

Elmer

Post-processing utilities

ElmerTeam
CSC – IT Center for Science

Alternative Visualization tools for Elmer



- ElmerPost & VTK widget
 - Postprocessors of Elmer suite
- ParaView
- Visit
- Gmsh
- GiD
- OpenDX

Visualization tools – Poll (5/2015)



What visualization software do you use?				
ElmerPost	12	17%		
ElmerGUI VTK postprocessor	7	10%		
Paraview	29	41%		
ViSit	3	4%		
Mayavi	0	No votes		
Mayavi Gmsh	3	No votes 4%		
Gmsh	3	4%		
Gmsh GiD	3 1	4% 1%		
Gmsh GiD Matlab	3 1 6	4% 1% 8%		

Exporting 2D/3D data: ResultOutputSolve



- Apart from saving the results in .ep format it is possible to use other postprocessing tools
- ResultOutputSolve offers several formats
 - vtk: Visualization tookit legacy format
 - vtu: Visualization tookit XML format
 - Gid: GiD software from CIMNE: http://gid.cimne.upc.es
 - Gmsh: Gmsh software: http://www.geuz.org/gmsh
 - Dx: OpenDx software
- Vtu is the recommended format!
 - offers parallel data handling capabilities
 - Has binary and single precision formats for saving disk space
 - Suffix .vtu in Post File does this automatically



Exporting 2D/3D data: ResultOutputSolve

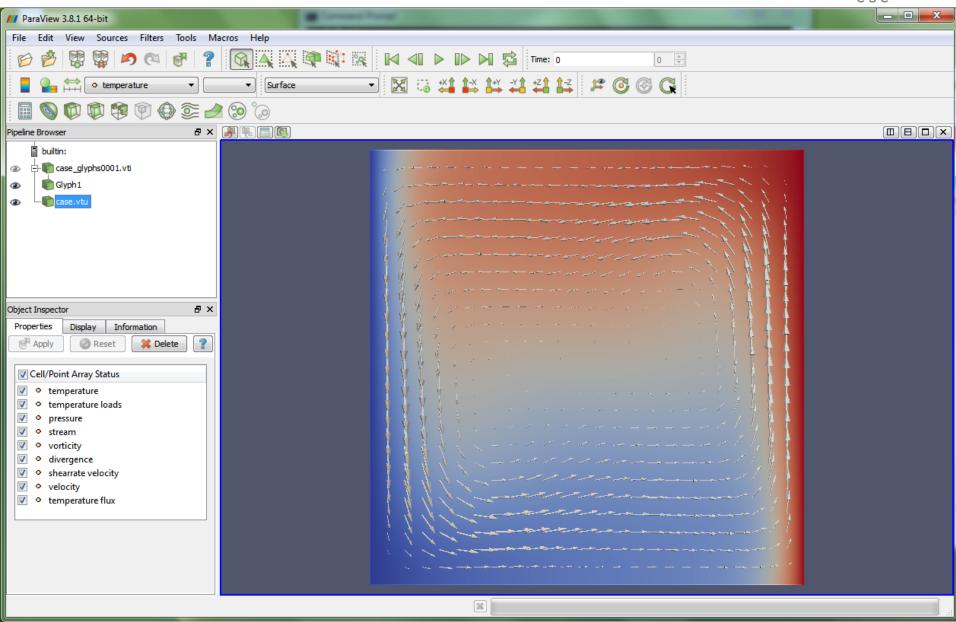
An example shows how to save data in unstructured XML VTK (.vtu) files to directory "results" in single precision binary format.

```
Solver n
   Exec Solver = after timestep
   Equation = "result output"
   Procedure = "ResultOutputSolve" "ResultOutputSolver"
   Output File Name = "case"
   Output Format = String "vtu"
   Binary Output = True
   Single Precision = True
End
```

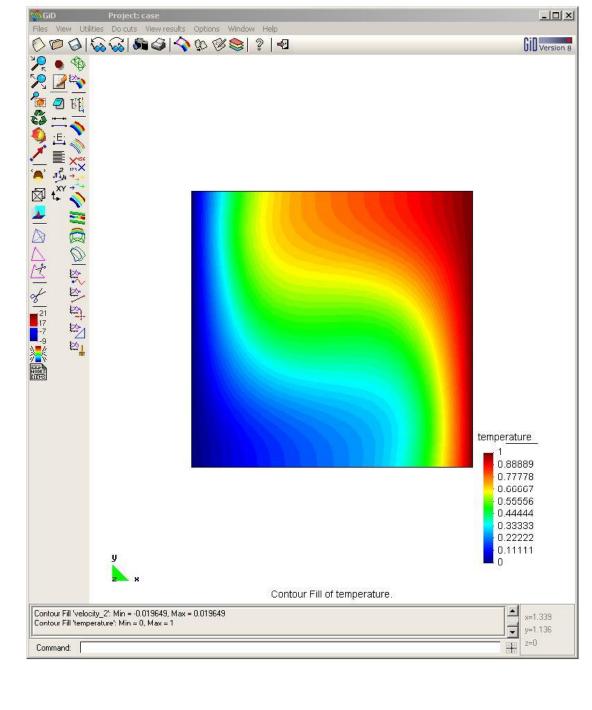
Basic functionality also just by adding suffix .vtu to the Post File in simulation section

Case: View in Paraview

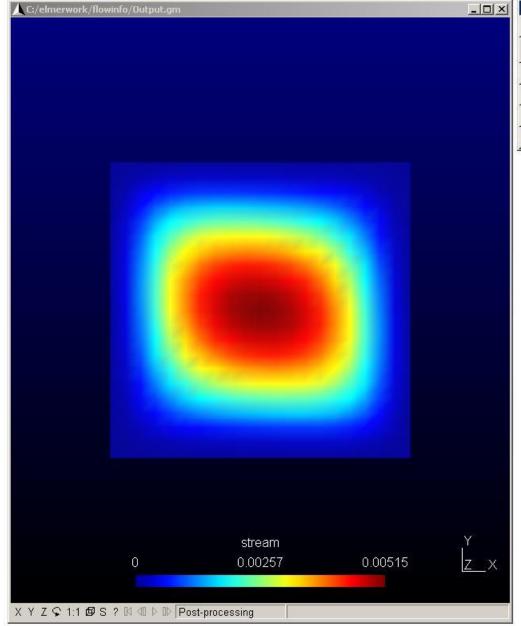




Example: view in GiD



Example: view in Gmsh







Visualization with Paraview



Exporting 2D/3D data: ResultOutputSolve

By setting suffix for **Post File** to .**vtu** paraview format is saved automatically.

An example shows how to save data in unstructured XML VTK (.vtu) files to directory "results" in single precision binary format.

```
Solver n
   Exec Solver = after timestep
   Equation = "result output"
   Procedure = "ResultOutputSolve" "ResultOutputSolver"
   Output File Name = "case"
   Output Format = String "vtu"
   Binary Output = True
   Single Precision = True
   Save Geometry Ids = True
End
```

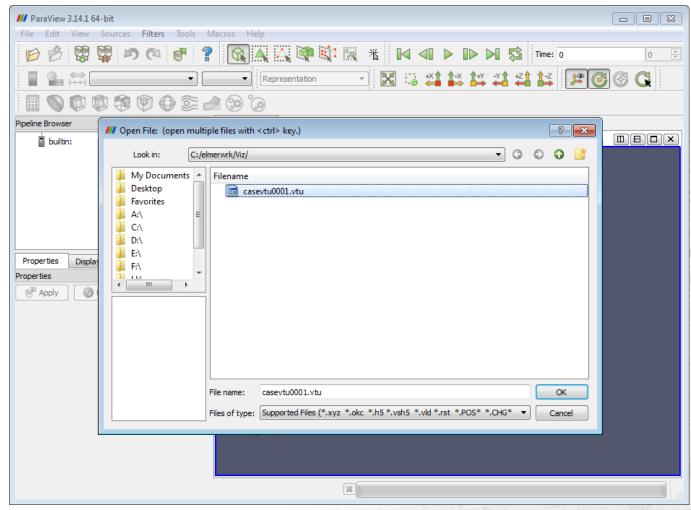
Filename conventions



- Suffix of unstructured XML based VTU file is .vtu
- Timesteps numbered #step
- Partitions numbered with #partpar#step
- Holder for vtu files in parallel is .pvtu

Loading data

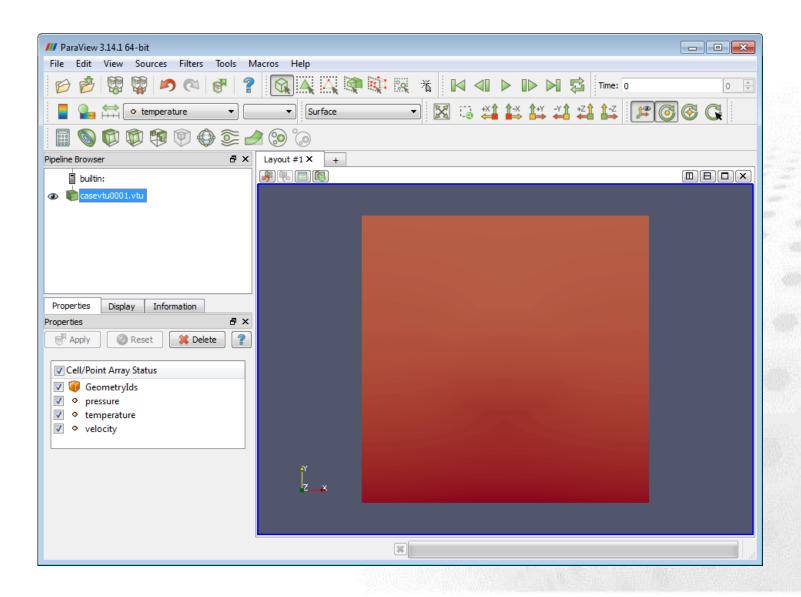




Note: Paraview may have several datasets at the same time!

Solid color





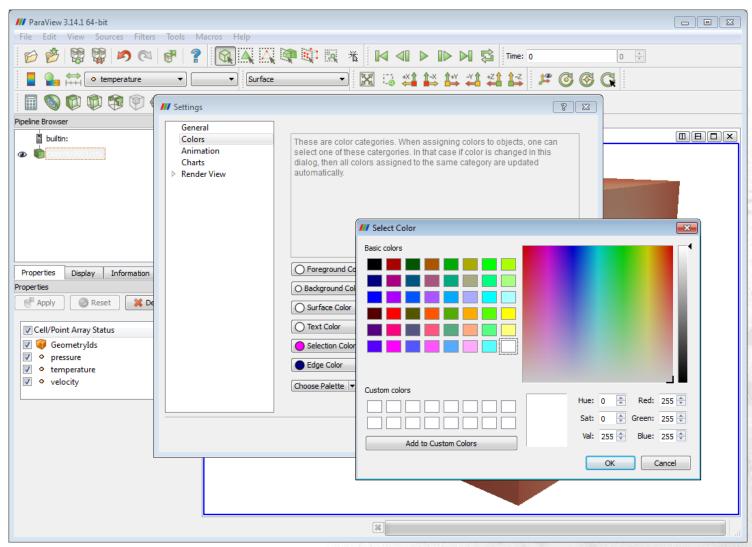
Moving object in Paraview



- Rotate
 - Mouse: Left bottom
- Scale
 - Mouse: Right bottom
- Translate
 - Mouse: Center bottom

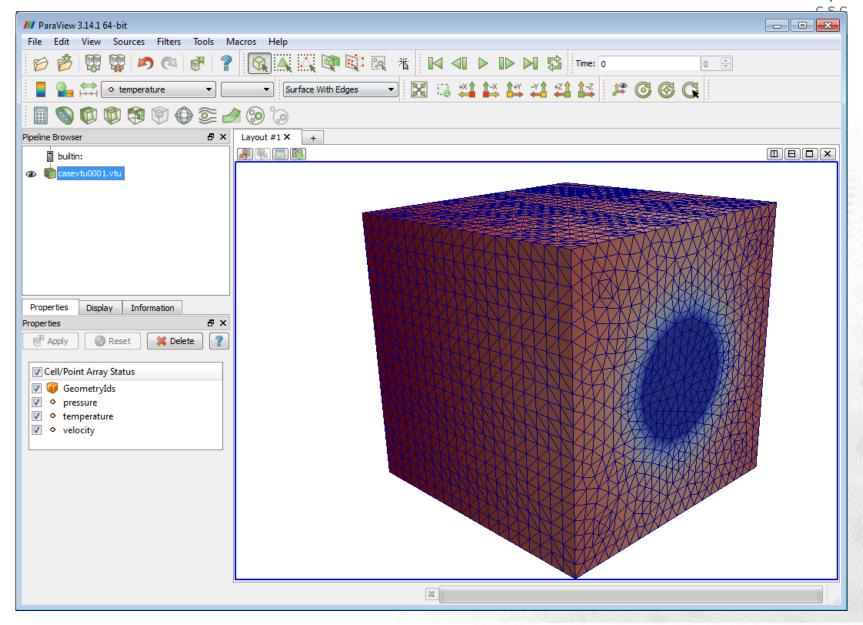
Setting background color





Color mesh with surface + edges





AMR Contour

AMR Dual Clip

Annotate Time Filter

Append Attributes

Append Datasets

Append Geometry
Block Scalars

Calculator Cell Centers

Cell Data to Point Data

Clean

Clean Cells to Grid Clean to Grid Clip

Clip Closed Surface Clip Generic Dataset Compute Derivatives

Connectivity
Contingency Statistics

Contour

Contour Generic Dataset

Curvature
D3
Decimate
Delaunay 2D
Delaunay 3D
Descriptive Statistics

Elevation
Extract AMR Blocks
Extract Block
Extract CTH Parts

Extract Cells By Region Extract Edges

Extract Generic Dataset Surface

Extract Level

Extract Selection

Extract Subset

Extract Surface

FFT Of Selection Over Time FOF/SOD Halo Finder

> Feature Edges Gaussian Resampling

Gaussian Resampling Generate Ids

Generate Quadrature Points
Generate Ouadrature Scheme Dictionary

Generate Surface Normals

Glyph

Glyph With Custom Source

Gradient

Gradient Of Unstructured DataSet

Grid Connectivity

Group Datasets

Histogram

Image Data to Point Set

Integrate Variables

Interpolate to Quadrature Points

Intersect Fragments

Iso Volume K Means Level Scalars Linear Extrusion

Loop Subdivision Mask Points

Material Interface Filter

Median Merge Blocks Mesh Quality

Multicorrelative Statistics

Normal Glyphs

Octree Depth Limit
Octree Depth Scalars

Outline

Outline Corners

Outline Curvilinear DataSet

Particle Pathlines
ParticleTracer
Plot Data

Plot Global Variables Over Time

Plot On Intersection Curves Plot On Sorted Lines

Plot Over Line

Plot Selection Over Time Point Data to Cell Data

Principal Component Analysis

Probe Location

Process Id Scalars

Programmable Filter

Python Calculator

Quadric Clustering

Random Vectors

Rectilinear Data to Point Set Rectilinear Grid Connectivity

Reflect Resample With Dataset

Ribbon Rotational Extrusion Scatter Plot Shrink

Slice Slice Generic Dataset

Smooth

Stream Tracer

Stream Tracer For Generic Datasets

Stream Tracer With Custom Source Subdivide

Surface Flow Surface Vectors

Table To Points

Table To Structured Grid

Temporal Cache

Temporal Interpolator Temporal Shift Scale

Temporal Snap-to-Time-Step

Temporal Statistics Tessellate

Tetrahedralize

Texture Map to Cylinder
Texture Map to Plane

Texture Map to Sphere

Threshold

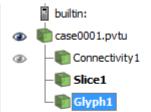
Transform
Triangle Strips
Triangulate

Tube

Warp By Scalar

Warp By Vector

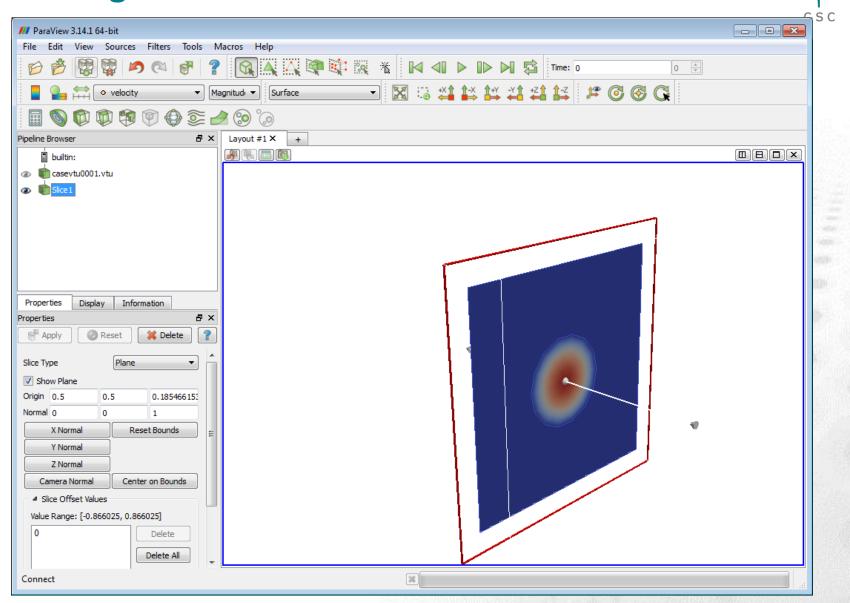
Youngs Material Interface



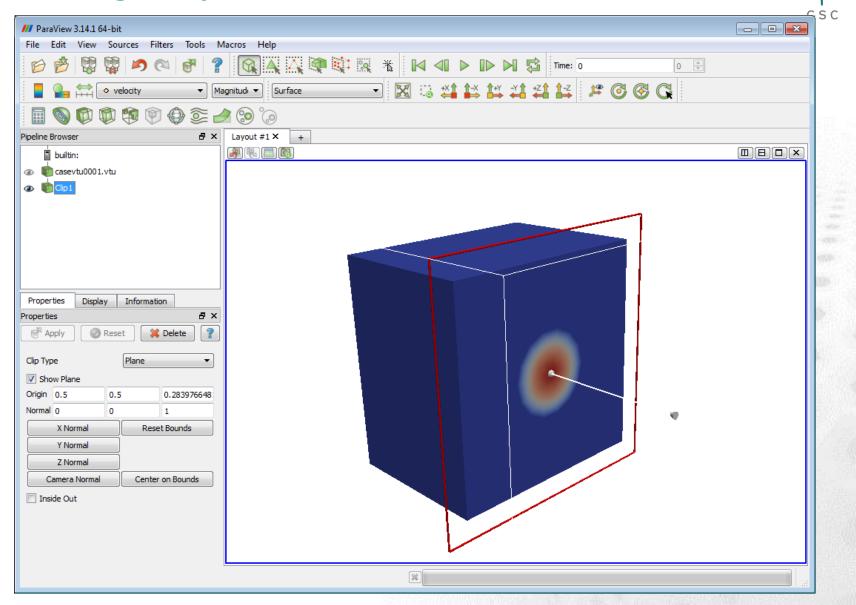


- Paraview uses
 extensively *filters* to
 create new datasets
- Filters and datasets
 may be set active or
 passive by clicking the
 eye
- Several datasets may be visualized at the same time

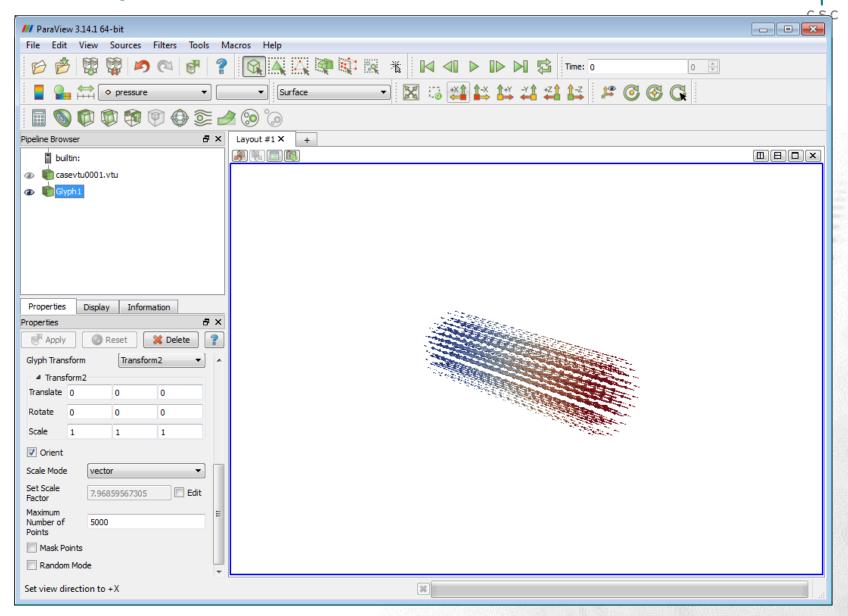
Plotting a slice



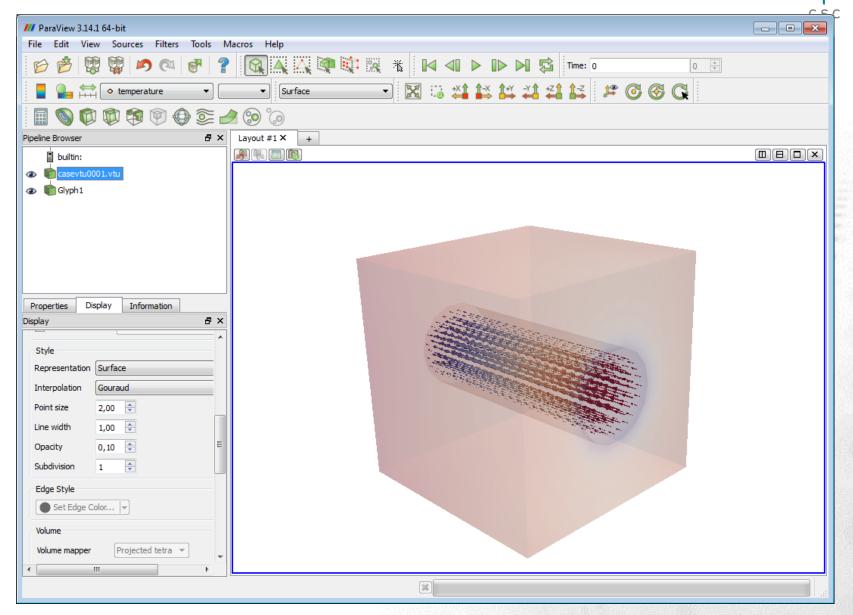
Plotting a clip



Vector plot

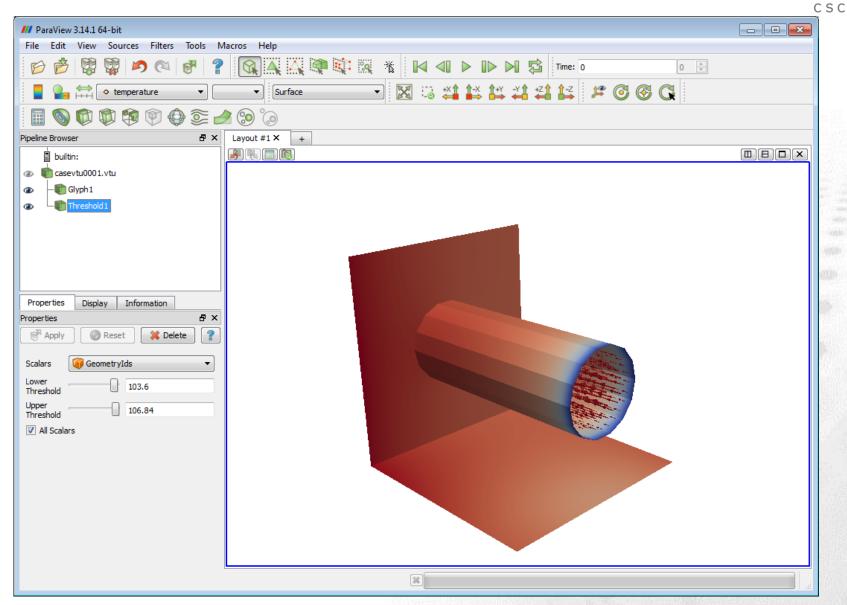


Vector plot + opaque solid surface



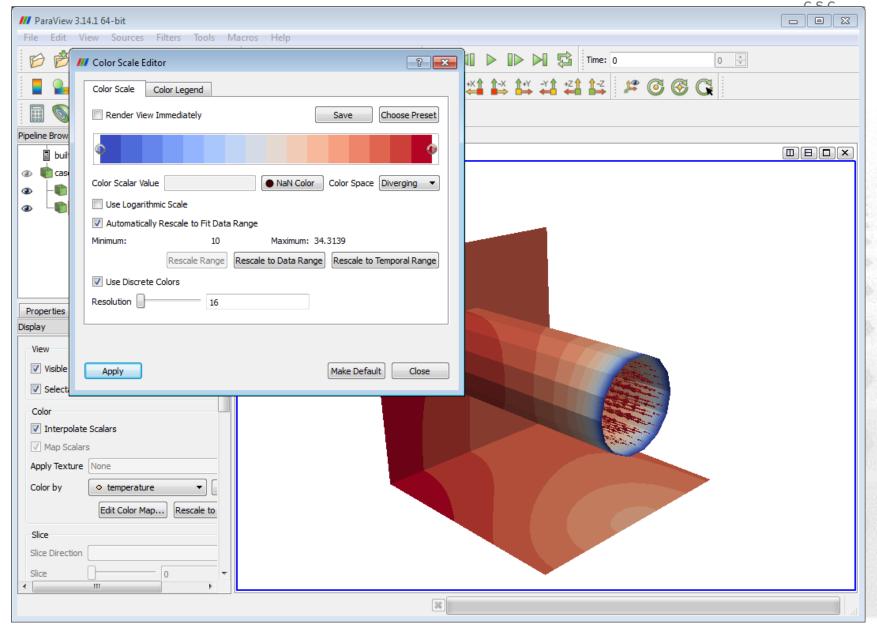
Vector plot + solid surface with Id treshold





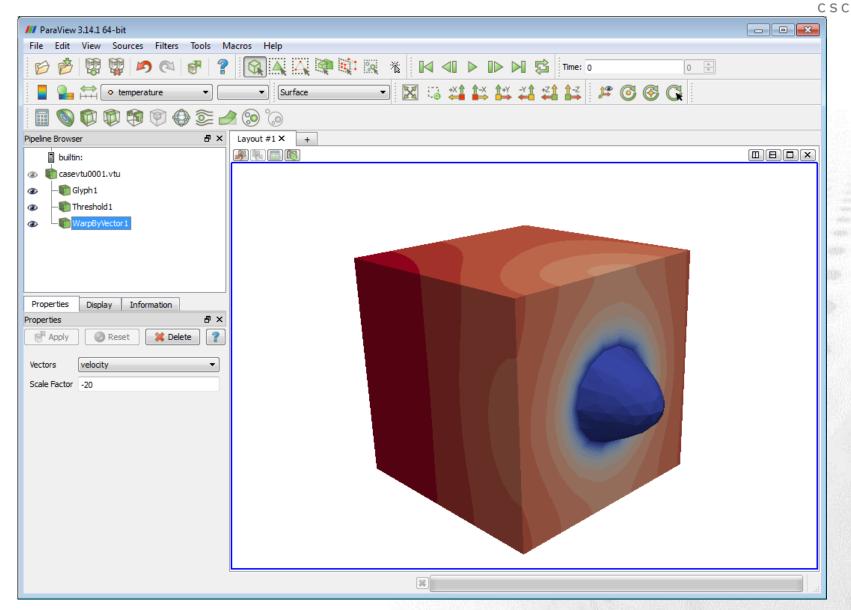
Change of colormap



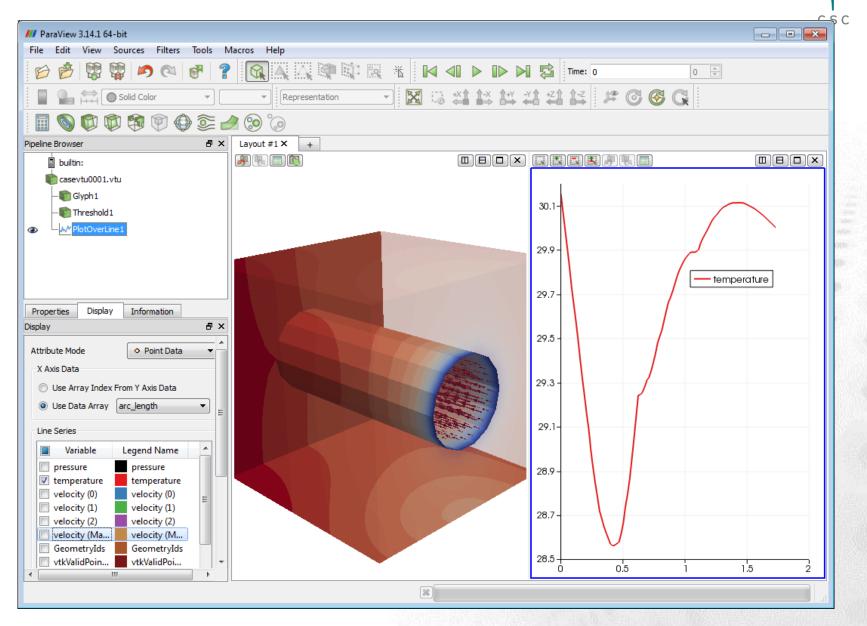


Deformation – WarpByVector filter





Plot line - PlotOverLine filter



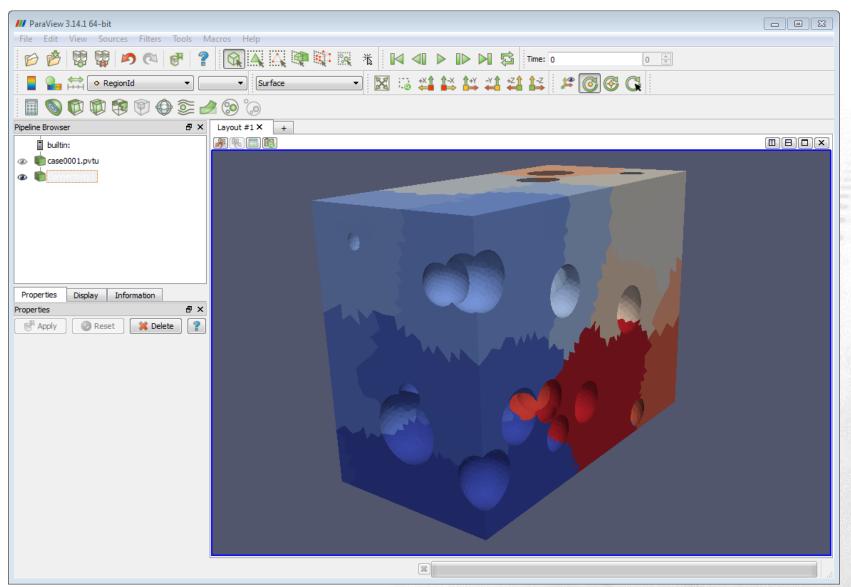
Streamlines – Filter StreamTracer



- - X /// ParaView 3.14.1 64-bit File Edit View Sources Filters Tools Macros Help temperature Surface Layout #1 X Pipeline Browser builtin: casevtu0001.vtu StreamTracer 1 Information Properties Display ₽× Properties X Delete M Apply ■ Stream Tracer Vectors Vector Interpolator Type Interpolator with Pc ≡ Integration Direction BOTH Runge-Kutta 4-5 Integrator Type Integration Step Unit Cell Length Initial Step Length 0.2 Minimum Step Length 0.01 Maximum Step Length Maximum Steps 2000 Maximum Streamline Lenoth 1

Partitioning – Connectivity filter





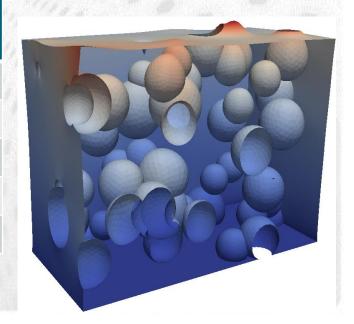
File size in Paraview output



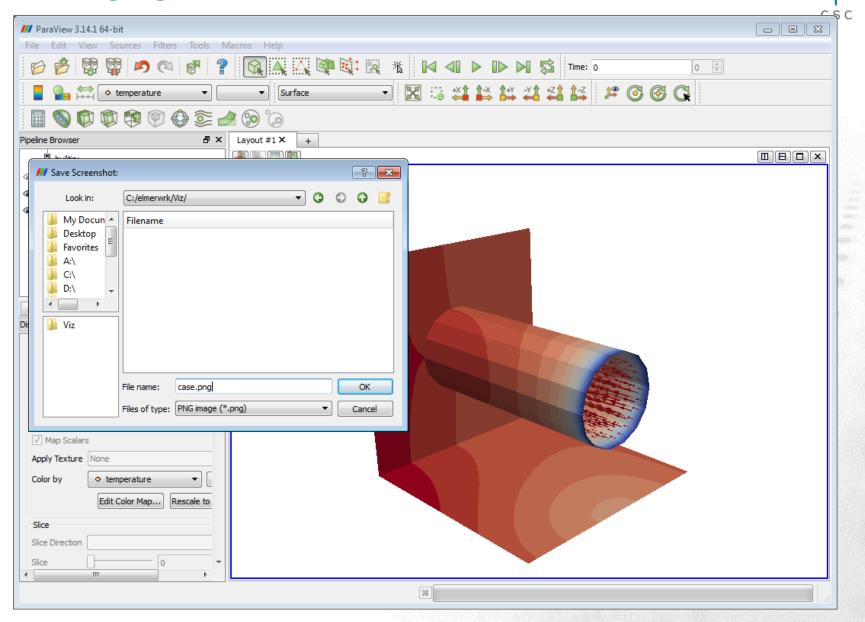
- Memory consumption of vtu-files (for Paraview) was studied in the "swiss cheese" case
- Saving just boundaries in single precision binary format may save over 90% in files size compared to full data in ASCII
- With larger problem sizes the benefits are amplified

Binary output	Single Prec.	Only bound.	Bytes/ node
-	X	-	376.0
X	-	-	236.5
X	X	-	184.5
X	-	X	67.2
X	X	X	38.5

Simulation Peter Råback, CSC, 2012.



Saving figures



Saving animations with Paraview



- The only packing method that comes with Paraview by default is motion AVI
- It is advicable to save the animation as separate files
- You may use ElmerClips to make mpg animations of the separate PNG figures
- Or you may compose an animated GIF from single JPEG or PNG frames using convert (ImageMagik)

Conclusions



- Use Paraview and VTU format
- For large visualizations ViSiT could be an option