Mapping, tracking, simulating

An introduction to mapping and animating with Houdini, and After Effects

>> **Workshop 7**

>> Design Tools and Skills 1

>> *Semester 1 - August-December 2024*

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>> *Coordinator:*
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1. Pedagogical Activities

In **Workshop 7** of **DTS1**, you will explore mapping, tracing, and simulating urban spaces using **Houdini, Rhino and After Effects**. This workshop introduces both theoretical and practical concepts, guiding you through data extraction from **OpenStreetMap** and how to generate 3D site models with added complexity such as **tree placement, human simulation, and vehicle traffic.**

Through this process, you will be introduced to the fundamentals of **Houdini**, the procedural modeling software, while also learning about data types, procedural modeling, and basic animation techniques. The course emphasizes the connection between 2D and 3D mapping in **Rhino** and **Houdini**, and you will visualize and present your work using **After Effects.**

OSM Houdini

2. Objectives

You will learn Houdini basics, including procedural modeling, data types, and geometry management. They will use LABS tools like OpenStreetMap, Building Generator, and Roads Generator to create 3D site models. Through basic animation, you will simulate human and vehicle movements, and render using OpenGL and Flipbook. Integrating Rhino and Houdini, you will export-import models and finalize a narrative-driven video in After Effects.

3. Procedures

3.1. Location
Chulapat 14, Floor 16 (Presentation space)
Chulapat 14, Floor 13 (Studio space)

3.2. Agenda
13:00 - 13:15 - Attendance Check *(Aj.Tom)*
13:15 - 13:45 - Workshop Introduction *(Aj. Deniz)*
13:45 - 14:00 - Set up
14:00 - 15:00 - Task A-1
15:00 - 17:30 - Task A-2
17:30 - 18:00 - Attendance Check + Submission on discord

3.3. In-Class Task | (in Class)

3.4. Homework

Task A.1: Mapping OSM (1 Hour)

Import and refine OpenStreetMap data to create a basic 3D site model using Houdini. Check the explanation of the Houdini nodes for this task below:

a. **osm_import**: Import OpenStreetMap data.
b. **osm_buildings**: Extract building geometry.
c. **osm_filter**: Filter OpenStreetMap data for targeted feature selection.
d. **road_generator**: Generate roads for your site.
e. **merge**: Merge various geometry layers into one cohesive model.
f. **fuse, blast, delete small parts**: Clean up geometries, remove unwanted geometry and small elements.
g. **transform:** Align and rotate
h. **normal**: Adjust normals for proper shading.
i. **matchsize**: Match the size of different elements in your model.
j. **box_clip**: Clip your model to define specific regions.
k. **turntable**: Create a turntable render of your model.

Task A.2: Populate Trees-Turn Table-Flipbook Render (2.5 Hours)

Export the green areas using OSM.pdf from Rhino
Export the design studio object (optional) from Rhino

a. **OpenStreetMap Export**: Export your OpenStreetMap data as a PDF.
b. **Import in Rhino**: Import the exported PDF into Rhino.
c. **Isolate Greenery**: Use the **Select Color** command in Rhino to isolate and select greenery areas from your imported data.
d. **Create Surfaces**: Use **DupBorder** to duplicate borders of the selected curves and then apply **Surface from Planar Curves** to create surfaces from these curves.
e. **Export Surfaces**: Export your created surfaces as `.obj` files for use in Houdini.

Import the surfaces and the object in Houdini

Houdini Trees and The Object Placement: Use the following nodes to place and manage trees:

f. **file:** Import .obj in Houdini
g. **LABS quick_basic_tree**: Basic tree models.
h. **line**: Line representations for tree distribution.
i. **pack**: to treat the geometry as 1 point
j. **color**: Color adjustments
k. **attribcreate**: Attribute creation
l. **attribrandomize**: Randomize attributes for variation.
m. **Scatter**: Scatter points on surfaces
n. **mountain**, **remesh**: Terrain and remesh adjustments for tree placement.
o. **copytopoints**: Copy tree models to specific points.
p. **merge**, **output**: Merge tree geometries and output the final tree model.
q. **box_clip**: Apply clipping to refine the area for your project
r. **polyreduce**: This node reduces the polygon count of your model, optimizing it for better performance while preserving essential details.
s. **matchsize**: Ensure all elements are scaled correctly.
t. **turntable**: Prepare a turntable render to showcase the site model with populated trees and your design.

Task B: Simulate and Track (Homework)

Simulate vehicles and agents, Track and Render (video)

Preparing the **vehicle simulation**:

u. **file**: Imports external geometry, pre-saved car models,
v. **matchsize**: Aligns and scales the car model to fit within the defined bounding box, ensuring consistent dimensions.
w. **transform**: Adjusts the rotation of the car model in the scene.
x. **pack**: Packs the car geometry into a more memory-efficient form, preparing it for instancing or further simulation.

Preparing **the routes**:

y. **osm_filter**: Filter OpenStreetMap road data
z. **group**: to place start and end points on the path
aa. **findshortestpath**: Algorithm for calculating shortest paths.
bb. **pointjitter**: Adds randomness to point positions for natural variation.
cc. **foreach_begin**, **foreach_end**: Loop structure for iterating over elements.
dd. **unpack**: Unpacking operation to expand grouped data.
ee. **attribcreate**: Creates attributes to store additional data on geometry.
ff. **carve**: Carving operation for modifying geometry.
gg. **polyframe**: Creates frames for polygons.
hh. **copytopoints**: Copy the cars to the points.

Bring the simulation into your scene outside of the geo1 node, in a separate geo node, with **object merge**

Preparing the **agent simulation**:

ii. **agent**: Incorporates Mixamo characters as agents, defining their behavior and properties in the simulation.
jj. **matchsize**
kk. **retime**: Adjusts timing of agent animations or movements in the simulation.
ll. **attribcreate**: Piece attribute to copy pieces randomly to scattered points

Preparing **the routes for agents**:

mm. **Attribute create (piece) Attribute randomize (piece):** In addition to the cars' routes procedure, copy the pieces (1-2-3) in random order on the scattered points

nn. **Attribute wrangle**: This refers to an Attribute Wrangle node in Houdini, which is a powerful and flexible tool for manipulating attributes using VEX code

oo. **rivet**: The rivet node in Houdini is often used to attach objects to surfaces or to create connections between different geometries. You will use it to attach the camera to a point(agent/car)

Required Materials

Hardware
Laptop
Laptop charger
Computer mouse with middle wheel <- very important!
Headphones
Extension cord (optional but highly recommended)

3D objects and drawings from DTS or/and studio project

Software
SideFX Houdini (Apprentice) version: 20.5
SideFX Labs and Packages (Production Build 20.5)
Rhinoceros 7 or 8
Adobe After Effects (optional)

4. Submissions

Material to be submitted should be complete and in accordance with the guidelines presented in class.

Task A.1 - A.2 (in class)

Upload a screenshot of your site model or Flipbook render screenshot to discord under your DTS group tutorial upload #group-xxx between 17:30-18:00.

Task A.2

Tuesday 25th, 8pm. (see submission link and form)

Upload the turntable video using the submission form

Render requirements: 200 frames [flipbook or openGL)
Video requirements: [720x720 pixels] [24 frames per second]

Task B

Tuesday 25th, 8pm. (see submission link and form)

Upload the Tracking Agent/Car video using the submission form

Render requirements: 500 frames [flipbook or openGL)
Video requirements: [1920x1080pixels] [24 frames per second]

File Naming:
DTS Code_WK07_01_TurnTable.mp4
DTS Code_WK07_02_Simulation.mp4

Submission Form Link:
>>CLICK HERE<<

Submit the digital copy of your work via this google form by Tuesday 25th, 8pm.

4. Grading Criteria

All submissions are present and performed according to the instructions defined by the brief procedure.

Completion
Timely submission in good condition 40%

Quality
Conceptual clarity and craftsmanship 60%

Craft and quality of effort is evaluated based on the efficient use of Houdini's Labs tools for urban modeling, creative mapping, and simulation. While basic technical skills are necessary, the emphasis is on personal artistic expression and personal interpretations of urban environments. Deliverables should showcase individual creativity and experimental approaches in both static and animated outputs.

Keywords

This is a list of words that will be used in class and you should familiarise with:

procedural,vectorial, node, attribute, network, data, data-driven, osm, mapping, tracking, simulating, animating, speculating

See 'a. b. … to … nn. oo.' To get familiar with the nodes used for this exercise

Supporting Material

Houdini Interface SideFX tutorial

Introduction to Houdini

Animated Agents Mixamo Adobe

Some platforms you can download 3d models:

Sketchup Warehouse Sketchfab Free3d