



Post-processing with Paraview



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Post-processing with Paraview: Overall Program

Post-processing with Paraview I (ParaView GUI and Filters) Post-processing with Paraview II (ParaView scripting with hands-on) Post-processing with Paraview III (ParaView for large data visualization)







OUTLINE

PART A

- What is Paraview
- The GUI
- Sources
- Loading Data
- Text annotation
- Views management
- Save figures

PART B

- Filters
- Vectors visualization
- Streamlines
- Plotting over line
- Select data
- Create a custom filter
- Animations
- Time dependent data







What is Paraview

ParaView is an open-source application for visualizing 2D/3D data.

To date, ParaView has been demonstrated to process billions of unstructured cells and to process over a trillion structured cells.

ParaView's parallel framework has run on over 100,000 processing cores.

ParaView's key features are:

- An open-source, scalable, multi-platform visualization application.
- Support for distributed computation models to process large data sets.
- An open, extensible, and intuitive user interface.
- An extensible, modular architecture based on open standards.
- A flexible BSD 3-clause license.
- Commercial maintenance and support.









PARAVIEW: a standard de-facto

ParaView is used by many academic, government, and commercial institutions all over the world.

ParaView is downloaded roughly 100,000 times every year.

ParaView also won the HPCwire Readers' Choice Award and HPCwire Editors' Choice Award for Best HPC Visualization Product or Technology.













Obtaining Paraview & Official Resources

• Main website:

http://www.paraview.org/

- Download page: <u>http://www.paraview.org/paraview/resources/software.php</u>
- Resources (video): <u>http://www.paraview.org/paraview/resources/webinars.html</u>
- Resources (wiki):

http://www.paraview.org/Wiki/ParaView







The big picture

The application most people associate with ParaView is really just a small client application built on top of a tall stack of libraries that provide ParaView with its functionality.

ParaView comes with a pypython application that allows you to automate the visualization and post-processing with Python scripting.

A ParaView Server library provides the abstraction layer necessary for running parallel, interactive visualization. It relieves the client application from most of the issues concerning if and how ParaView is running in parallel.

The Visualization Toolkit (VTK) provides the basic visualization and rendering algorithms.

ParaView Client	pvpython	Custom app							
UI (Qt Widgets, Python Wrappings)									
	ParaView Serve	r							
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openGL	MPI	lceT							







GUI









GUI elements









GUI elements definition

Menu Bar As with just about any other program, the menu bar allows you to access the majority of features.

Toolbars The toolbars provide quick access to the most commonly used features within ParaView.

Pipeline Browser ParaView manages the reading and ltering of data with a pipeline. The pipeline browser allows you to view the pipeline structure and select pipeline objects. The pipeline browser provides a convenient list of pipeline objects with an indentation style that shows the pipeline structure.

Properties Panel The properties panel allows you to view and change the parameters of the current pipeline object. The properties are by default coupled with an Information tab that shows a basic summary of the data produced by the pipeline object.

3D View The remainder of the GUI is used to present data so that you

may view, interact with, and explore your data. This area is initially populated with a 3D view that will provide a geometric representation of the data.







/Menu-bar/help (!)

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📼 Display		Outline	3D outline of the specified bounds.	
		<u>Plane</u>	Create a parallelogram given an origin and two points. The resolution indicates the number of division along each axis of the plane.	
		Point Source	Create a point cloud of a certain size, radius, and center.	
		Programmable Source	Executes a user supplied python script to produce an output dataset.	
		Sphere	Create a 3D sphere given a center and radius.	
		SplineSource	Tessellate parametric functions.	
		Superquadric	Create a superquadric according to the theta and phi roundness parameters. This one source can generate a wide variety of 3D objects including a box, a sphere, or a torus.	
		Text	The Text source generates a table containing text.	
		Time Source	Produces a single cell uniform grid with data values that vary over a sin(t) wave from t=0 to t=1 (radian).	
		<u>Ruler</u>	This is a line source that can be used to measure distance between two points	
		Wavelet	Create a regular rectilinear grid in up to three dimensions with values varying according to a periodic function.	
		AMR GaussianPulse		



CINECA





Personalize your GUI

The GUI is customizable so that toolbars can be displayed or hidden when needed.







Sources



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Data can be uploaded into ParaView 3D scene using VTK source objects or loading files (readers).





Sources











3D objects manipulations

Test the usage of your mouse buttons:

- •Left button: rotation
- •Right button: panning
- •Middle button: zooming







Camera control basics

Set camera location Set zoom



Set view on/off for axis and center of rotation









Change center of rotation

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Apply/Reset Undo/Redo

Apply: click on the apply button to 'sync' your data state. (Automatic apply of changes button 🔐)

Reset: click this button to restore the default configuration state.

Undo: go back to the previous state

Redo: return to the state you changed back

Camera Undo: same as above but for camera views changes

Camera Redo: same as above but for camera views changes







Main objects menu

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Informations







Change object properties







Display



Play with different display options for this object.

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Loading your data (no filtering)

- Load the data file provided for the school.
- Inspect available variables and ranges.
- Adjust view and display settings as learned above.
- Adjust representation and coloring
- Adjust text and legend





U field

- Select surface view + U magnitude
- Scale the data range
- Show label and colorbar
- Add a text to your scene and manage
- Change legend dimensions, format, position and range
- Save an image













END OF PART A





Filters



Calculator Evaluates a user-defined expression on a per-point or per-cell basis.

Contour Extracts the points, curves, or surfaces where a scalar field is equal to a user-defined value. This surface is often also called an iso-surface.

Clip Intersects the geometry with a half space. The effect is to remove all the geometry on one side of a user-defined plane.

Slice Intersects the geometry with a plane. The effect is similar to clipping except that all that remains is the geometry where the plane is located.

Threshold Extracts cells that lie within a specified range of a scalar-field.

Extract Subset Extracts a subset of a grid by defining either a volume of interest or a sampling rate.

Glyph Places a glyph, a simple shape, on each point in a mesh. The glyphs may be oriented by a vector and scaled by a vector or scalar.

Stream Tracer Seeds a vector field with points and then traces those seed points through the (steady state) vector field.

Warp (vector) Displaces each point in a mesh by a given vector field.

Group Datasets Combines the output of several pipeline objects into a single multi-block data set.

Extract Level Extract one or more items from a multi block data set.







Recent The list of most recently used filters sorted with the most recently used filters on top.

AMR A set of filters designed specifically for data in an adaptive mesh refinement (AMR) structure.

CTH Filters used to process results from a CTH simulation.

Common The most common filters. This is the same list of filters available in the filters toolbar and listed previously.

Cosmology This contains filters developed at LANL for cosmology research.

Data Analysis The filters designed to retrieve quantitative values from the data. These filters compute data on the mesh, extract elements from the mesh, or plot data.

Material Analysis Filters for processing data from volume fractions of materials.

Statistics This contains filters that provide descriptive statistics of data, primarily in tabular form.

Temporal Filters that analyze or modify data that changes over time. All filters can work on data that changes over time because they are executed on each time snapshot. However, filters in this category will introspect the available time extents and examine how data changes over time.

Alphabetical An alphabetical listing of all the filters available. If you are not sure where to find a particular filter, this list is guaranteed to have it. There are also many filters that are not listed anywhere but in this list.





Other Filters



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Other customized filters

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Working with filters over data

Perform basic filtering on the data provided for the school

- •Slicing
- Iso-surface
- •Extract surface
- •Clipping
- Vectors
- •Streamlines







Vectors Visualization

- Select filter for 3d vectors
- Select a slice normal to z axis
- Select 2d vectors on the slice
- Modify vectors aspects











Streamlines

- Insert streamlines by line
- Change stream properties
- Color by rotation
- Enhance streams using tubes







Plotting













Multiple views



3d + 2d







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Data selection/saving

 Select your data

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Save as csv

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Save a pipeline as a scene

Save the obtained pipeline a PV scene for future processing by loading the scene back into ParaView.

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Build and use a new filter from a pipeline

File

- Create a custom filter by grouping a pipeline
- Save the filter
- Close and re-load your custom filter

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Hands-on 1

- Load the data provided for the tutorial
- Process the data to obtain:
 - ✓ Slice info
 - ✓ Contour plot
 - ✓ Warp on scalar
 - ✓ 2d lineplot
 - Animate over time
 - ✓ Save the animation





- Load the data provided for the tutorial
- Process the data to obtain:
 - ✓ Smaller dataset to process
 - ✓ Contour plot of iso-Q
 - ✓ Extract the isosurface
 - ✓ Smooth
 - Save the surface for future visualization
 - Color by velocity or pressure or both and compare
 - ✓ Build a filter that will do all the work in a single click
 - ✓ Add text and colorbar
 - ✓ Save meaningful visualizations







