An Introduction to Scientific and Data Visualization with ParaView

Part 1 – Introduction & Overview
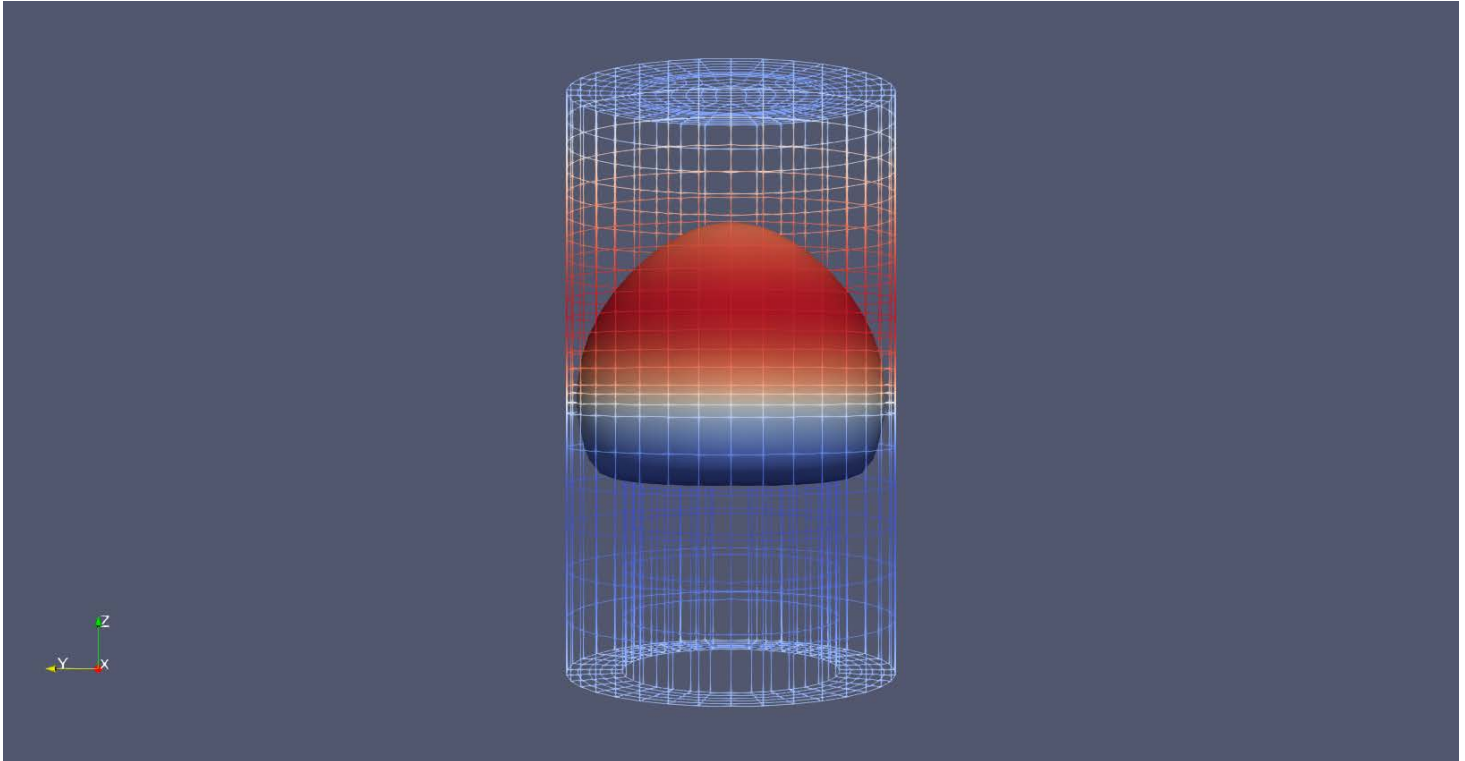**Part 2 – Overview part 2**
Part 3 – Overview part 3 and
              Python Scripting
Part 4 - Animation

EXERCISE

- Load the 'disk_out_ref.ex2' data file
- In the 'Properties' tab, select (check) all the variables by simply making sure 'Variables' is checked
- Create a wireframe and color by 'Pres'
- Create a new layer using the Contour filter
- Contour by 'Temp'
- Set the Contour isovalue to 400

Your exercise output should resemble this
Note: for the contour we contoured by the temperature at 400 C and colored it by pressure!

Adding a Annotations

Annotations such as Titles can easily be added by using the 'Text' source.

- Click on Sources->Text
- Rename your 'Text1' layer to 'Title' by double clicking on 'Text1'
- In the 'Text' box enter 'Disk Out Ref'
- Change the font to 'Times New Roman', font size of 15, enable Bold and Shadow ('S' btn)
- In the 'Text Position' section click on the 'Top Center' button
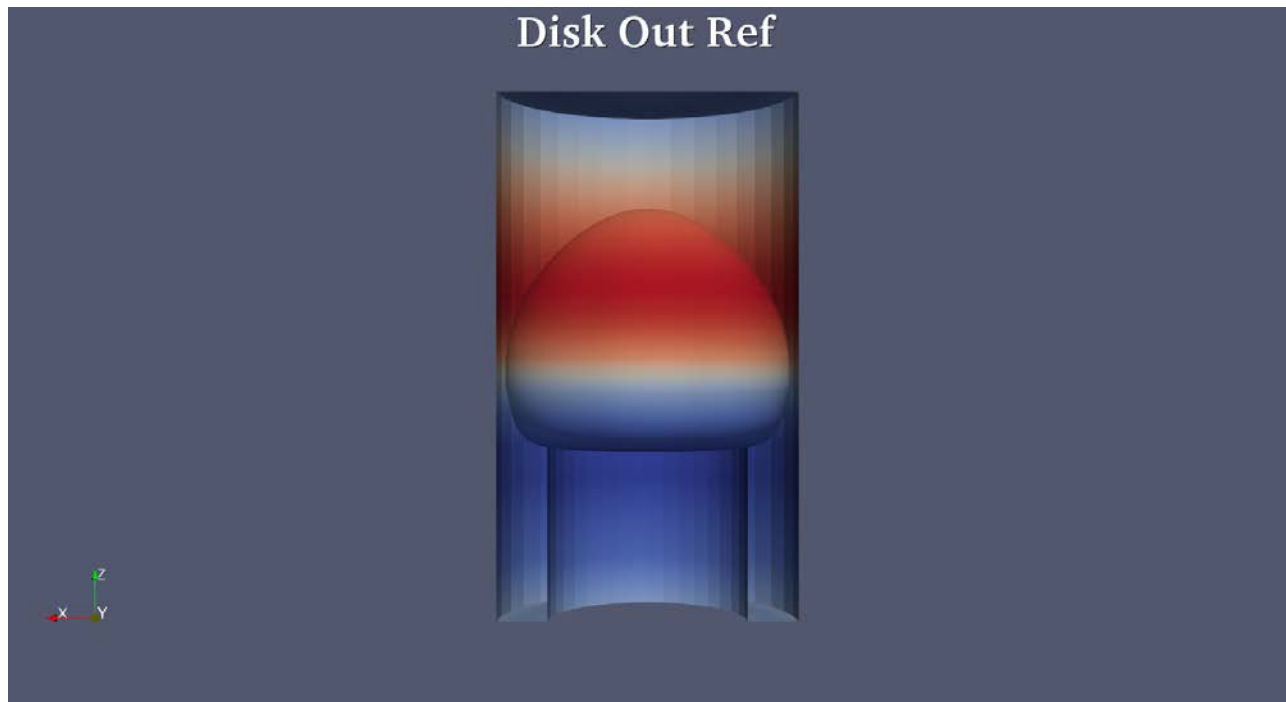
Your final output should resemble this

Extracting surfaces

You can and often do need extract and work with separate surfaces from your data. Often to represent them in different ways, to lighten the geometry (and thus memory) footprint and dozens of other reasons.

- In the Pipeline Browser make sure the 'disk_out_ref.ex2' layer is selected
- Click on Filters->Alphabetical->Extract Surface
- Make sure 'ExtractSurface 1' is selected in the Pipeline Browser
- Click on Filters->Common->Clip (or the toolbar Clip button)
- Under the Properties tab set 'Normal' to [0, -1, 0]
- Under the 'Plane Parameters' section click 'Show Plane' off
- Click on the 'Set view direction to –Y' toolbar button
- Make sure you are still coloring by 'Pres'

Exercise: Creating a Temperature Map (coloring problem part 1)

This layer is not important to our final visualization but it will introduce a major issue with Paraview (and Visit for that matter). But I will teach you the real meaning of CG with a way around this problem.

- Hide all layers
- Make sure the 'disk_out_ref.ex2' layer is selected
- Click Filters->Common->Slice (or use the toolbar Slice button)
- Set 'Coloring' to 'Temp'
- Click on the 'Y Normal' button
- Turn 'Show Plane' off
- Rename your Slice1 layer to 'Temp'
- Hide your 'Temp Map' layer
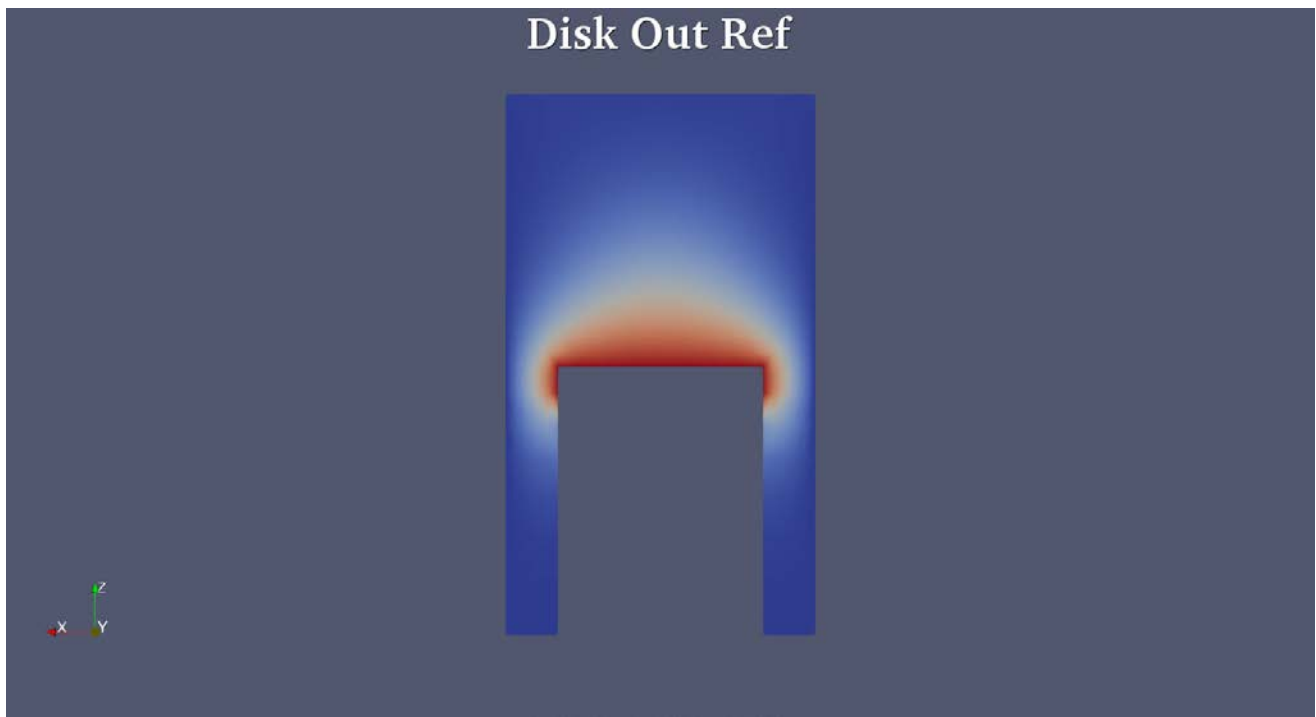
Your temperature slice should resemble the above

The problem we are going to run into is that once a variable has a transfer function (meaning colored by a color map) attached to it every instance of the variable will be colored the same. But what if we use, say Temperature, in a couple different ways and want or even need them colored differently? There are several options and most of them VERY non-user friendly and yields only so-so results. But there is a really easy way to get around this.

Vector Plotting – Streamlines, tubes, and glyphs

Creating Streamlines

There are a few different ways to create streamlines in Paraview. We will start with the most common way and add on to them.

- Hide your temperature slice
- Make sure the 'disk_out_ref.ex2' layer is selected
- Click Filters->Common->Stream Tracer
- Change 'Seed Type' to 'Point Source'
- Change 'Center' to [0, 0, 0.07]
- Change 'Radius' to 3

Adding a New Variable (coloring problem part 2)

Remember that coloring problem we were just talking about? Well let's begin getting around it by creating a new variable based on our original variable.

The Calculator tool is a POWERFUL tool used for an infinite number of needs. In our first usage of it we will simply create a new Temperature variable.

- With the 'StreamTracer1' layer selected
- Click Filters->Common->Calculator or click on the 'Calculator' button
- Change "Result Array Name' to 'Temp1'
- Click on 'Scalars' and select 'Temp'
- In the calculator editor field (where 'Temp' just popped up) add '+ 0.0'
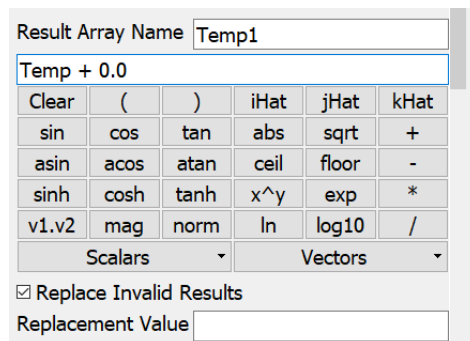
Your calculator set should look like this.

We'll leave this for now but note it's important that we create this new variable before we need to use it. You can, to a very small extent move layers but its troublesome at best and impossible for the norm. NOTE – we jump into Python next week most of these problems vanish!

Adding Tubes

Streamlines are nice but don't, in SciViz app's, render very nice so they are hard to see clearly. Plus, its limited in the information it can give. By adding tubes (linked and smoothed cylinders) we resolve these issues.

- With 'Calculator1' selected click Filters->Alphabetical->Tube
  (We use the Calculator layer and not the StreamTracer1 layer because we are going to want our new variable shortly so it needs to be inherited into our pipeline hierarchy.)
- Set 'Coloring' to 'Pres'
- Change 'Radius' to 0.025
- Change 'Varying Radius' to 'By Scalar'
- Change 'Scalars' to 'Temp'
- Change 'Radius Factor' to 5

- Change 'Number of Sides' to 8
- Go back to the 'StreamTracer1' layer (Making sure only the 'Tube 1' layer is visible)
- Change 'Maximum Streamline Length' to 50
- Change 'Number of Points' to 75
- Change 'Initial Step Length' to 0.05
- Click on the '+X' view direction toolbar button
- If you're not saving your state, you might want to reconsider your saving frequency!

Your viewport should resemble the above

Adding Glyphs and Object Shading
- Click on the 'Calculator1' layer in the Pipeline Browser
- Click on Filters->Common->Glyph
- Under 'Active Attributes' set the 'Vectors' dropdown to 'V'
- Scroll up and under 'Glyph Type' select 'Cone' from the dropdown button
- Set 'Resolution' to 64
- Under the 'Scaling' section set 'Scale Mode' to 'Vector'
- Set 'Scale Factor' to .05
- Make sure 'Coloring' is set to '*Temp'*

Creating a New Transfer Function

Transfer functions are designed to transfer a specific color to a specific data value. We do this across a range that spans your variables full range using a color map.

- Under 'Coloring' click the 'Edit' button, or press the 'Edit Color Map' toolbar button to open the Color Map Editor
- Click the 'Choose Preset' button (it's the folder icon with a red heart on it)
- Scroll down the list and select 'Cold and Hot' click 'Close'
- Click on the 'Rescale to Data Range' button (the scalebar button with double arrows above it)
- Desaturate each of the colors by clicking on the color handles and change the 'Saturation' to 200.
- Click on the 'Save to preset' button
- Scroll to the bottom of the preset list and single click on the 'Preset' preset
- Rename 'Preset' to 'Cold-Hot Desaturated' by double clicking on the colorbar to set it

Adjust the Lighting and Material Properties

- Back in the 'Properties' panel scroll down to the 'Lighting' section
- Change 'Specular' to 0.3
- Set 'Specular Power' to 35
- Set 'Ambient' to 0.05
- Set 'Diffuse' to 0.9

- Click on the 'Tube 1' layer in the Pipeline Browser
- Change 'Specular' to 0.3
- Set 'Specular Power' to 75
- Set 'Ambient' to 0
- Set 'Diffuse' to 0.9
- Scroll to the bottom of the 'Properties' panel
- Under the 'Background' section click on the 'Color' button and change the color to [20,20,20]
- Click on the '+X' view direction toolbar button

Adding Colorbar Legends

- Select the 'Tube1' layer and activate the color legend by clicking on the 'Toggle Color Legend Visibility' button.
- Open the 'Edit Color Map' editor and click on the 'Edit color legend properties' button
- Change the 'Title' to 'Pressure'
- Change 'Component Title' to '(bars)'. NOTE: I have no idea what the actual units are!
- Change both 'Title Font Properties' and 'Text/Annotation Font Properties' to a font size of 12 and make them bold.
- Uncheck 'Automatic Label Format'
- Change 'Label Format' and 'Range Label Format' to '%0.3f' (These properties use normal printf)
- Position the 'Tube1' color legend to the right center with a vertical orientation

- Repeat this for the 'Glyph1' layer with a 'Title' set to 'Temperature (Glyphs)', 'Component Title' set to '(C)' and the formats set to '%0.1f'.
- Position the 'Glyph1' color legend to the bottom center with a horizontal orientation
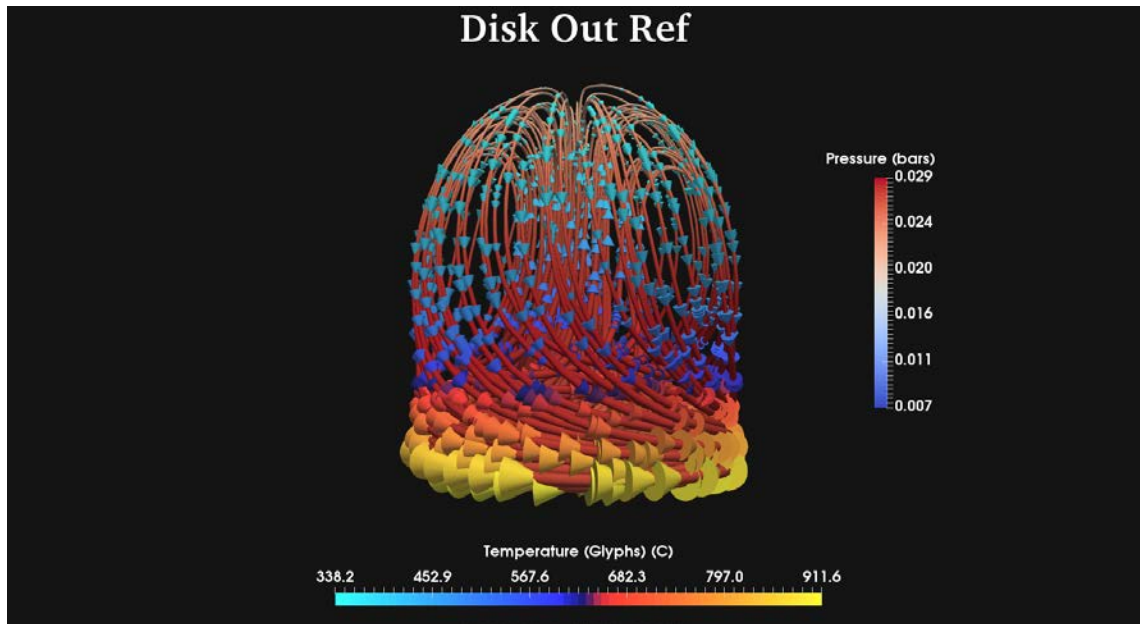
Your viewport should resemble the above

Volmeterics and Fixing Transfer Function Issues

- Turn the visibility off on all layers
- File->Open a new copy of 'disk_out_ref.ex2'
- Rename the new object-layer to 'Volumetrics'
- Change 'Coloring' to 'Temp'
- Open the color legend editor
- Change the transfer function's color map preset to 'Black-Body Radiation'
- Click on 'Rescale to custom range' and Minimum=293, Maximum=913
- Now in the transfer functions 'Mapping Data' plot, click on the black line (the black line above the color graph itself) to create a new point.
- With the point selected, drag the point to something near 650.0:0.25 (just get as close as possible). Make sure you watch what happens to the color mapping in the viewport as your adjusting your point around.


Your 'Black-Body Radiation' transfer function should look like this

Coloring problem part 3 – Final resolution!

- Note that when you made these changes to the colormap for 'Temp' it made it universal for ALL layers coloring with the Temp variable. To prove this, hide your 'Volumetrics' layer and take a look at your Slice1 layer. Grrrrrr we broke it!
- Turn the visibility for the 'disk_out_ref.ex2' color legend off
- Turn the visibility on and select the 'Glyph1' layer
- Change Coloring to 'Temp1'
- Change the transfer function to our 'Cold-Hot Desaturated' color map
- Turn the color legend off for the Volumetrics layer
- Make the new Glyphs color legend visible and change the Legend to match what we had for the 'Temp' legend
- Boom problem solved!
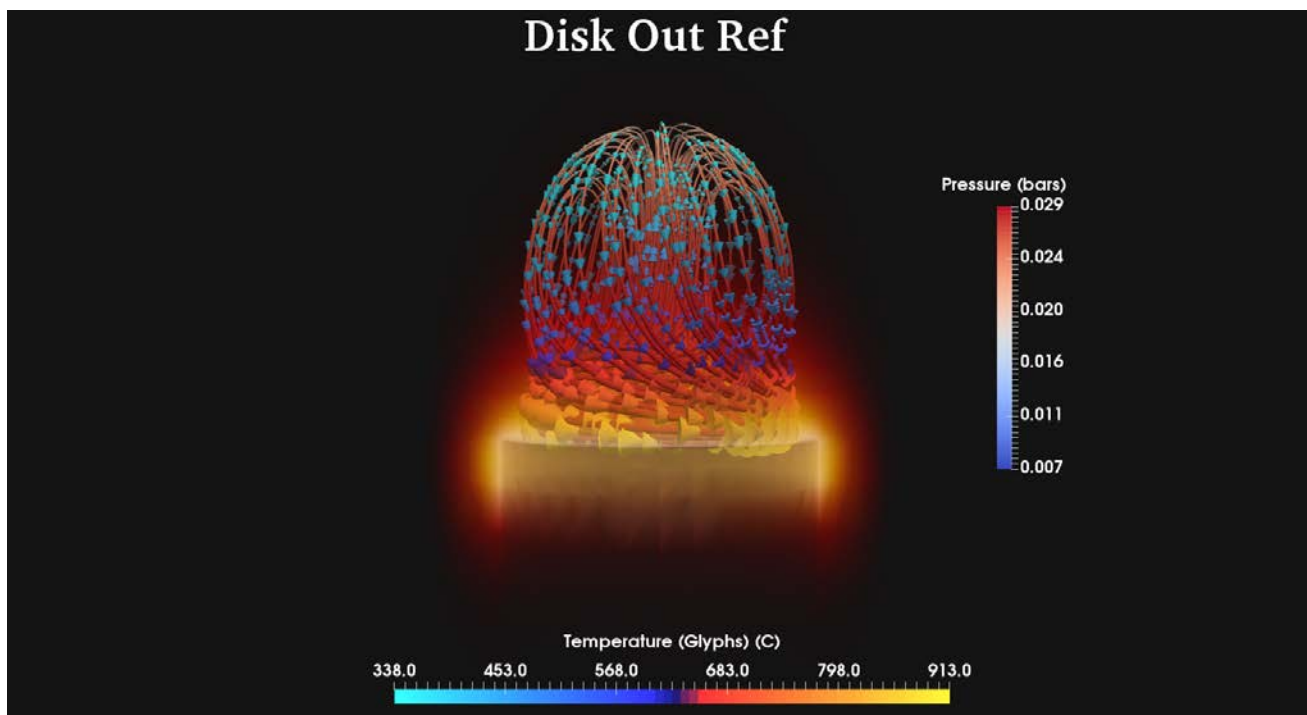
Putting it all together your viewport should resemble the above