

Going with the Flow

— Supplement Material Guide —

We have implemented our code in [SideFX](#) Houdini. It is a 3D animation software by that is broadly used in filming industry. Its built-in shader language (VEX), geometric data structures, and its integration with Python (where one can call numerical linear algebra library such as SciPy) make it a powerful tool for scientific computing and geometry processing. Moreover Houdini comes with industry standard renderer allowing stunning visualization.

Its **free** apprentice license is fully functional to reproduce our results, with only a few limitations in the resolution of rendering preventing commercial uses.

1 Installing SciPy in Houdini

Installing Houdini is straightforward on Windows, Linux and Mac OSX. However, if we want to import the Python numerical linear algebra library SciPy, additional steps are required. We recommend installing the latest version of Houdini.

To install additional Python packages we make sure we install them to Houdini's Python, as Houdini ships with its own Python which is located in the Houdini installation folder.

First, let us make sure SciPy is indeed not installed: Open Houdini, on any dock add a tab "Python Shell" (e.g. click "+" right next to the "Geometry Spreadsheet" tab). Typing

```
>>> import scipy
```

should give us error `ModuleNotFoundError: No module named 'scipy'`. (If there is no error, then for some reason you do have SciPy installed, and you can skip all following steps and you are good to go.)

We will now provide the OS specific instructions on how to pip install scipy into the right folder.

1.1 MacOSX / Linux

1. Find the Python directory. Open Houdini. On any dock (subwindow) add a tab "Python Shell." In the Python shell, type:

```
>>> import os
>>> path=os.path.abspath(os.__file__)
>>> print(path)
```

The result should be something like:

```
/Applications/Houdini/HoudiniXX.X.XXX/Frameworks/Python.framework/
Versions/3.X/lib/python3.X/os.py
```

Where XX.X.XX is your version number and 3.X the python version.

2. Open Terminal, and goto the `bin` directory `.../Versions/Current/bin` (according to the path shown on Step 1.)

```
$ cd /Applications/Houdini/HoudiniXX.X.XXX/Frameworks/Python.framework/
Versions/Current/bin
```

3. Use the local pip to install SciPy.

```
$ sudo ./pip install scipy
```

4. Back to the Houdini Python shell (no need to restart Houdini). Now

```
>>> import scipy
```

should give no error.

1.2 Windows

1. Run windows cmd with admin rights and navigate to your Python folder, e.g.:

```
cd C:\Program Files\Side Effects Software\Houdini XX.X.XXX\python3X
```

Where XX.X.XXX is your Houdini version and python3X is the *highest* python version Houdini is shipped with.

2. Execute the command `python3.X.exe -m pip install scipy` and wait for SciPy to install.
3. Back to the Houdini Python shell (no need to restart Houdini). Now

```
>>> import scipy
```

should give no error.

2 Using our Code

If you open the provided Houdini file, you will see a desktop as shown below. Inside of it will be instructions on how to proceed.

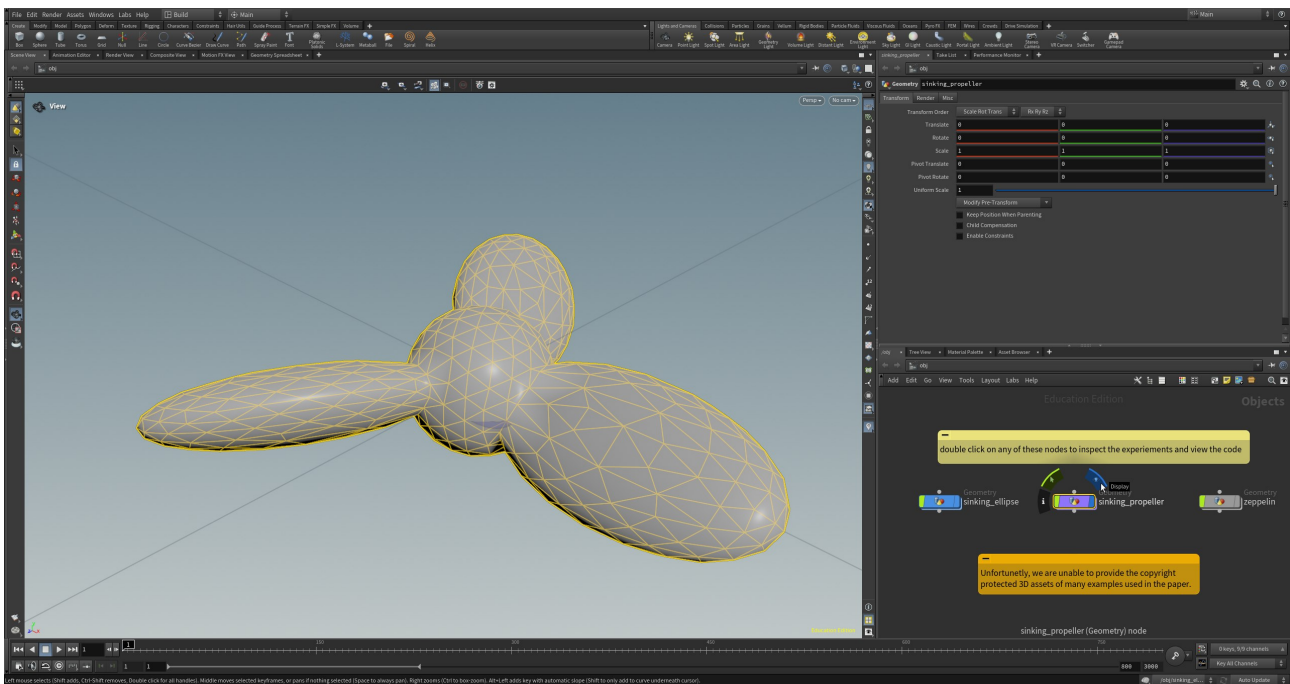


Figure 1: Left: Scene view. Top right: Parameter view. Bottom right: Navigation to our provided examples.