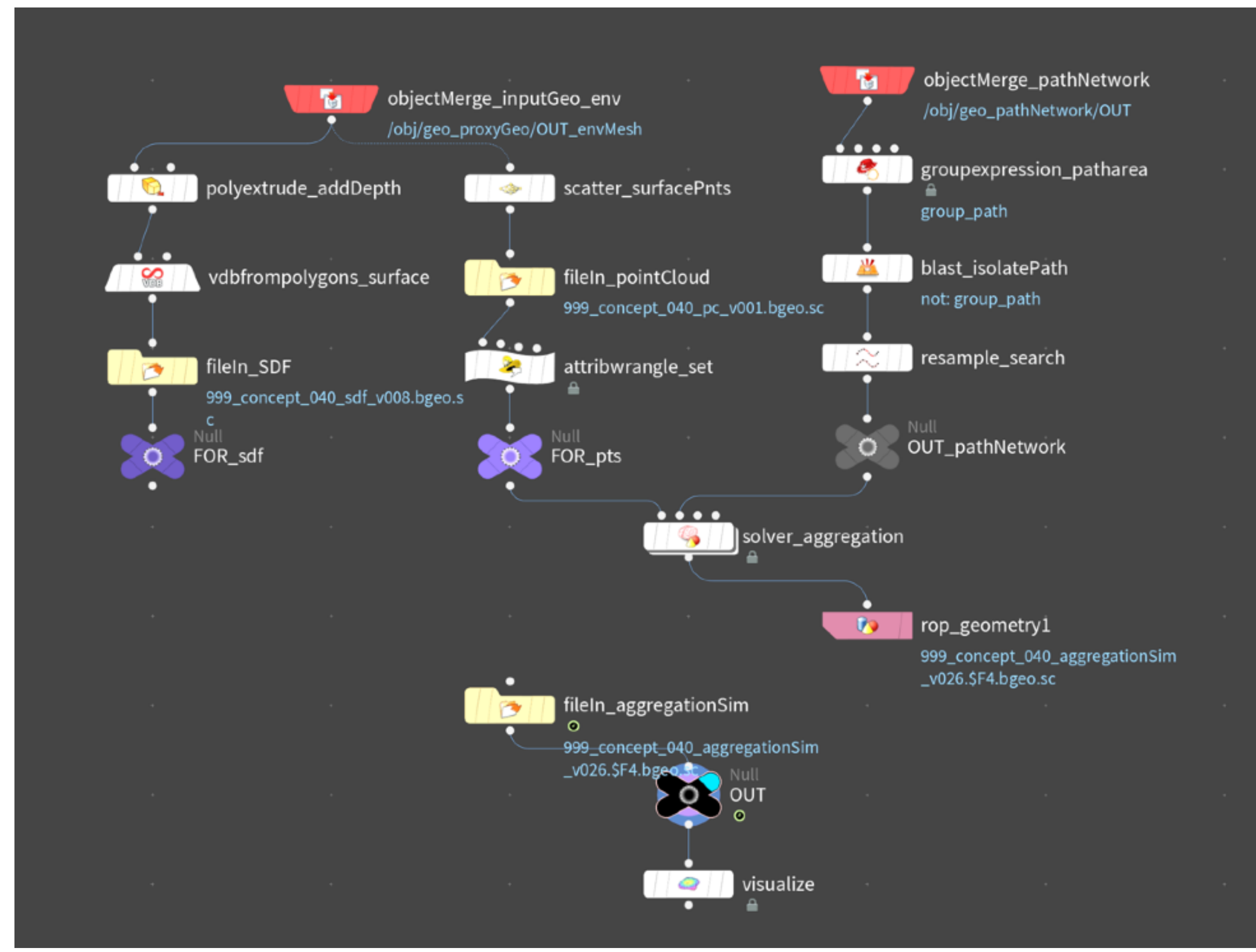
Note: The path network will step through the point cloud, collecting points as it searches. Each point within the cache will have a radius to find new points; defined by an evolving noise pattern during the propagation stage.

2 Limit the number of input curves



Control the direction of growth by restricting the number of input curves.

3 Simulate



aggregation

/agrɪˈɡeɪʃ(ə)n/

noun

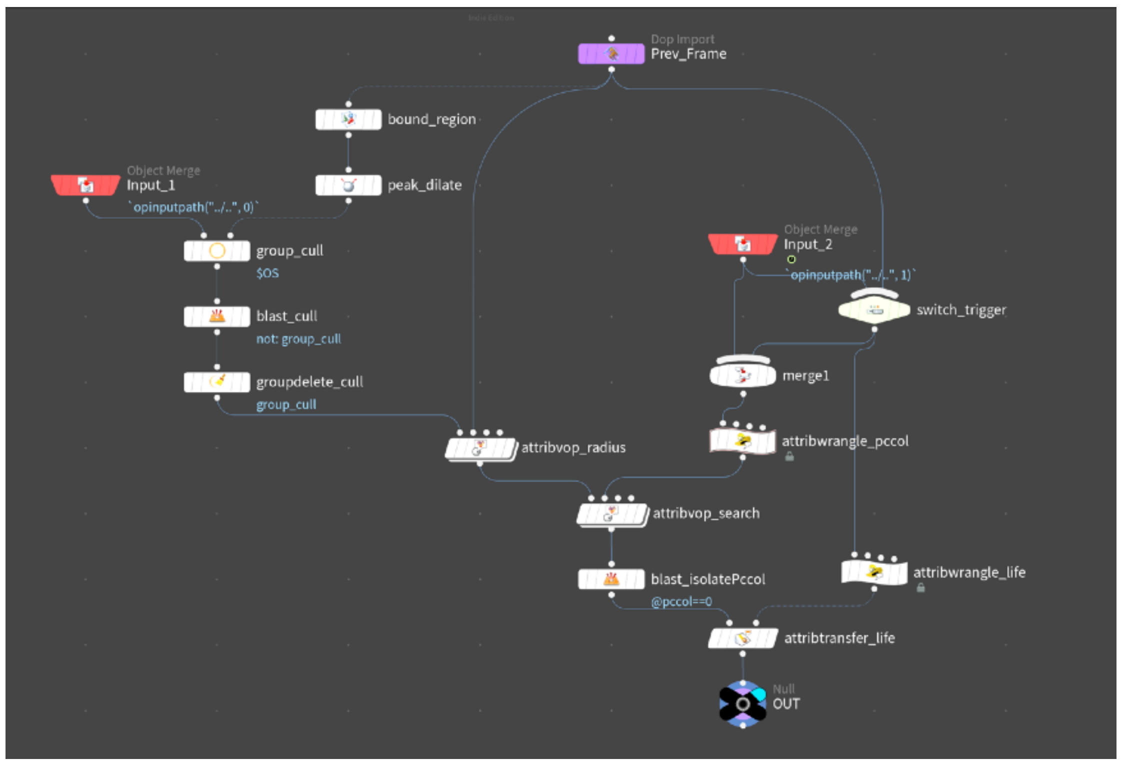
the formation of a number of things into a cluster.
"a single dose of aspirin irreversibly inhibits the normal aggregation of platelets"

- a cluster of things that have come or been brought together.
"the pelican is the other bird likely to be found in large aggregations in East Africa's wetlands"

AGGREGATION

Continued...

④ Inside the SOP Solver



Radius An animated 2D fractal noise value used to search for available points.

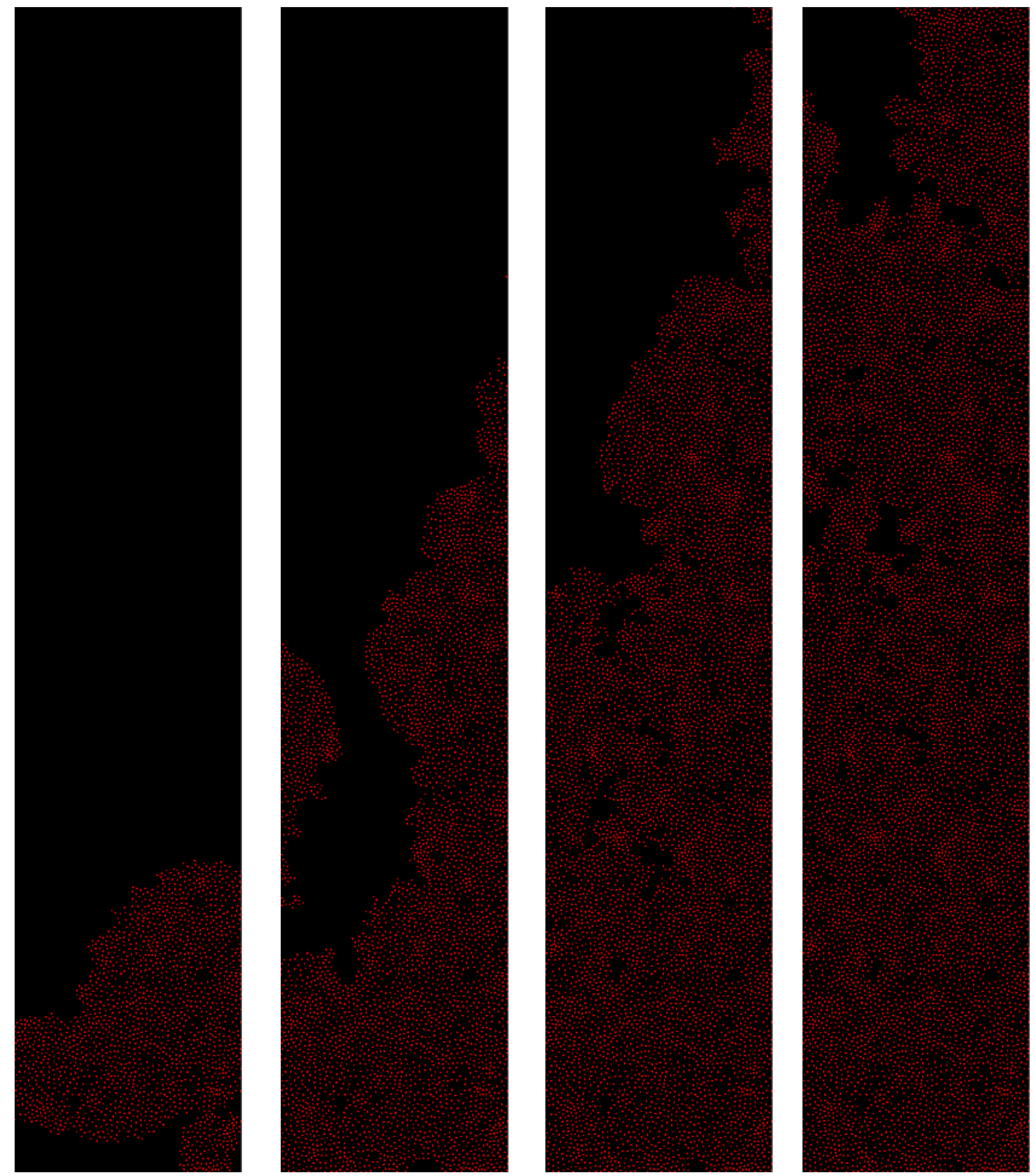
Search Assigns the pccol attribute by evaluating the point cloud data against the radius value.

Culling Method A dilated bounding region of the previous frame; used to object group the point cloud so calculations are restricted to relevant points

Life The sim data is reset every frame so to calculate life use @*TimeInc*.

Pccol The value assigned to a point when it is added to the cluster.

Trigger Switch is enabled only on first frame of simulation.



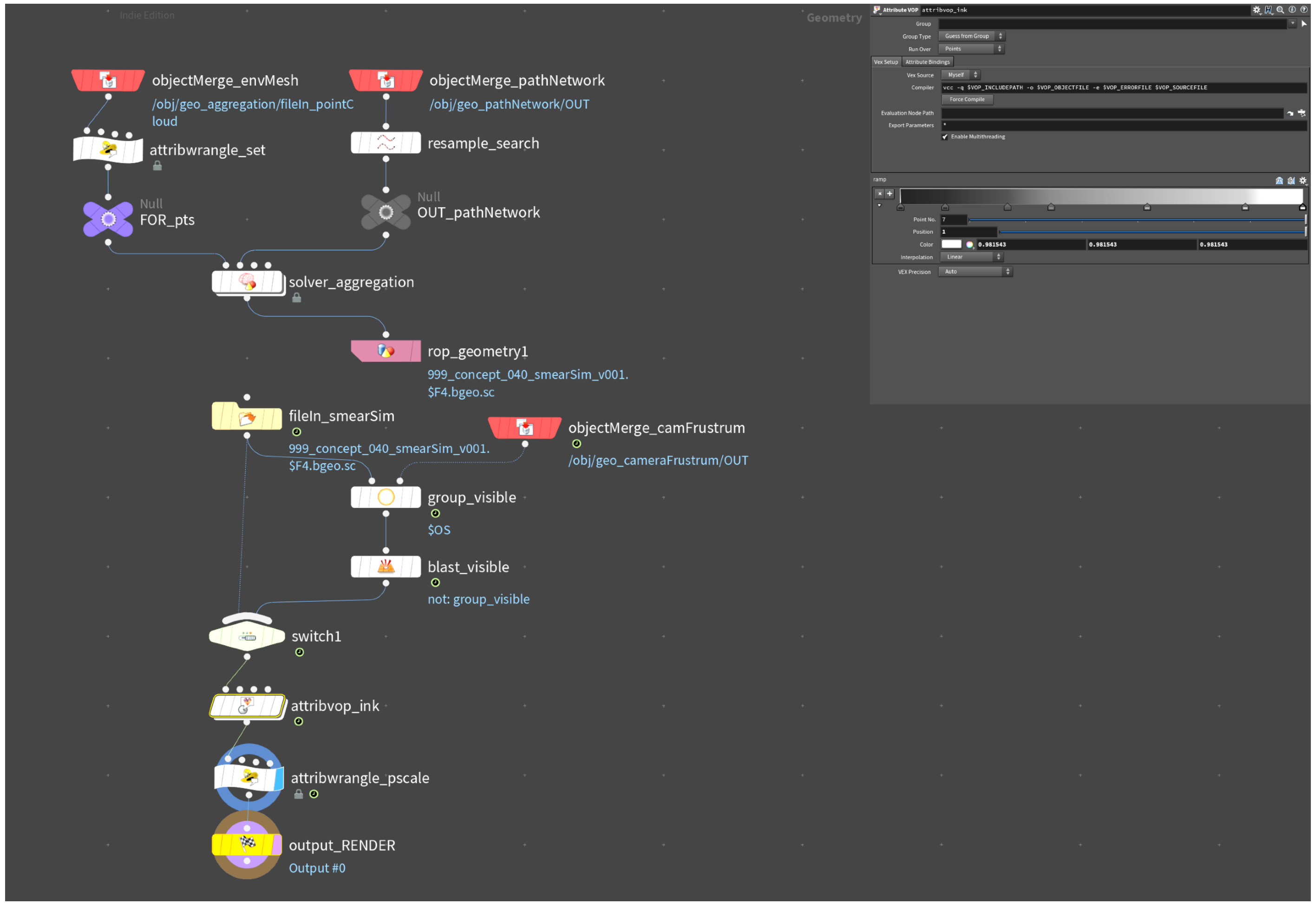
Example of growth behaviour over 120 frames.

Stage 3

DIFFUSION SOLVER

- Identical to Aggregation (Stage 2)
- Re-mapping of attributes
- Reference oil in water
- Viscous smear effect

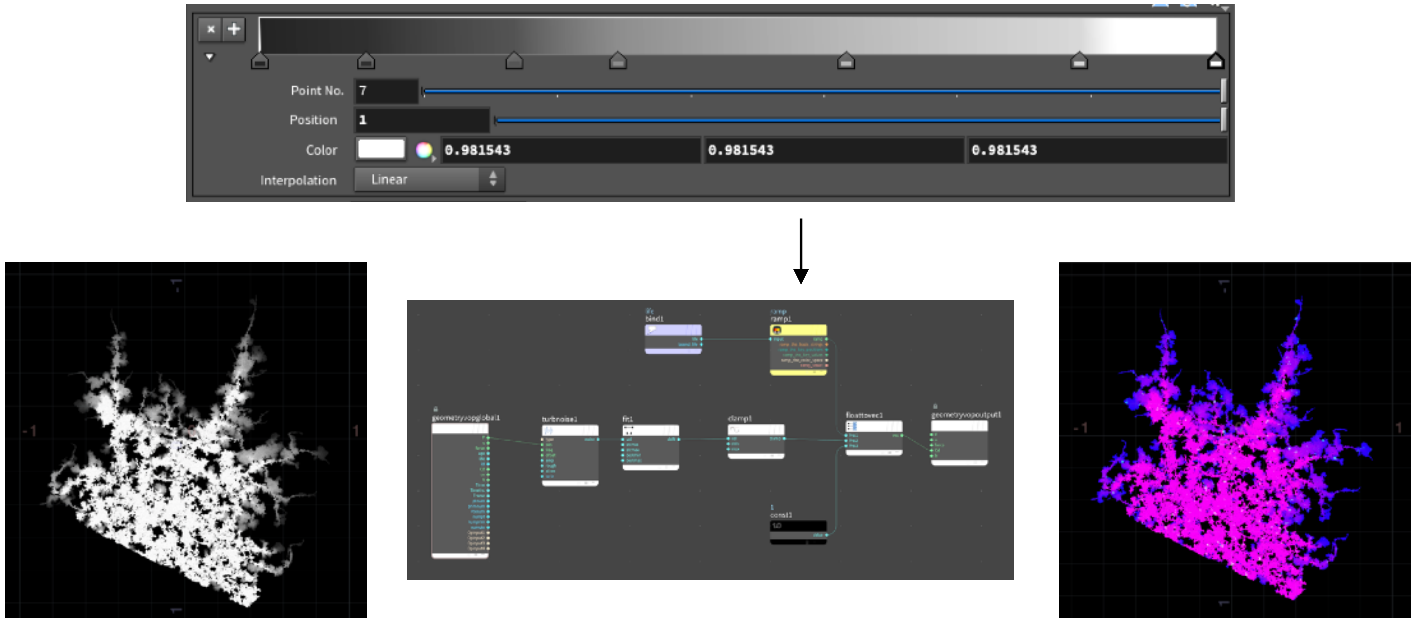
1



Clone simulation of Stage 2: Aggregation but with no limit to the input curve network.

Note: At artist's discretion, increase the max search radius within the solver to expand the diffusion area away from the path network.

2



Re-map the life attribute using a vector ramp and assign the output to the RGB channels.

Note: Explore alternate G or B channels, currently granular noise is available but a texture or pattern could be inserted.

1

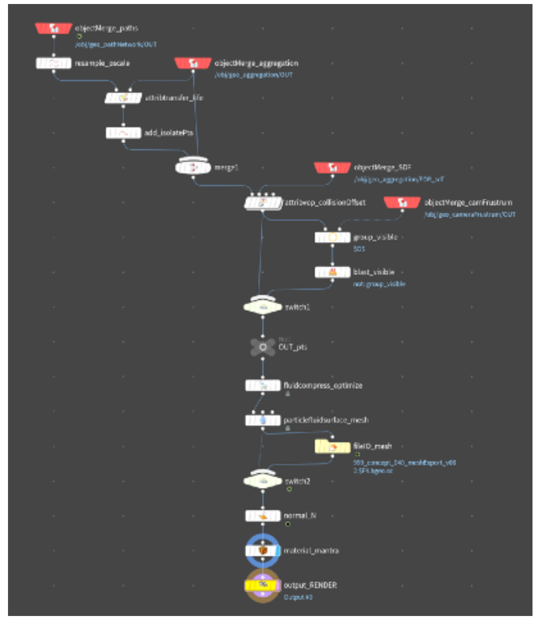
Two stages are required before we mesh the point cloud.

- Share Attributes
- Collision Offset
- Frustum Culling

Once the data has been filtered, create the final mesh using the particle fluid surface SOP.

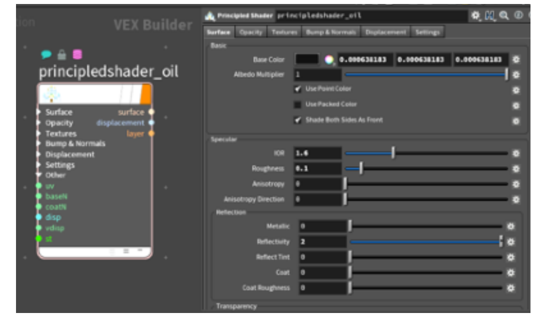
Transfer any required render attributes at this stage.

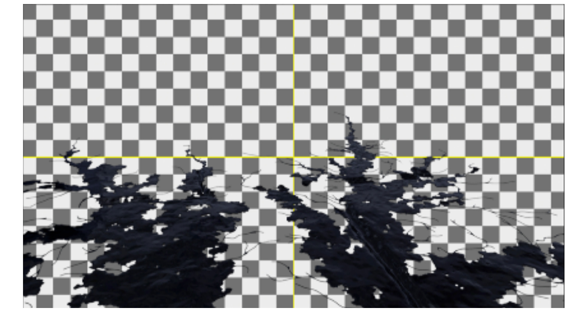
Note: No collision input is required, as this was covered during the pre-process.



Note: To speed up IFD generation and overall processing time we cull the point cloud via the camera frustum prior to building the mesh; IO the geometry to enhance render speed.

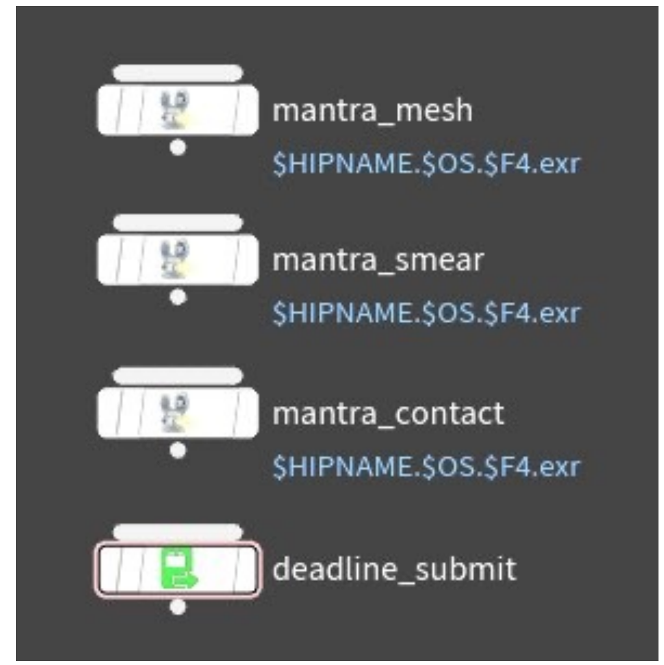
2





The shader used to render the mesh is the principled shader within Houdini. In combination with an on-set HDR, project the plate onto the phantom geometry to get accurate reflections.

3



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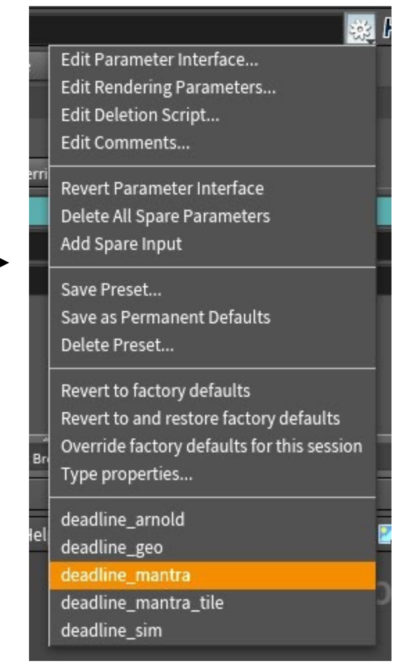

Render the mesh, smear & contact shadows locally or via Deadline using the default parameters.

Stage 4

TOPOLOGY & RENDERING

- **Mesh & Point Cloud**
- **Contact shadows required**
- **Mantra PBR**
- **Custom AOV's available**

NOTES

- Always remesh your input geometry from matchmove.
- All surface detail is pre-defined by the shape of the point cloud, use a lidar / photo scan of the environment if available.
- If your aggregation is patchy along the input curve, check the minimum search radius is not too small.
- If bumpy edges are present, increase the point count or increase point separation in particle fluid surface SOP.
- Limit the scatter area to the bounds of the path network.
- The ‘cull’ method in the solver will rapidly reduce simulation time but frames do increase as sim area progresses.
- When copying sphere’s onto the path for branch replication, check the scale to ensure only a single point is grouped per instance. (50% of the edge length is advised).
- Best surface reflections are created via the plate being projected onto phantom geometry.
- Rim lights help define edges in dark environments.
- Diffusion (smear) effect is rendered with a constant shader; the values are directly piped directly into RGB.
- The collision offset uses a VDB to calculate the normals of the environment; these vectors are used to displace the point cloud.
- All geometry can be rendered in other engines, shader assignment is required.
- All standard AOV’s apply.
- Render with PBR where possible. (Diffusion should be rendered with micropolygon).
- No velocity blur needed.
- Always check overscan requirements.
- Aggregation & Diffusion will require tens of millions of points.
- Introduce avoidance groups within the find shortest path SOP to move away and around objects.
- Two additional attributes are calculated which are irrelevant but worth having available. **Dir** is a vector used to copy additional geometry onto the curve. **Length** is a gradient which provides a normalised float value along the distance of a curve.
- Don’t hesitate to get in touch if you have any questions.

James Roberts - Research & Development

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