Blood Flow Aneurysm Tutorial Vector Field Visualization

From VisItusers.org

Contents

Simulation Data

This tutorial uses the **aneurysm** dataset -- available at: http://www.visitusers.org/index.php?title=Tutorial_Data

To begin:

- Launch VisIt
- In VisIt's GUI, under the [Sources] section, click **Open**
- Navigate your file system to select the **aneurysm.visit** file.

Visualizing the Velocity Vector Field

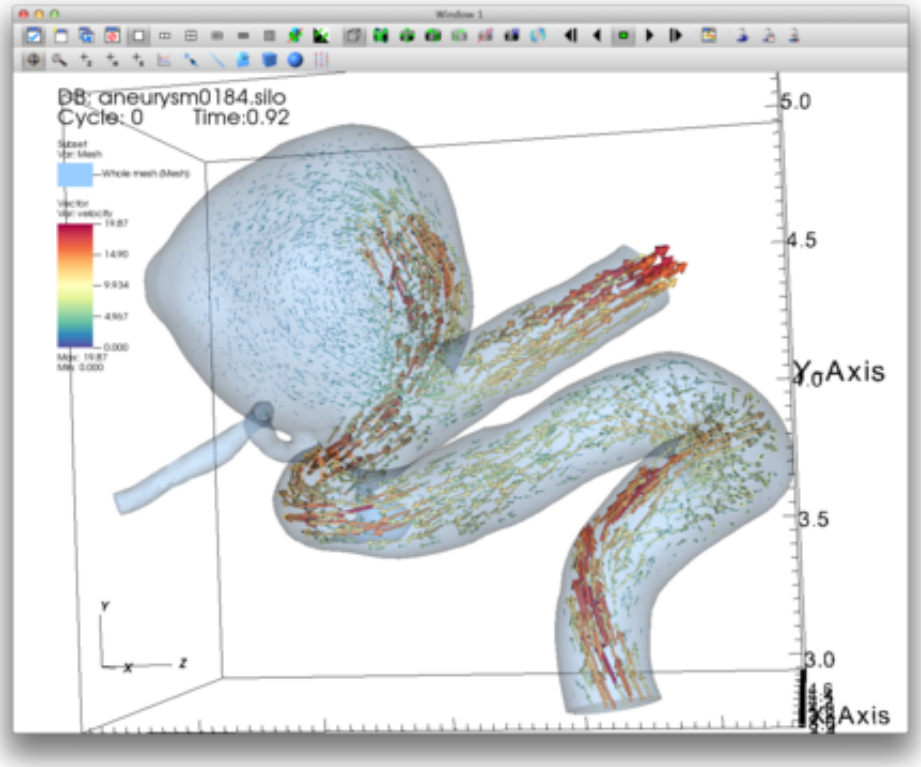
This section of the tutorial outlines using Glyphs, Streamlines, and Pathlines to visualize the velocity vector field from the simulation.

This section follows the Initial Dataset Exploration Tutorial section. To create the reference blue semi-transparent plot of the simulation mesh, review the Blood_Flow_Aneurysm_Tutorial_Dataset_Exploration#Creating_a_Semi-Transparent_Exterior_Mesh_Plot content.

Plotting the Vector Field Directly with Glyphs

VisIt's vector plot renders a vector field at each time step as a collection of Arrow Glyphs. This allows us to see the direction of the vectors as well as their magnitude. We will create a vector plot to directly view the simulated **velocity** vector field.

- Add a **Vector Plot** of **velocity**
  - [Plot List] Add->Vector->**velocity**
- Open the **Vector Plot Attributes Window**
  - In the **Vectors** tab
    - Set **Stride** to **5**
  - In the **Data** tab, **Color** section
    - Change the color table to **Spectral**, and check the **Invert** option
  - In the **Glyphs** tab:
    - Under the **Scale** section, set the scale to **0.5**
    - Under the **Style** section, chance the **Arrow body** to **Cylinder**
    - Under the **Rendering** section, set **Geometry Quality** to **High**
  - Click **Apply** and dismiss the window.
- Click **Draw** and use the **Play** button to animate



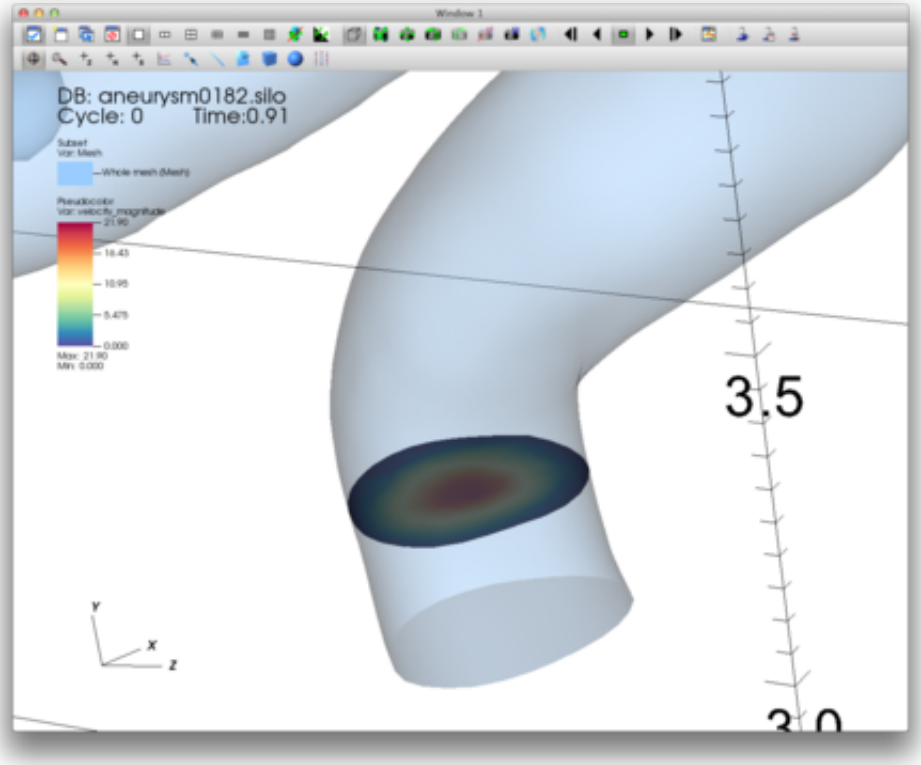
Examining features of the Flow Field with Streamlines

To explore the flow field further we will seed and advect a set of streamlines near the inflow of the artery. Streamlines show the path massless tracer particles would take if advected by a static vector field. To construct Streamlines, the first step is selecting a set of spatial locations that can serve as the initial seed points.

We want to center our seed points around the peak velocity value on a slice near the inflow of the artery. To find this location, we query a sliced pseudocolor plot of the **velocity_magnitude**.

- Add a **Pseudocolor** Plot of **velocity_magnitude**
  - [Plot List] Add->Pseudocolor->**velocity_magnitude**

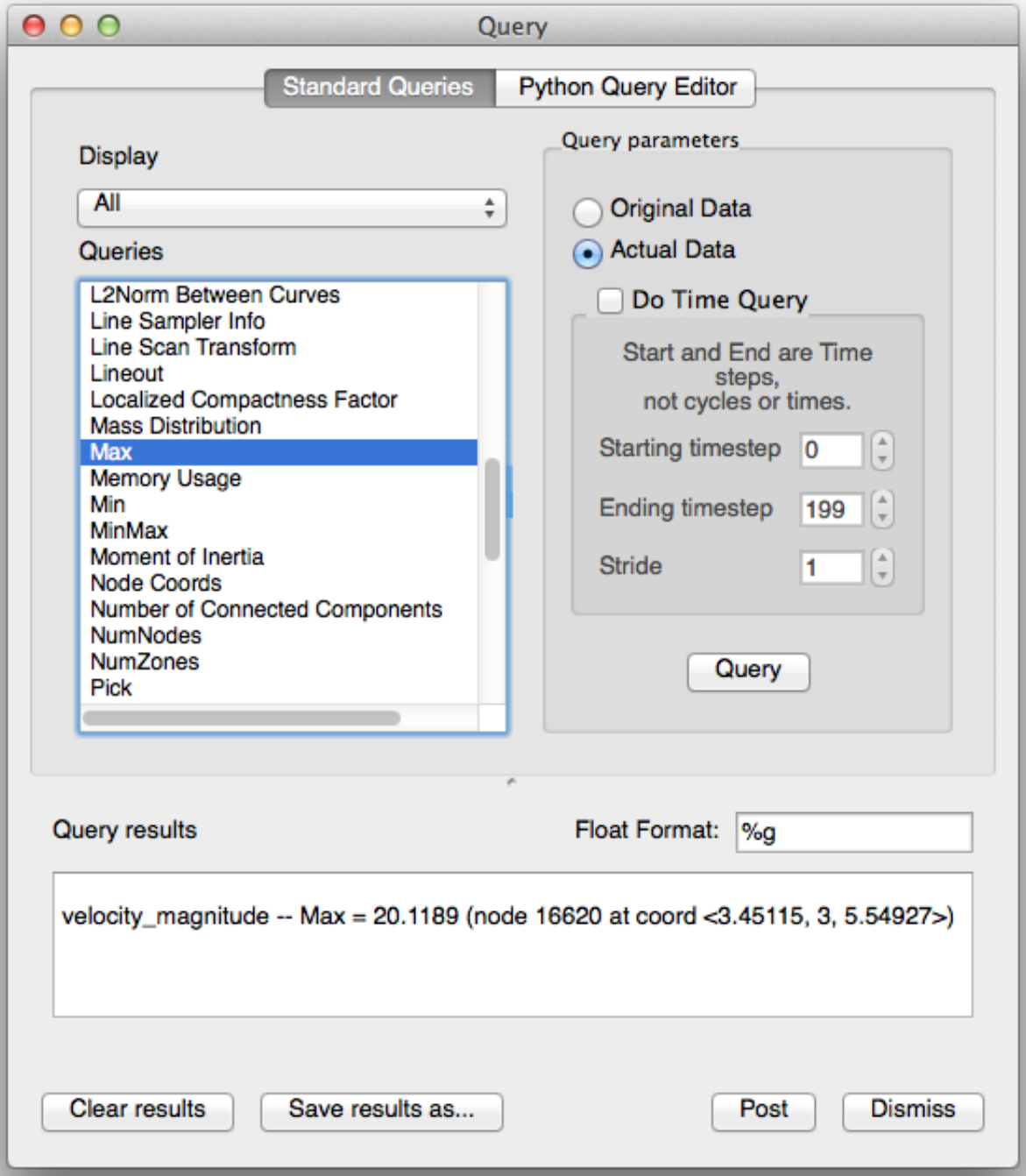
    - Open **Pseudocolor Plot Attributes Window** and set the color table options as before.
- Add a **Slice** Operator near the inlet
    - [Plot List] Operators->Slicing->**Slice**
- Open the **Slice Operator Attributes Window**
    - Under the **Normal** Section
        - Set **Orthogonal** to **Y Axis**
    - Under the **Origin** Section
        - Select **Point** and set the value to **3 3 3**
    - Under the **Up Axis** Section
        - Uncheck **Project to 2D**
    - Click **Apply** and dismiss the window.
- [Plot List] Click **Draw**



Query to find the Maximum Velocity on the Slice

- [Plot list] Click to make sure the Pseudocolor plot of your **velocity_magnitude** slice is active
- [Controls Menu]->Query
    - Select **Max**
    - Select **Actual Data**
    - Click **Query**

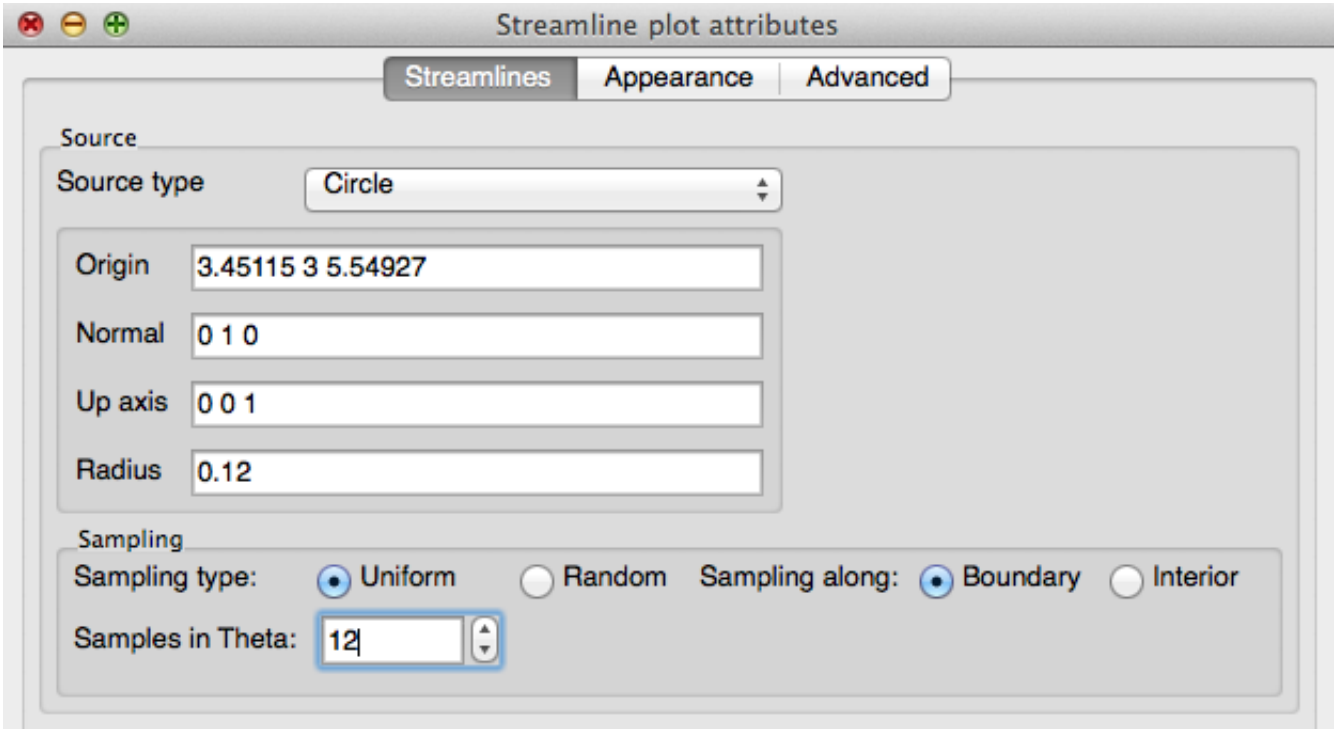
This will give you the maximum scalar value on the slice and the x,y,z coordinates of the element associated with this value. We will use the x,y,z coordinates of this element to seed a set of streamlines.



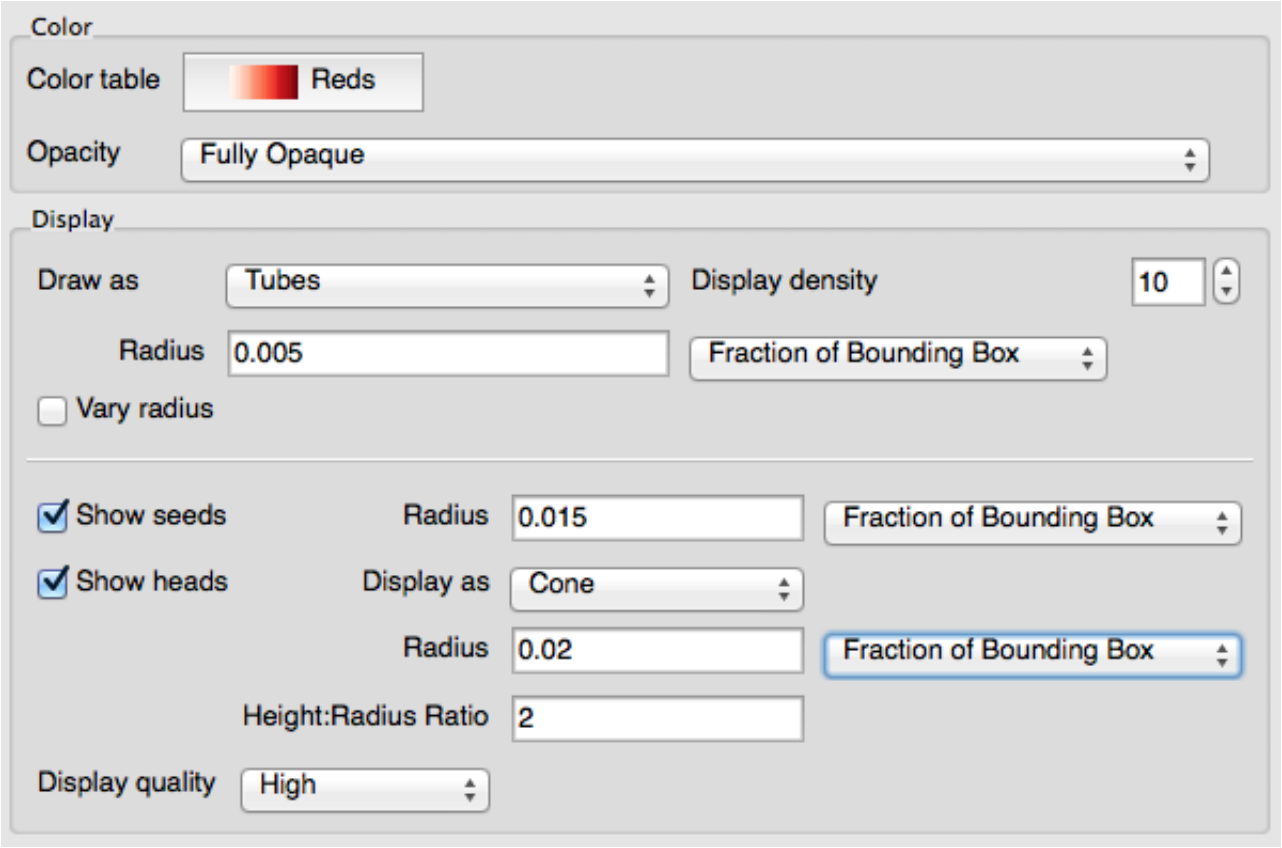
- Add a **Streamline** Plot of **velocity**
  - [Plot List] Add->Streamline->**velocity**

- Open the **Streamline Plot Attributes Window**
- In the **Streamlines** tab
  - Under the **Source** section
    - Set the **Source type** to **Circle**

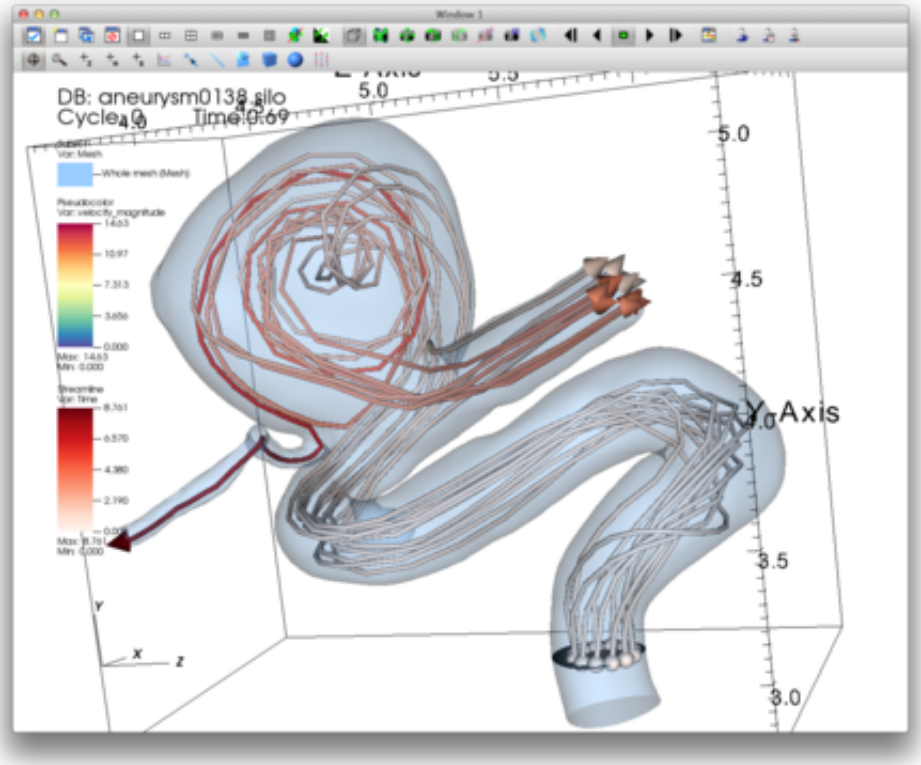
        - Set the **Origin** to the value returned from the max query: **3.45115 3.0 5.54927**
            - (Exclude any commas in the input text box)
        - Set the **Normal** to the y-axis: **0 1 0**
        - Set the **Up axis** to the z-axis: **0 0 1**
        - Set the **Radius** to **0.12**
    - Under the **Sampling** section
        - Set **Sampling along:** to **Boundary**
        - Set **Samples in Theta** to **12**



- In the **Appearance** tab
    - Under the **Color** section,
        - Change the **Color table** to **Reds**
    - Under the **Display** section
        - Change **Draw as** to **Tubes**
        - Check the **Show heads** check box, and set **Display as** to **Cone**
        - Set the **Display quality** to **High**



- In the **Advanced** tab:
  - Under the **Warnings** section, uncheck all of the warning checkboxes
- Click **Apply** and dismiss the Streamline plot attributes window.
- Click **Draw** and use the [Time Slider] Control to view a few time steps.

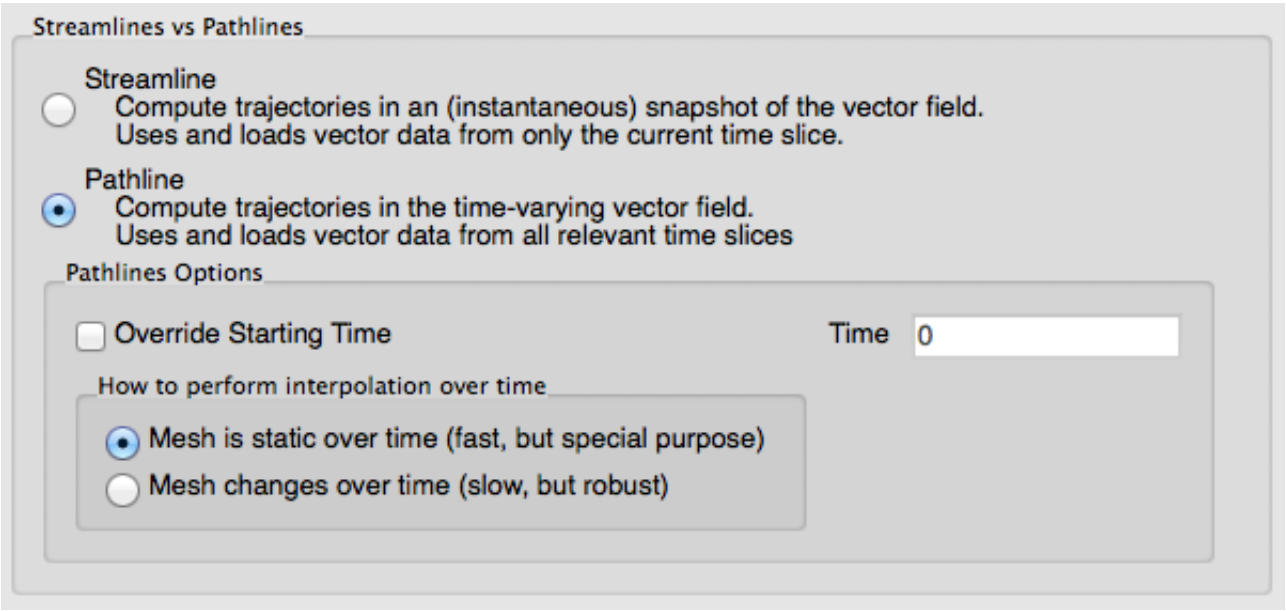


Examining features of the Flow Field with Pathlines

Finally, to explore the time varying behavior of the flow field we will use Pathlines. Pathlines show the path massless tracer particles would take if advected by the vector field at each timestep of the simulation.

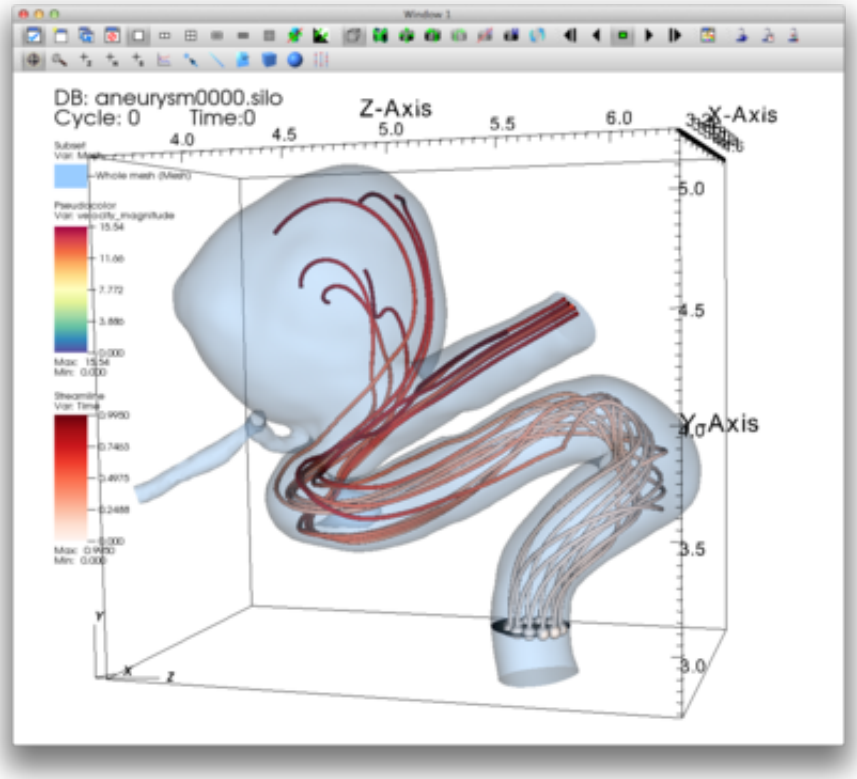
We will modify our previous Streamline plot to create Pathlines.

- Set the [Time Slider] Control to the first timestep.
- Open the **Streamline Plot Attributes Window**
  - Under the **Advanced** tab
    - In the **Streamlines vs Pathlines** section
      - Select **Pathline**
      - In the **Pathlines Options** section
        - Set **How to perform interpolation over time** to **Mesh is static over time**



- Click Apply and dismiss the window.

This will process all 200 files in the dataset and construct the Pathlines that originate at our seed points.



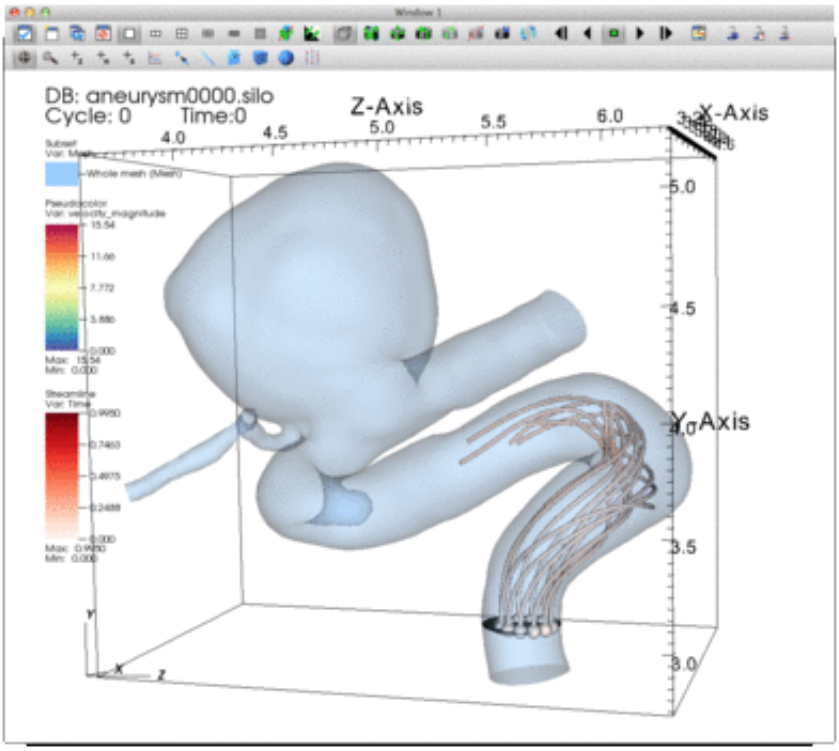
After this calculation is done, we can animate the Pathlines by cropping away portions of the curves based on advection time.

- Open the Commands Window
  - [Controls Menu]->Command
- Find an empty tab
- Paste the following Python snipper into this tab

```
# Animate our pathlines by cropping based on time
satts = StreamlineAttributes()
satts.referenceTypeForDisplay = satts.Time
satts.displayEndFlag = 1

nsteps = 100 # Number of steps
final_time = .995
for i in range(nsteps+1):
  satts.displayEnd = final_time * i /nsteps
  SetPlotOptions(satts)
```

- Click **Execute**



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