Blood Flow Aneurysm Tutorial Calculating Flux

From VisItusers.org

Contents

Description of Simulation Data

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

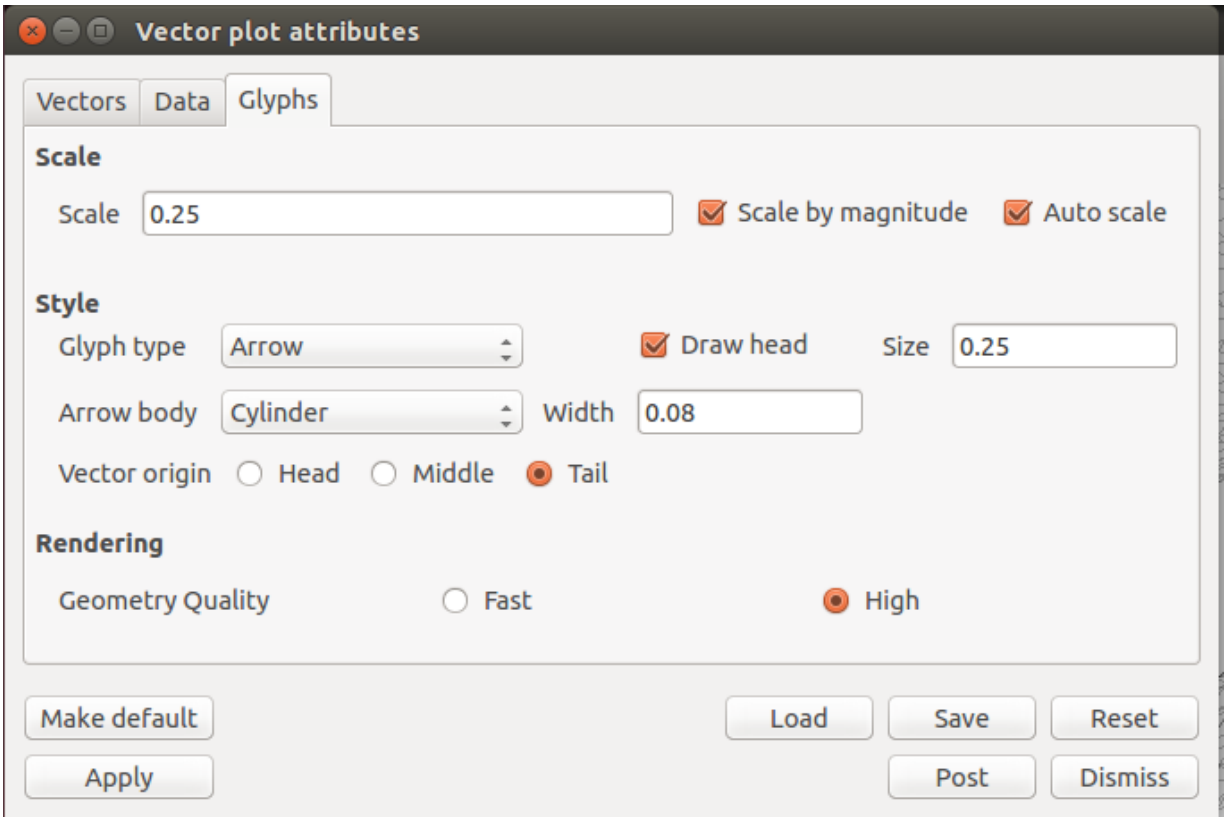
Calculating the flux of a Velocity Field through a surface

To calculate a flux, we will need the original velocity vector, the normal vector of the surface, and VisIt's Flux Operator. We will calculate the flux through a cross-slice located at Y=3, at the beginning of the artery. We are assuming that you have open the datafile series, and that you start with a blank page.

Creating the slice and showing velocity glyphs

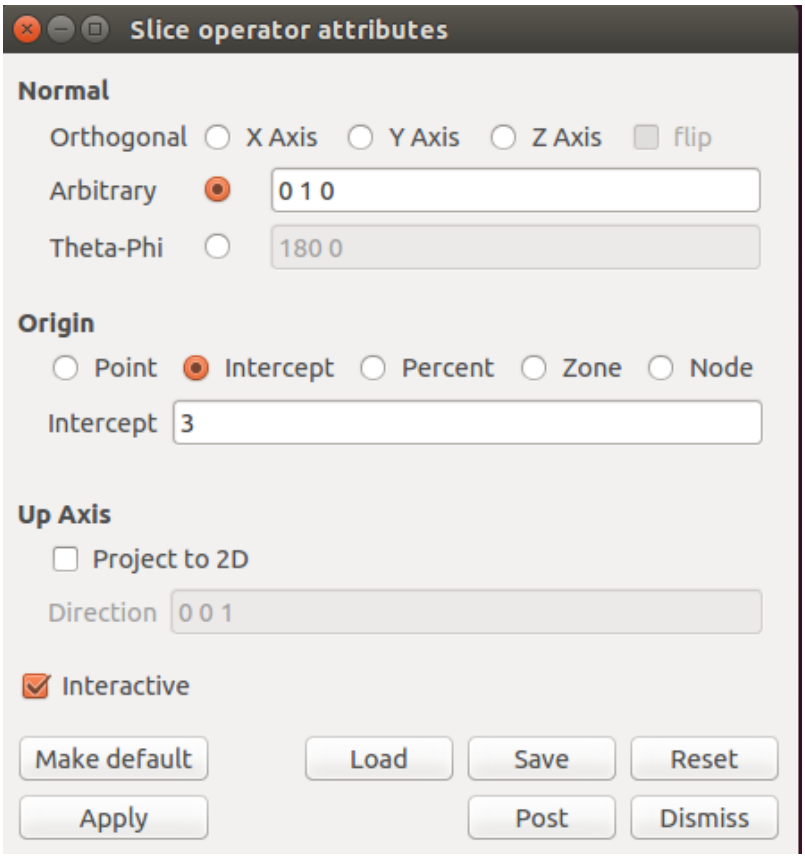
First we will directly plot the velocity vectors that exist on the slice through the 3D mesh.

- Add a **Vector** plot of **velocity**
- Open the **Vector** plot attributes
- On the 1st tab (Vectors), set the **Fixed number** to 40
- On the 3rd tab (Glyphs)
  - Set **Arrow body** to **Cylinder**
  - Set **Geometry Quality** to **High**

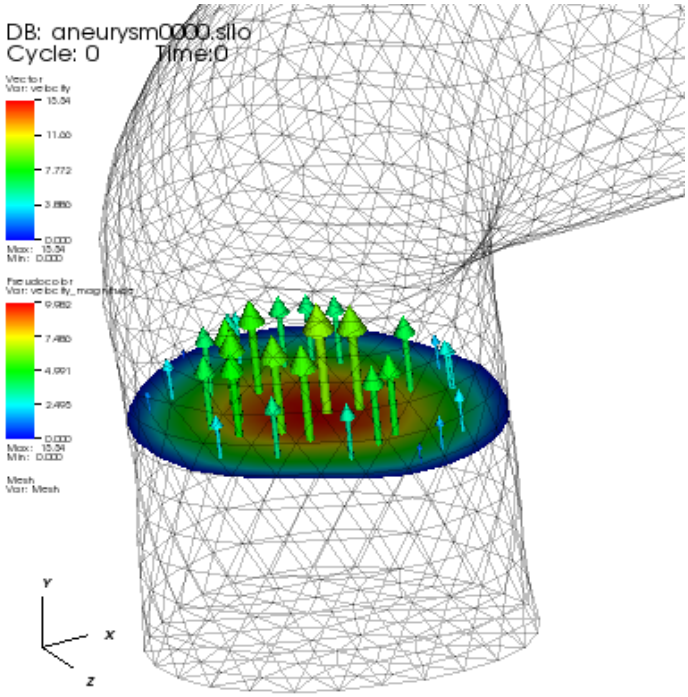


- Click Apply and Dismiss
- Add a **Slice** operator
- Open the **Slice** operator attributes
  - Set **Normal** to **Arbitrary** and to **0 1 0**
  - Set **Origin** to **Intercept** and to **3**
  - Set **Up Axis: Project to 2D** to **OFF**

- Click Make default, Apply and Dismiss
- Click Draw



- Zoom in to explore the plot results.

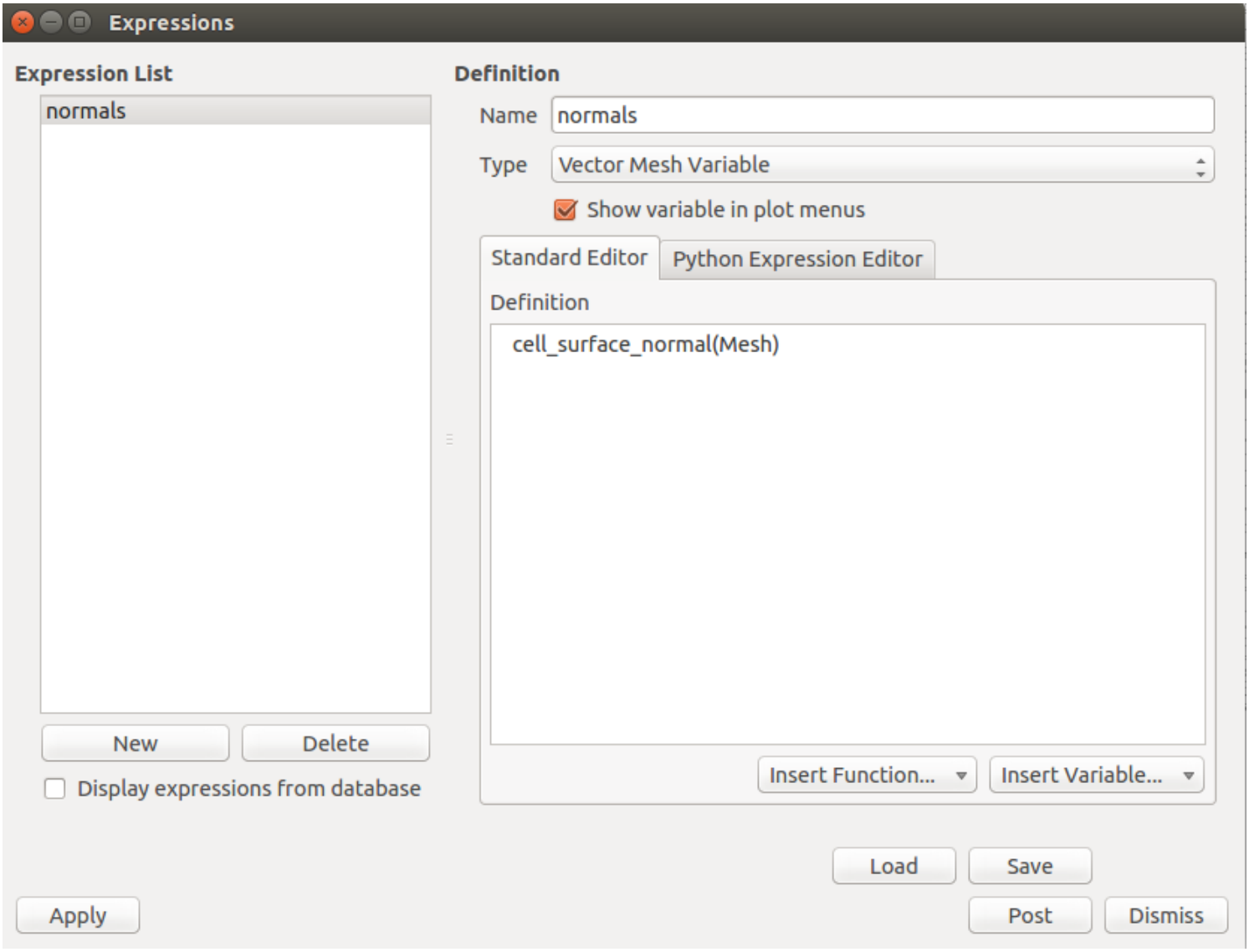


The vector plot uses glyphs to draw portions of the instantaneous vector field. The arrows are colored according to the speed at each point (the magnitude of the velocity vector). Next we create an expression to evaluate the vectors normal to the Slice. These normals should all point in the Y direction.

Creating a vector expression and using the Defer Expression operator

We will use VisIt's pre-defined expression to evaluate the normals on a cell-by-cell basis.

- Select the **Controls** and **Expressions** menu
- click **New**
- Change the name to **normals** and the **Type** to **Vector Mesh Variable**
- Edit the definition by selecting **Insert Function**, going to the **Miscellaneous** category and selecting **cell_surface_normal**. You then need to add the name of the mesh **Mesh** inside the parentheses.

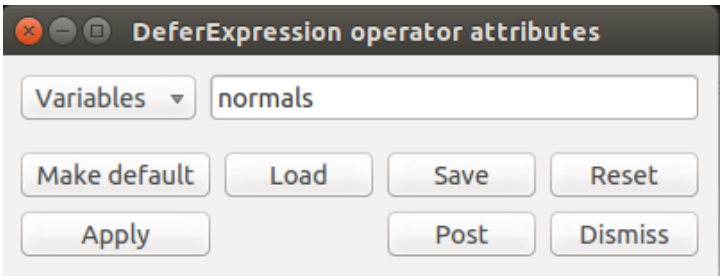


- Click Apply and Dismiss

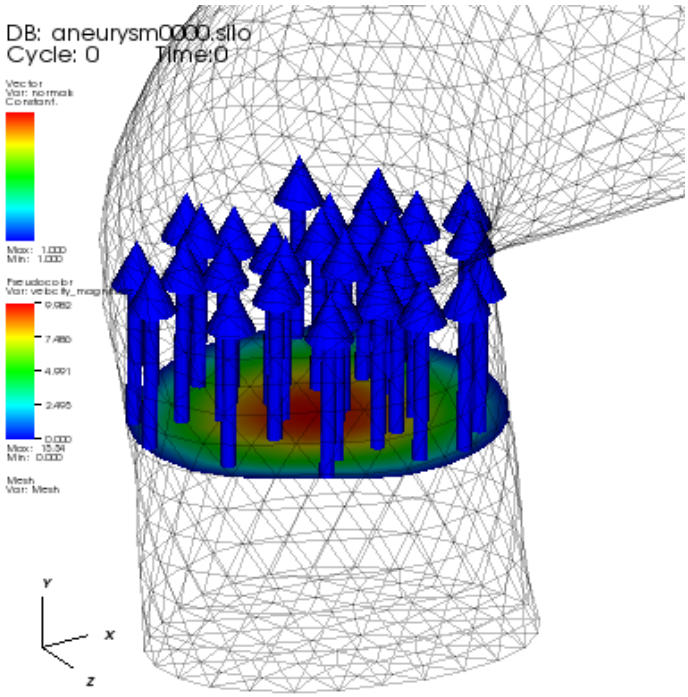
Return to the Vector plot and change its variable to **normals**

- you will most probably be greeted with an error message saying: *The 'normals' expression failed because The Surface normal expression can only be calculated on surfaces. Use the ExternalSurface operator to generate the external surface of this object. You must also use the DeferExpression operator to defer the evaluation of this expression until after the external surface operator*.
- in fact, VisIt cannot use the name **Mesh** which refers to the original 3D mesh. It needs to defer the evaluation, until after the Slice operator is applied. Thus, we add the **Defer Expression** operator (from the Analysis group).

- Open the **DeferExpression** operator attributes
- Add the name **normals** to the Variables list



- Click Apply and Dismiss
- Click Draw

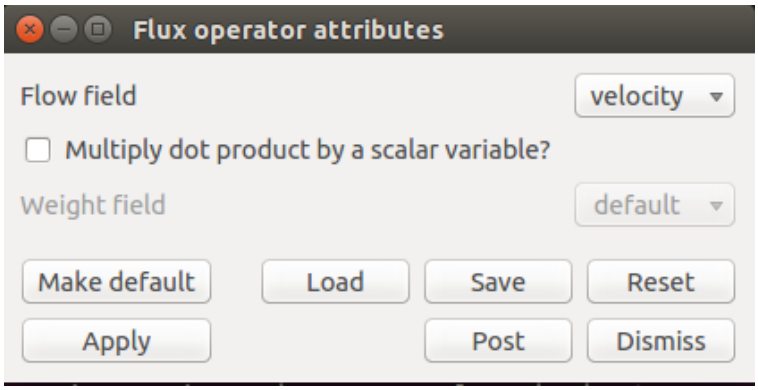


- Verify that all your normals point in the up (Y) direction.

Calculating the flux on the slice

We are now ready for the final draw.

- Add a **Pseudocolor** plot of variable **operator->Flux->Mesh**
- Add a **Slice** operator and verify that the default values previously saved are used.
- Move the **Slice** operator up, above the **Flux** operator
- Add a **Defer Expression** operator as before
- Move the **Defer Expression** operator up, above the **Flux** operator, and below the **Slice**
- Open the **Flux** operator attributes
- Change the Flow field name from **default** to **velocity**



- Click Apply and Dismiss
- Click Draw
- Verify that you have a display that is cell-centered, and that will vary with the Time slider

- Get the numerical value of the flux by query-ing for the **Weighted Variable Sum**