

An Introduction to Scientific and Data Visualization with ParaView

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Part 1 – Introduction & Overview

Part 2 – Overview part 2

Part 3 – Python Scripting

Part 4 – Animation

Data and materials available from:

<https://github.com/ResearchComputing/Scientific-and-Data-Visualization-with-Paraview>

If you have questions, please feel free to asked them in the Google Group
which you all should be members in:

<https://groups.google.com/forum/#!forum/paraview-course>

Getting Started and Setting Default Settings

- Start up ParaView
- In the menu bar click on Edit->Settings
- On the 'General' tab under the 'Properties Panel Options' check on
 - 'Auto Apply'
 - 'Load All Variables'
- Under 'Scalar Bar Mode' select 'Automatically show and/or hide color bars'
- Click 'OK' to exit

Exploring the Menu Bar

- Live demo

Exploring the Properties Panel

- Live demo

Resetting Your Session

- Edit->Reset Session

Loading Data Into Your Layout

- File->Open
 - Navigate to where you stored the files for this week's session and select 'CAT_Torso.vti'

Inspecting Data Information

- To view information on your data, Click on View->Statistics Inspector
- To view information on memory availability and usage click on View->Memory Inspector
- We'll explore other panels later

Exploring Data 'Representation'

'Representation' allows you to choose what the basic geometric structuring you want your data to be visualized as.

You can change the form either from the Properties panel via the dropdown next to 'Representation', or by using the 'Representation' dropdown in the main toolbar.

- Take a look at each currently available Representation type; (3D Glyphs, Outline, Points, Slice, Surface, Surface with Edges, Volume, Wireframe)

Exploring Coloring

Using 'Coloring' you can define the method, made available by your data, that you want your data to be colored by.

Like 'Representation' you can change 'Coloring' either from the Properties Panel or from the main toolbar

- Make sure your 'Representation' is set to 'Surface'
- Take a look at 'Solid Color' and 'Scalars_' (Note 'Scalars_' is defined in the dataset as a variable type!)
- We can change the colors and opacity but we won't discuss that till next week

Our First Data Filter - Slicing

Slicing allows you to make an infinitely thin cross section slice through your data. You can create a slice from either the Filters menu or from the tool bars 'Slice' button

- Click on Filters->Common->Slice
- We can define the slicing plane in the Properties panel under the 'Plane Parameters' section
- You can deactivate the plane, and should, once you have what you want so you don't accidentally change it

Saving and Loading Paraview States

One of the single most important operations to perform in Paraview is frequently saving the 'State' of your work. You should do this often as Paraview, although VASTLY improved over the last couple of years, can crash on you. The file will be saved as a *.pvsm file.

- To save your State go to File->Save State and save your current state
- Next, just to demonstrate reset your session (Edit->Reset Session)
- Now click on File->Load State, in the File browser select the *.pvsm file you just saved
- You will now be presented with a 'Load State Options' panel. Select the default setting which is 'Use File Names From State'

Data Filter – Clip

Clip allows you to make a clipping, slab, section from your data. Where-as Slice made an infinitely thin cross section slice through your data, clipping creates a Boolean slab subtraction leaving you with a cross section of your data along with the rest of the data that has not been subtracted, clipped, out.

The first and most important thing to do is make sure your creating a filter on the data you really want to act on. In our case we want to do it on our original, CAT_Torso.vti layer.

- In the Pipeline Browser, click on the visibility button, the little eyeball to the left, of the 'Slice1' layer to hide this layer
- Click on the visibility button for the CAT_Torso.vti layer and make sure you have that layer selected as well
- Click on Filters->Common->Clip
- When done exploring make sure you click 'Reset to Data Bounds' and then click on 'Y Normal' in the Planes Parameters section of the Properties panel

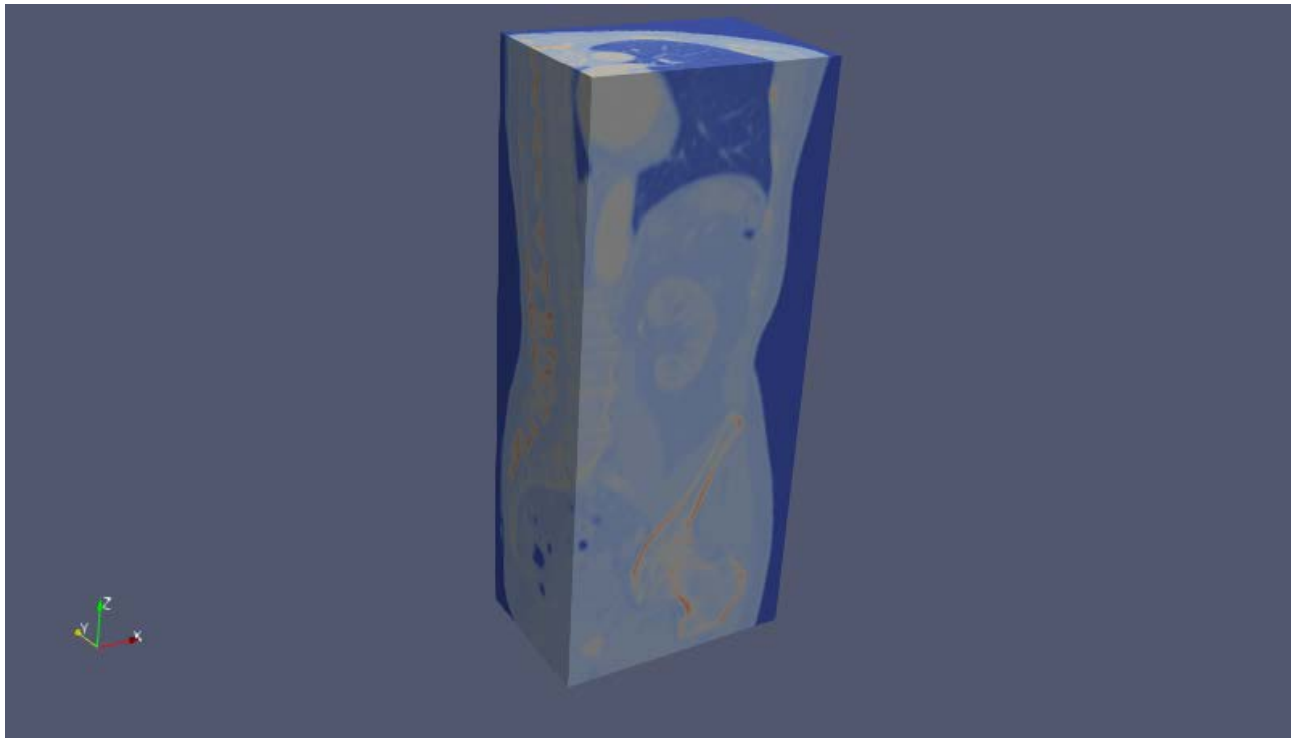
Filters can act on previous filters such that you can create a chain of filter operations to get the results you need. To demonstrate this let's make a clip on our already clipped object.

- Make sure you still have Clip1 selected and then click on the Clip toolbar button
- Click on 'X Normal'

Now we are looking at just 1/4th of the entire object. We will look at more advanced chains or operations in later and the pro's, the short comings, and what CG really stands for as we find ways around the short comings.

Saving an Image

- You save a screenshot of your render by clicking File->Save Screenshot
- Click on the little green lock to lock the aspect ratio
- You may change the Image resolution as desired noting that changing one makes Paraview change the other since we locked the aspect ratio.
- Click 'OK' and your taken to the File Browser panel
- Define a folder to save your images (it's always a good idea to make a images, plates, or whatever you want to call it folder for your output images.
- Define the file type as .png (or whatever you desire)
- Set the file name and click 'OK'



Your saved image should look something like this.

Data Filter – Contours

Contour filters create isocontour surfaces of your data.

- Hide the two Clip layers and make sure you are on the CAT_Torso.vti layer
- Click on the 'Contour' button or select from Filters->Common->Contour
- Make sure your Coloring is set to 'Solid Color' and your Representation is set to 'Surface'
- We can change the number of contours we are looking at in the 'Value Range' table.
- Click on the red 'x' at the bottom outside left of the table to delete the current isovalue
- Click on the 'Add a range of values' button just above the delete button to open the 'Add Range' panel. It will automatically set the 'From' to the minimum value found in the dataset and 'To' to the maximum value from the dataset. Steps tells it how many contours you want to generate between the desired min and max values.
- Leave the values at the default values and click OK.
- We can now add a Clip filter to dissect into the torso. Add a Clip operator and set it to 'Y Normal'
- Sadly, everything is a bland color, light grey, next week we'll look at how to deal with color but for now set Coloring to 'Normals'.
- We now have a new drop down available to us just to the right of our Coloring variable set, click on it and select 'Y'. This says we want to color based on distance from the camera.

Adding Additional Objects – Cat_Head.silo

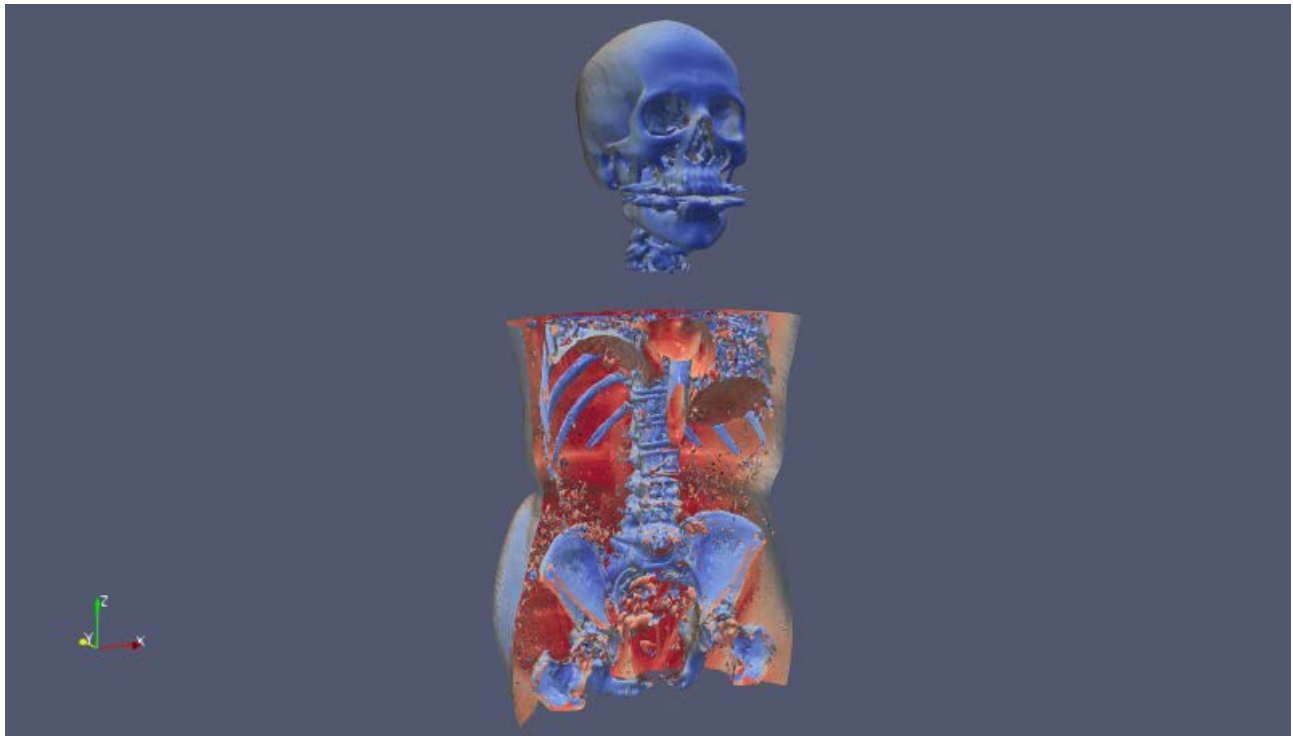
Paraview allows you to load in and work with more than just one data file. To demonstrate this let's load in a head to go with our torso.

- First head all the torso layers.
- Click on File->Open and select the CAT_Head.silo file
- Let's change the name of this layer by simply double clicking on the name of the layer and change it to 'HEAD' (Note: we can change the name of any layer and this because essential in large pipelines)
- Likewise change the name of CAT_Torso.vti to 'TORSO'
- Making sure you have the HEAD layer selected add a Contour filter to it
- Change the value range (just double click on it) to 14
- Set the Representation to Surface and Coloring to 'Solid'
- Turn the visibility on for the 'Clip 1' layer for the TORSO
- Uhm, is this what they mean by having your head up your ***? To say nothing about the fact we have *THE* worst Zika caused case of microcephaly. Time to do some operating!

Transforming

'Transformations' allows you to perform affine transformations on your object layers. There's a number of ways of doing this, but for now we will do just the most straight forward method which is made available to us in the Properties panel.

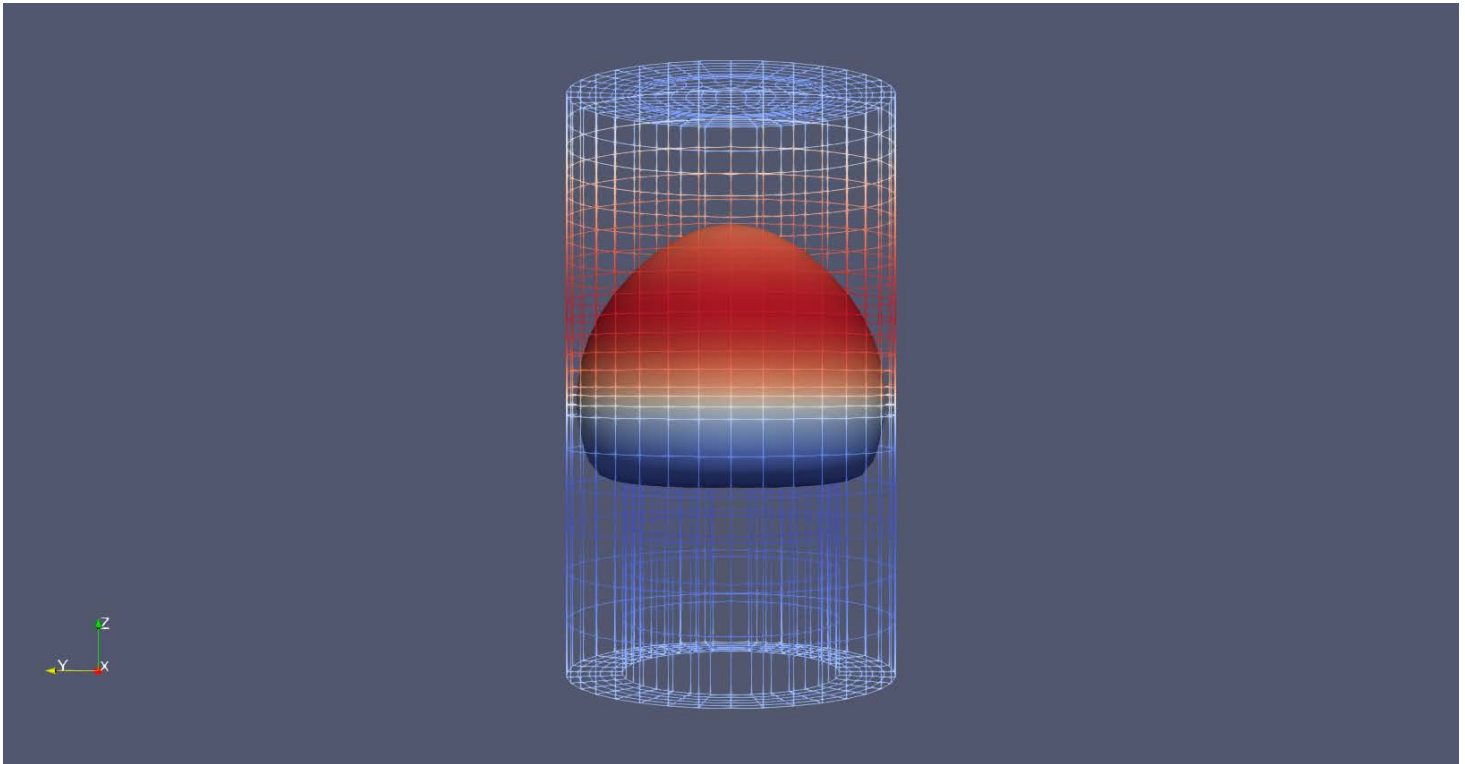
- First let's rotate the head. Move down the Properties panel till you get to the 'Transforming' section
- Set the 'Orientation' to 0, 180, 0
- Let's make the HEAD bigger by changing the scale to 2.25, 2.25, 2.25
- Finally, to roughly line the head up with the torso change 'Translation' to 310, 0, 750
- True it should be higher but for us, this works just fine.



The final result of the TORSO and HEAD scene should look something like this.

EXERCISE

- Save your state, screenshot (if you desire) and reset your session
- 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

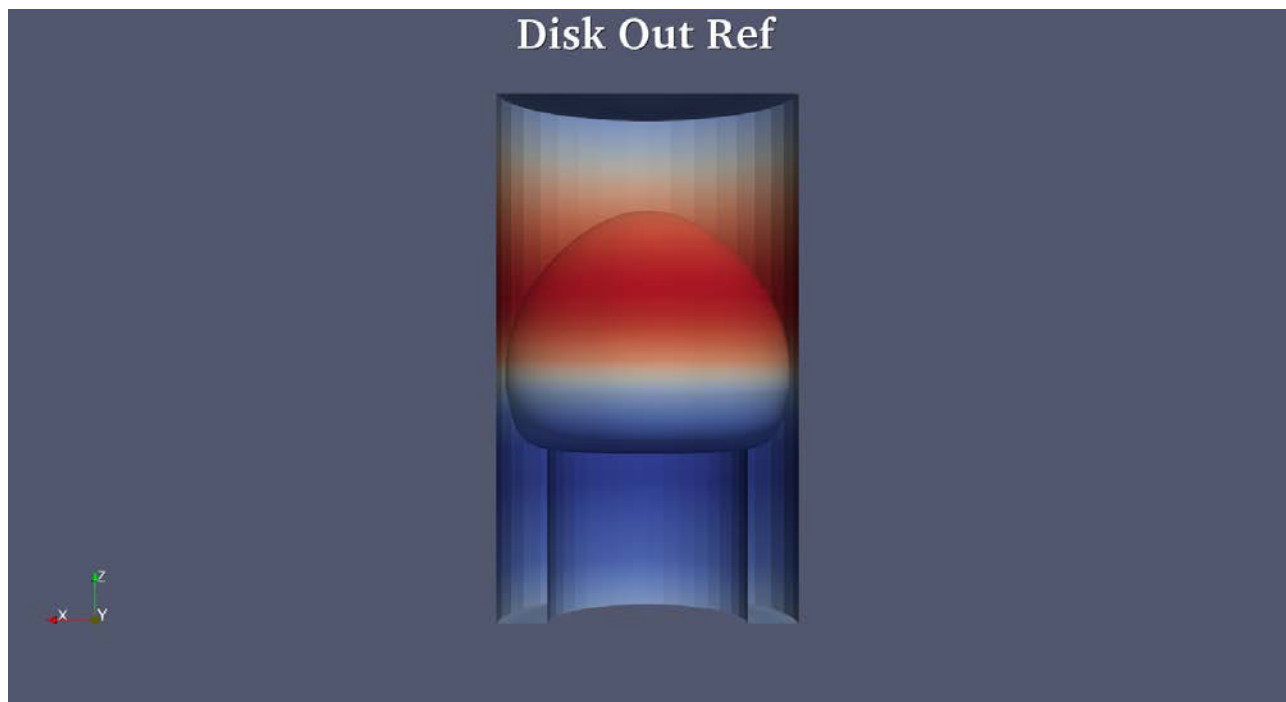
Note: for the contour we contoured by the temperature at 400 C and colored it by pressure!

Extracting Surfaces

- 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'

Adding a Title

- 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
- **Make sure you save your state as we will be starting next week with this scene!!!**



Your final output should resemble this