– Filament Based Plasma Code Instructions –

Houdini is a 3D animation software by SideFX 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, with only a few limitations in the resolution of rendering preventing commercial uses.

1 Installing SciPy in Houdini 19

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.

1.1 MacOSX / Linux

We recommend installing the latest version of Houdini (Houdini 19). To install additional Python packages we make sure we install them to Houdini's Python, as Houdini ships with its own Python.

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.)

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 / Houdini19 .0.498/ Frameworks /
    Python . framework / Versions /3.7/ lib / python3 .7/ os .
    py
```

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

```
$ cd / Applications / Houdini / Houdini19 .0.498/
    Frameworks / Python . framework / Versions / Current /
    bin
```

3. Use the local python to install the Python Package Installer (pip). In that directory execute (you will need to enter your root password for the superuser do (sudo) command)

```
$ sudo curl https :// bootstrap . pypa . io / get - pip . py -
    o get - pip . py
$ sudo ./ python3 get - pip . py
```

4. Use the local pip to install SciPy.

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

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

```
>>> import scipy
```

should give no error.

1.2 Windows

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 `ImportError: 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.)

1. Download `get-pip.py` from [bootstrap.pypa.io] (save as a text file) and place it in your Houdini python37 folder, e.g.:

```
C :\ Program Files \ Side Effects Software \ Houdini
    19.0.575\ python37
```

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

```
cd ``C:\Program Files\Side Effects Software\
    Houdini 19.0.575\python37''
```

3. Execute the following command to have Houdini's python installation run the get-pip.py script.

```
python3.7.exe get-pip.py
```

4. Execute the following command to have Houdini's new pip installation install scipy. This can be used to install many other packages too.

```
python3.7.exe -m pip install scipy
```

2   Using our Code

If you open our Houdini files, you will see a desktop as shown below. The textboxes in Fig. 1 and Fig. 2 guide you through the code. Simply follow the steps in the instructions.
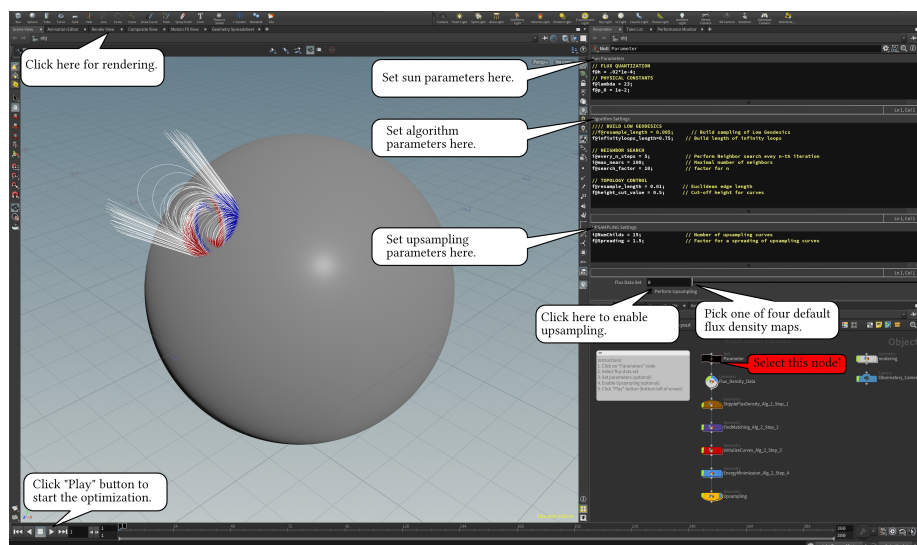

Figure 1: Run our code.

For rendering, you will only need to switch to the "render" tab and click on the render button.

Figure 2: Render an image.