



ParaView

All you need for parallel visualization

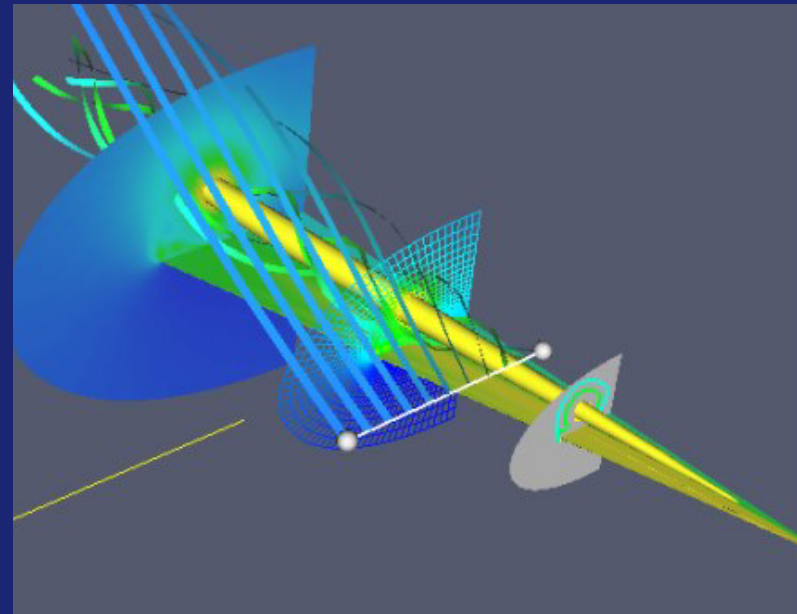
(cluster, network, display, and administration not included)

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Kitware Inc.

Outline

- What Is It?
- It Slices (importing data)
- It Dices (distributing data)
- It Cuts (and clips, and contours, ...)
- What Comes In The Package?
- But How Much Does It Cost?



ParaView – What Is It?



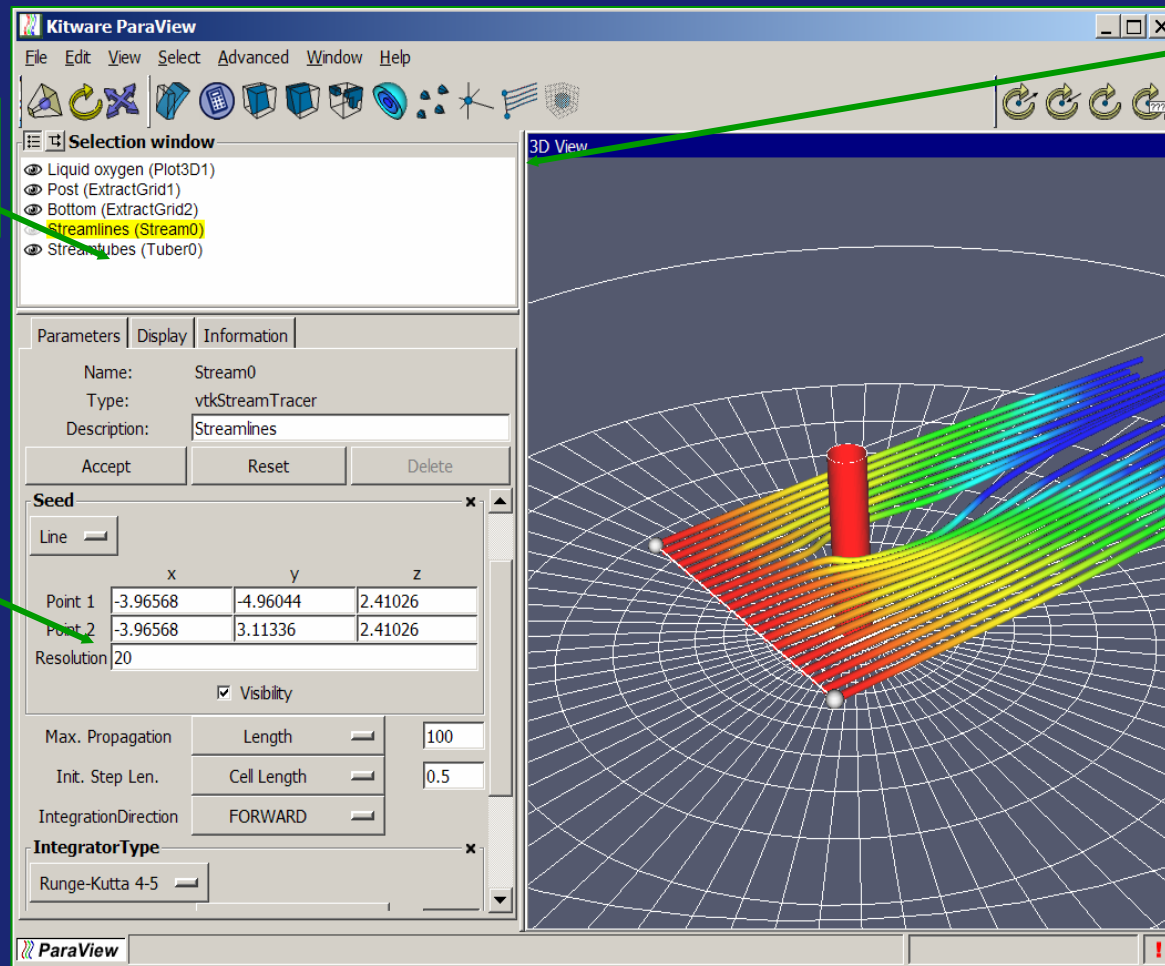
- Turn key application
- ParaView is built on top of VTK
- Distributed execution
 - Data parallelism
 - Sort last composite rendering
- Configurable
 - XML Readers and Filters
 - Rendering Modules
- Parallel visualization server

ParaView - What Is It?

Sources and
filters

Parameters for
current filter

Toolbar



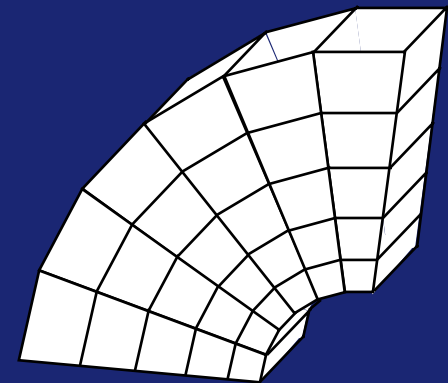
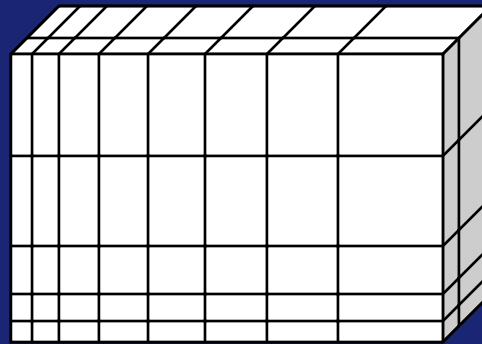
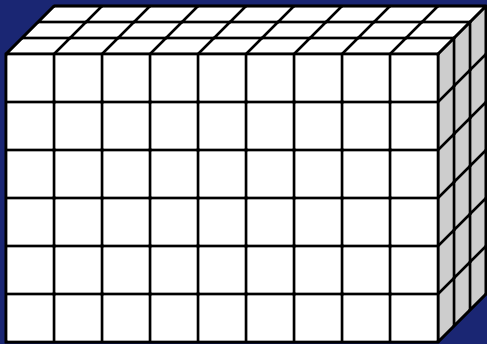
It Slices (importing data)

- VTK (all types including parallel, ASCII and Binary)
- EnSight 6 and EnSight Gold (read only)
- Plot3D (ascii and binary, C or Fortran; support for multiple blocks) (read only)
- AVS UCD files Binary and ASCII
- Various polygonal file formats including STL and BYU
- Utilities to convert HDF (4 and 5) to VTK format available
- The user can add readers and writers

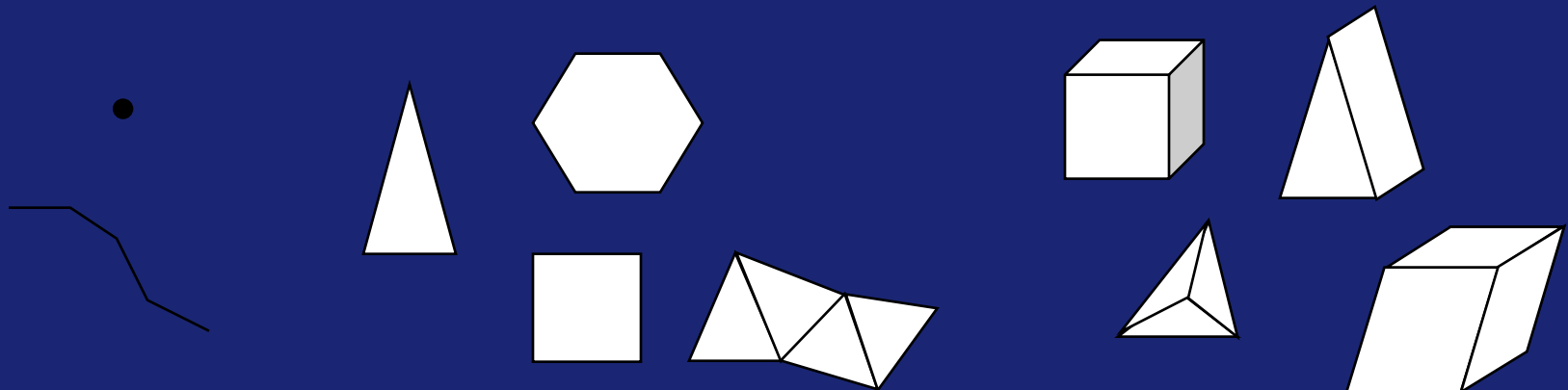
The Data Can Be In A Single File or Split Into Parallel Files

It Slices (what does it slice?)

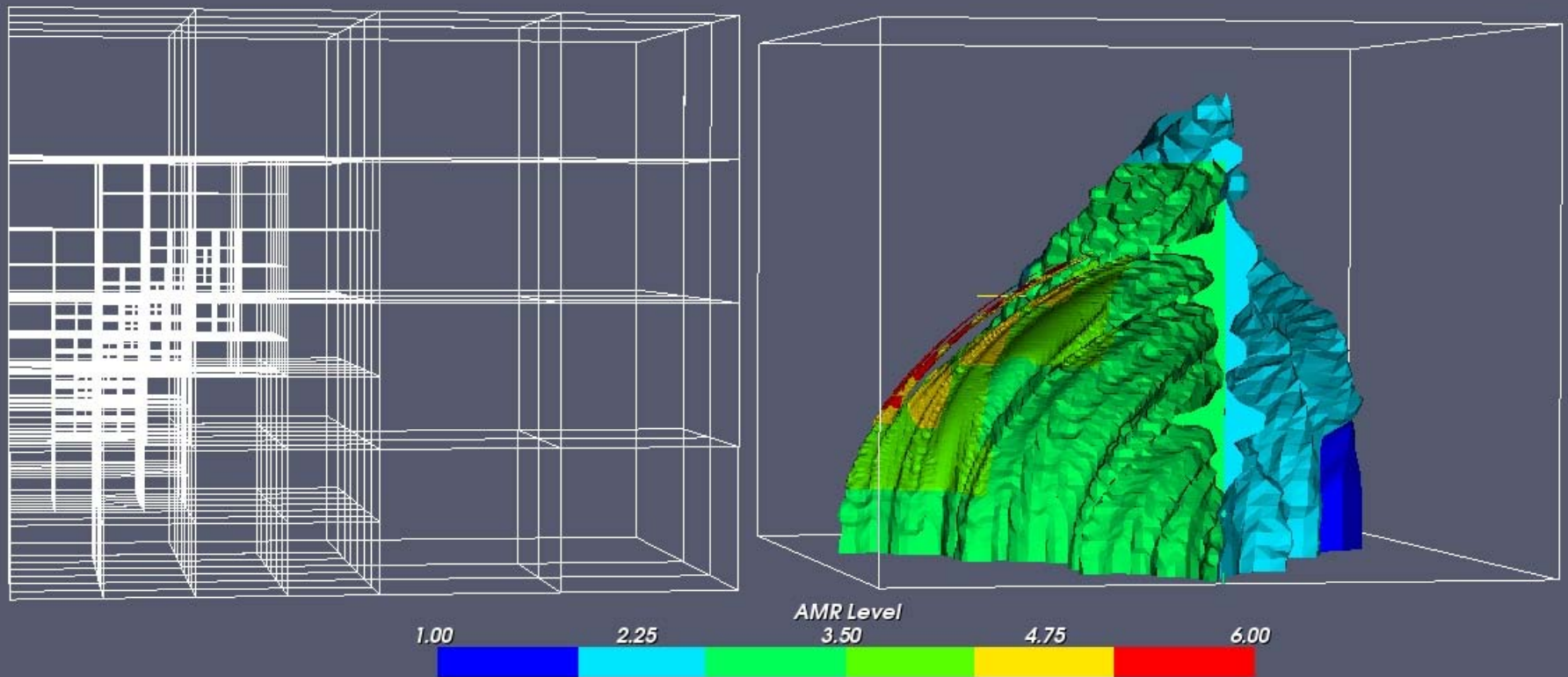
- Structured



- Unstructured (higher order cell types)



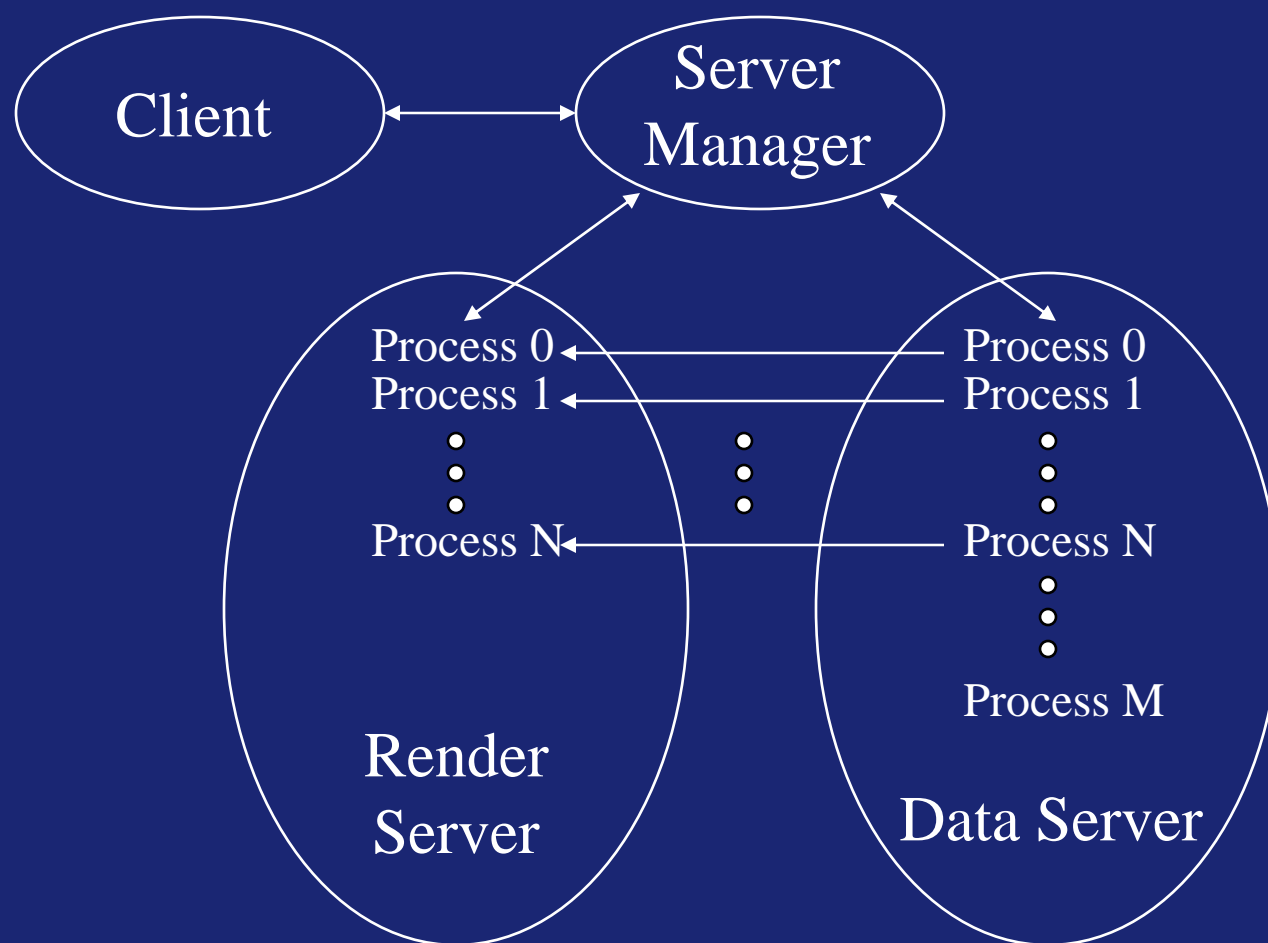
It Slices (AMR datasets soon)



It Dices (distributing data)

- Distributed, runs on clusters and large scale servers
- Distributed or local rendering
- Four major components
 - Client
 - Server manager
 - Data server
 - Render server
- Communication
 - Servers use MPI internally
 - Sockets between servers and client
- Components can be merged
 - Servers
 - Client and server manager
 - Single process execution

It Dices (across heterogeneous clusters)



It Dices (on the data-server)

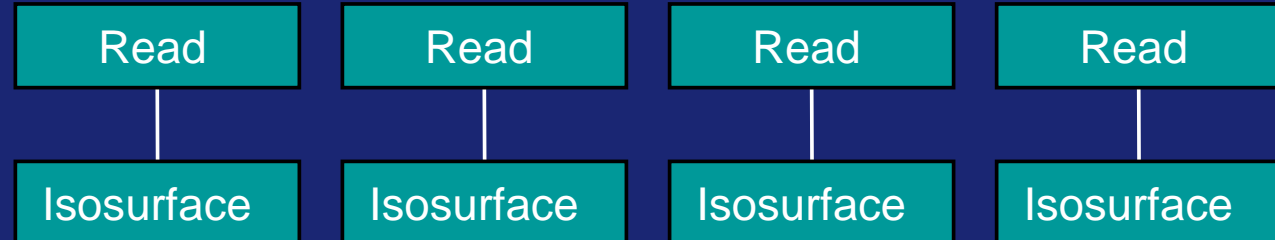
- Data parallelism
- Identical pipeline on all processes
- Readers are responsible for partitioning data
- Filters can use MPI in execute methods
- Repartitioning and load balancing filters are available
 - D3 from Sandia
 - Load balancing from LANL

It Dices (on the render-server)

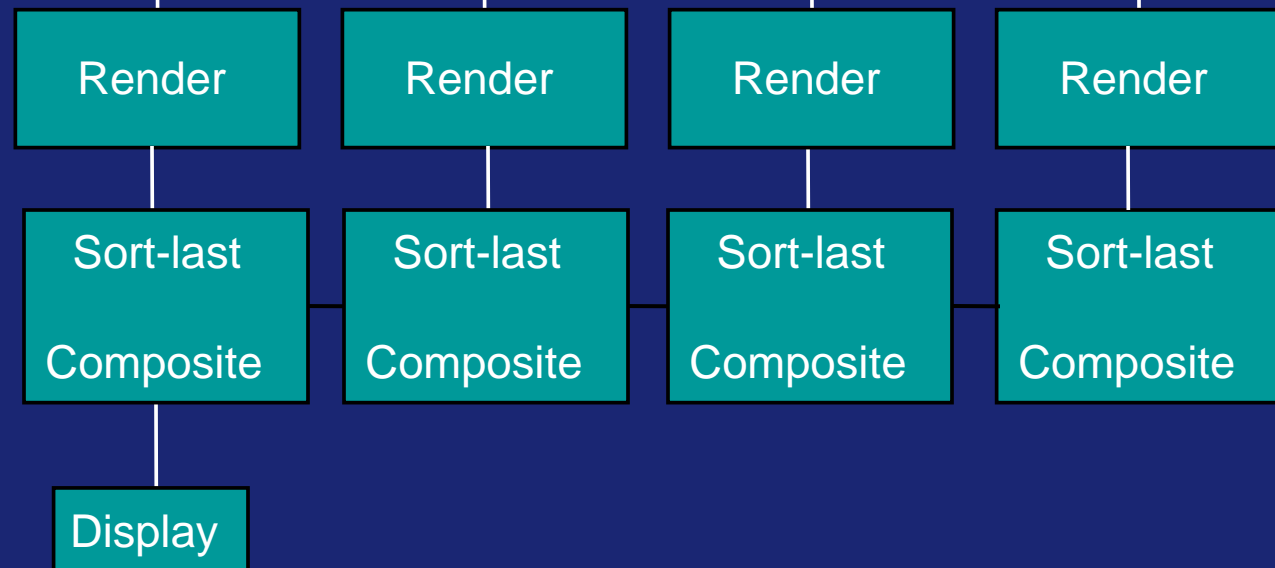
- Multiple socket connections with data server
- M->N redistribution executes on data server then data is transferred to render server
- Geometry can optionally be sent to the client for local rendering
- Socket connections can be initiated in many different configurations to handle fire-walls etc.

Example -- A data parallel visualization program

Data
Server



Render
Server



Server Manager



- Implements higher level visualization features
- Handles multi-block data sets
- Display objects that handle
 - Actors
 - Mappers
 - Properties
 - Decimation filters for geometry LOD's
- Render modules abstract the rendering algorithm

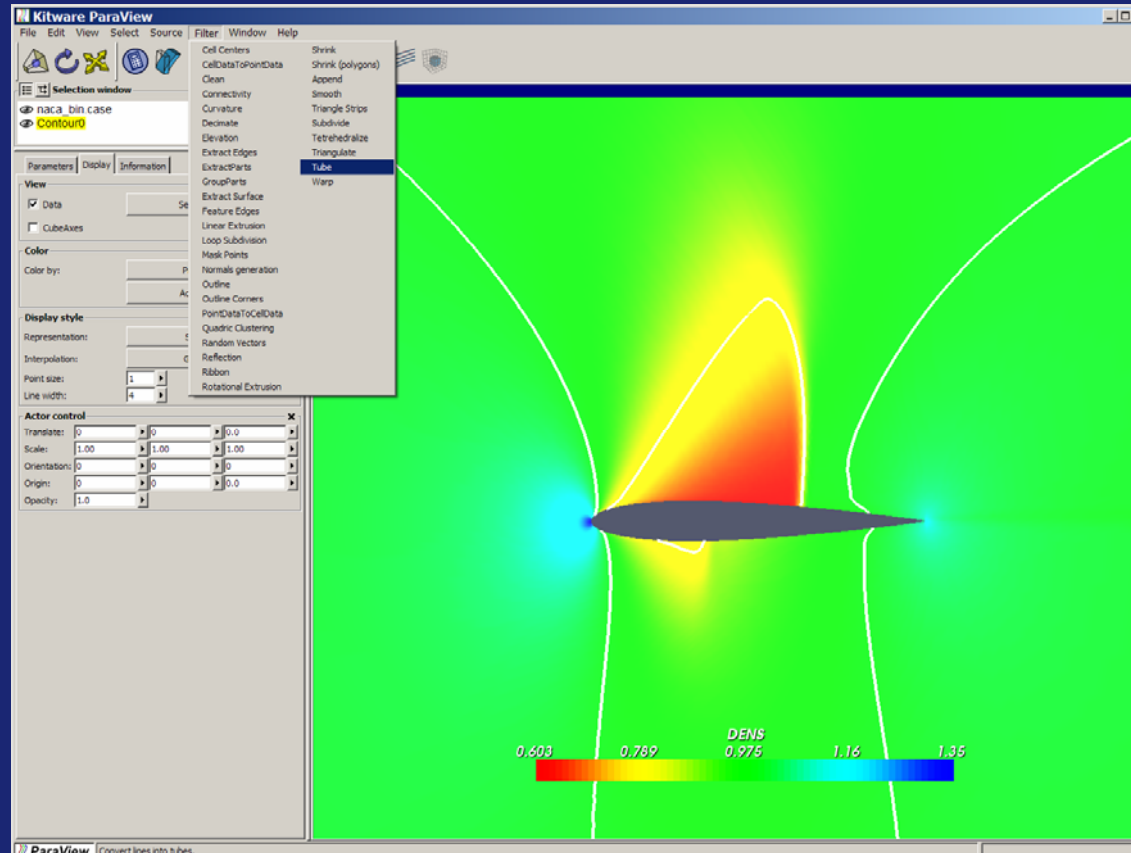
Render Module



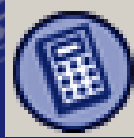
- Multiple options
 - Ice T (tiled displays)
 - Sort last tree compositing
 - Multidisplay (cave)
- Specified with a command line option
- Easy to add new modules
- Unstructured grid volume rendering (Sandia)

It Cuts (and clips and contours...)

Access to VTK Filters



Attribute Calculator



2004
VIS
austin, texas

Parameters | Display | Information

Name: **Calc0**
Class: vtkArrayCalculator
Label:
Description: Compute new attribute arrays as function of existing arrays.

Accept Reset Delete

Input

ResultArrayName

Attribute Mode:

Calculator ✕

Clear	()	iHat	jhat	khat	
sin	cos	tan	7	8	9	/
asin	acos	atan	4	5	6	*
sinh	cosh	tanh	1	2	3	-
x^y	sqrt	e^x	log	0	.	+
ceil	floor	abs	scalars <input type="text"/>			
v1.v2	mag	norm	vectors <input type="text"/>			

Scalar menu

RTData
BrownianVectors_0
BrownianVectors_1
BrownianVectors_2

Glyph



20
VIS04
austin, texas

Parameters | Display | Information

Name: **Glyph0**
Class: vtkPVGlyphFilter
Label:

Description: This filter generates an arrow, sphere, or cone at each point of the input data set. The glyphs can be oriented and scale by the input point attributes.

Input:

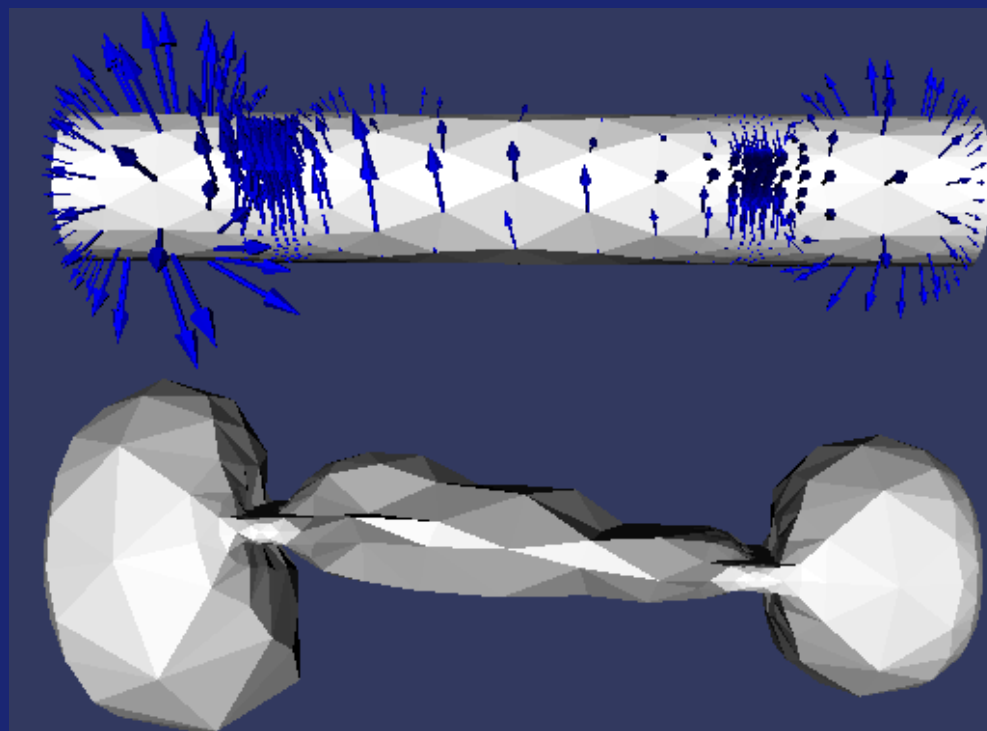
Glyph:

Orient

Vectors:

Scale mode

Scale Factor:



Warp



2004
VIS
austin, texas

Parameters

Display

Information

Name: **WarpV0**

Class: vtkPVWarpVector

Label: WarpV0

Description: This filter displaces point coordinates along a vector attribute. It is useful for showing mechanical deformation.

Accept

Reset

Delete

Input

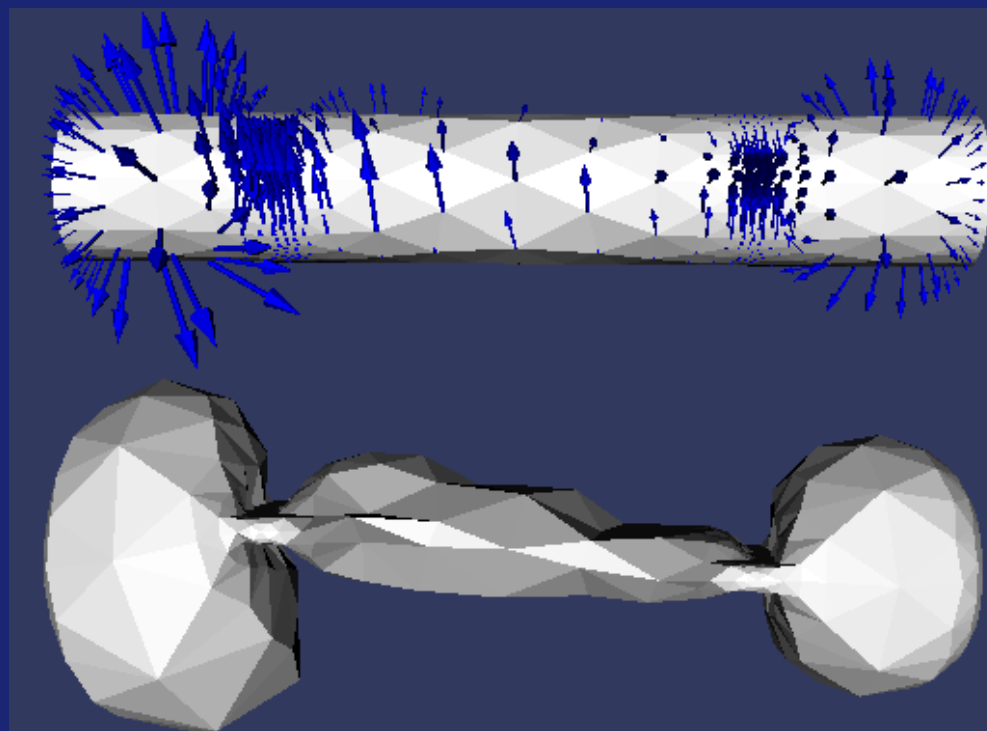
LegavTK0

Vectors

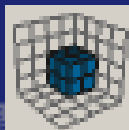
displacement10

Scale factor

1



Extract Grid



20
VIS04
austin, texas

Parameters | Display | Information

Name: **ExtractVOI4**
Class: vtkExtractVOI
Label: ExtractVOI4
Description: Extract a subgrid from a volume/image with the option of setting subsample strides.

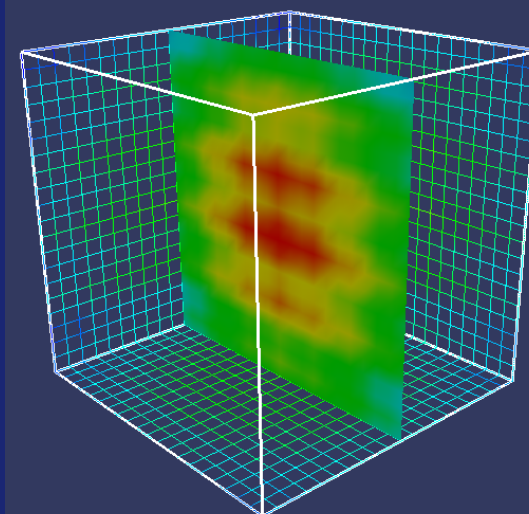
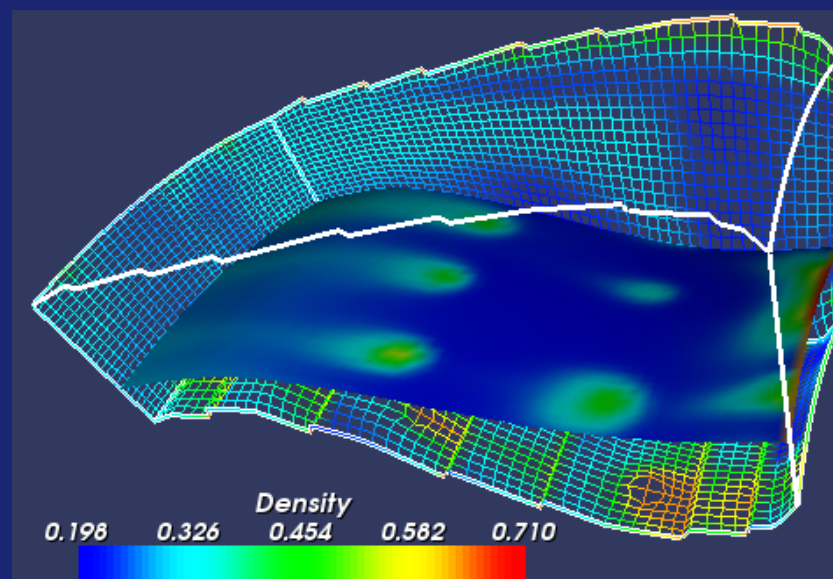
Accept Reset Delete

Input: RTSource0

VOI

Min:	<input type="text" value="0"/>	Max:	<input type="text" value="0"/>
I:	<input type="text" value=""/>		<input type="text" value=""/>
Min:	<input type="text" value="-10"/>	Max:	<input type="text" value="10"/>
J:	<input type="text" value=""/>		<input type="text" value=""/>
Min:	<input type="text" value="-10"/>	Max:	<input type="text" value="10"/>
K:	<input type="text" value=""/>		<input type="text" value=""/>

Sample rate:



Cut



20
VIS04
austin, texas

Parameters | Display | Information

Name: Cut0
Class: vtkKitwareCutter
Label: Cut0
Description: This filter cuts a data set with a plane or sphere. Cutting is similar to a contour. It creates surfaces from volumes and lines from surfaces.

Accept | Reset | Delete

Input | RTSource0

Input bounds ✕
X range: -10.000 to 10.000 (delta: 20.000)
Y range: -10.000 to 10.000 (delta: 20.000)
Z range: -10.000 to 10.000 (delta: 20.000)

Cut function ✕
Plane

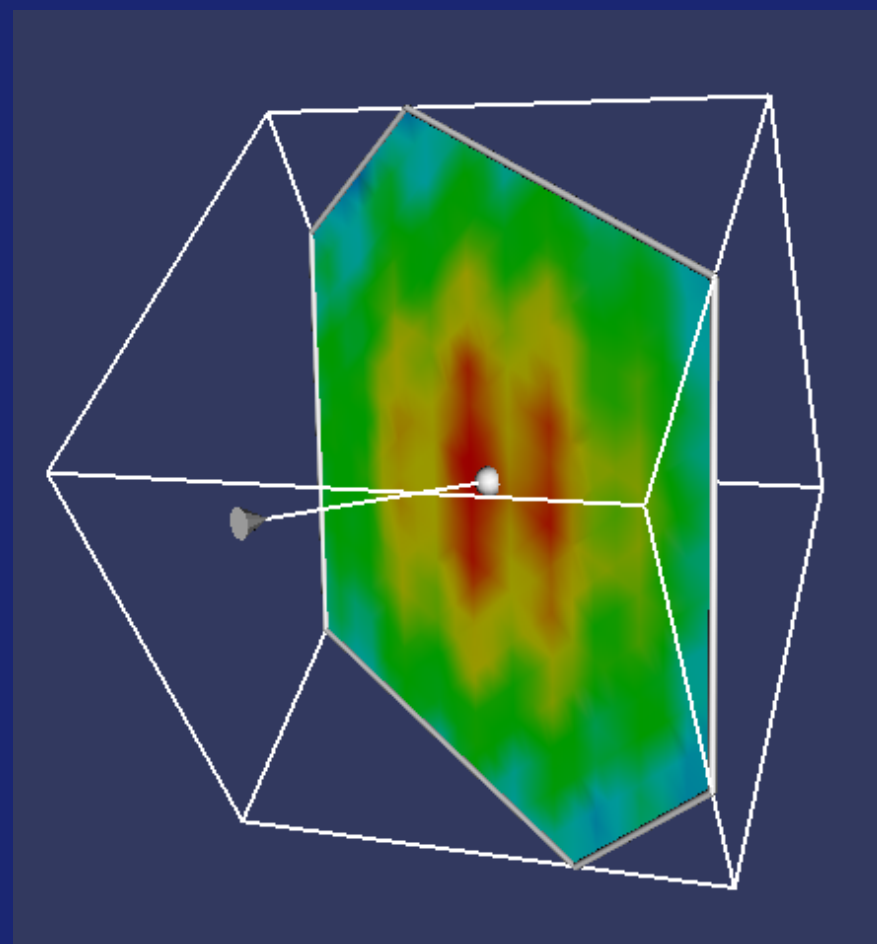
	x	y	z
Center	0.000	0.000	0.000
Normal	-0.700	0.500	-0.500

Set Plane Center to Center of Bounds

Use Camera Normal | X Normal | Y Normal | Z Normal

☒ Visibility

Cut Offset Values
0
New Value: | Add | Delete



Threshold



20
VIS04
austin, texas

Parameters | Display | Information

Name: **Threshold0**
Class: vtkPVThresholdFilter
Label: Threshold0

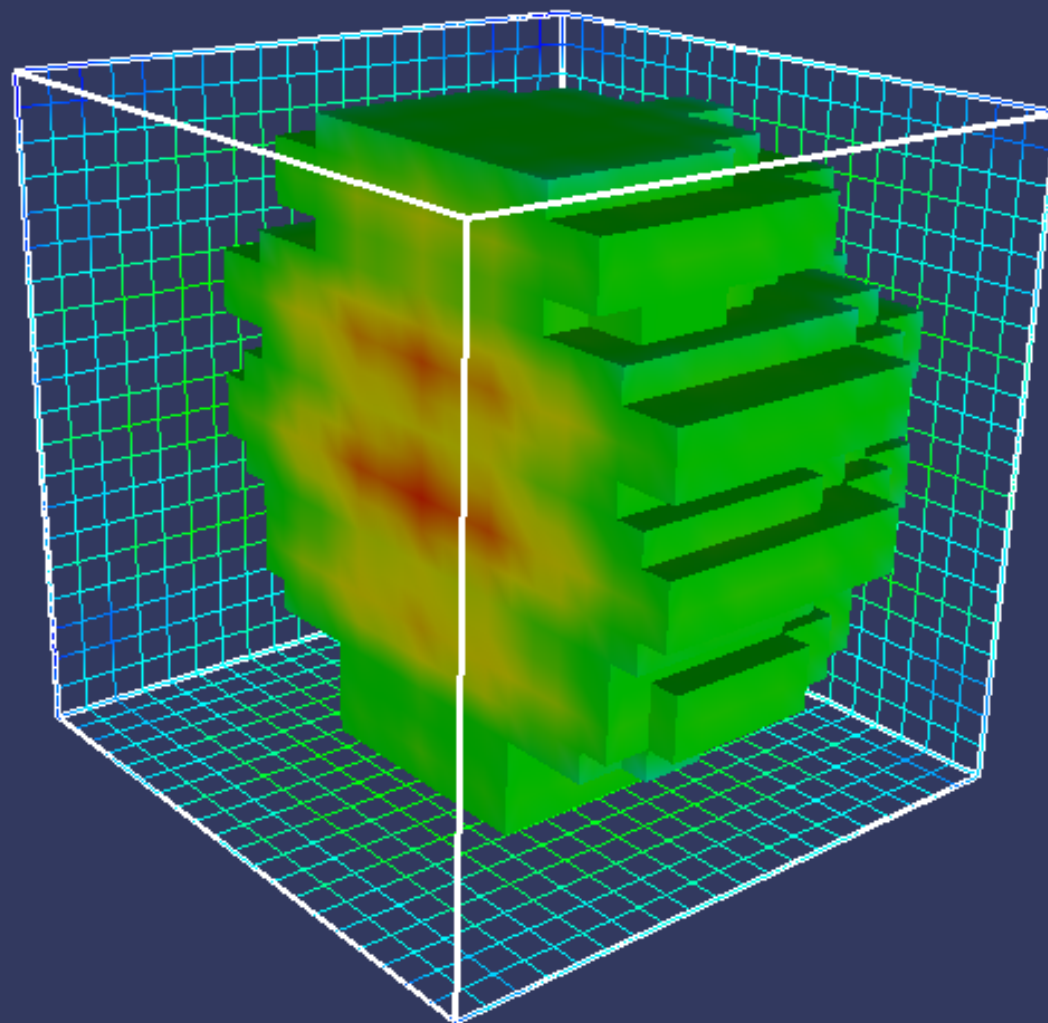
Description: This filter extracts cells that have point scalars in the specified range.

Accept Reset Delete

Input: RTSource0
Attribute Mode: Point Data
Scalars: RTData

Lower Threshold: 175
Upper Threshold: 277

All Scalars: ☐

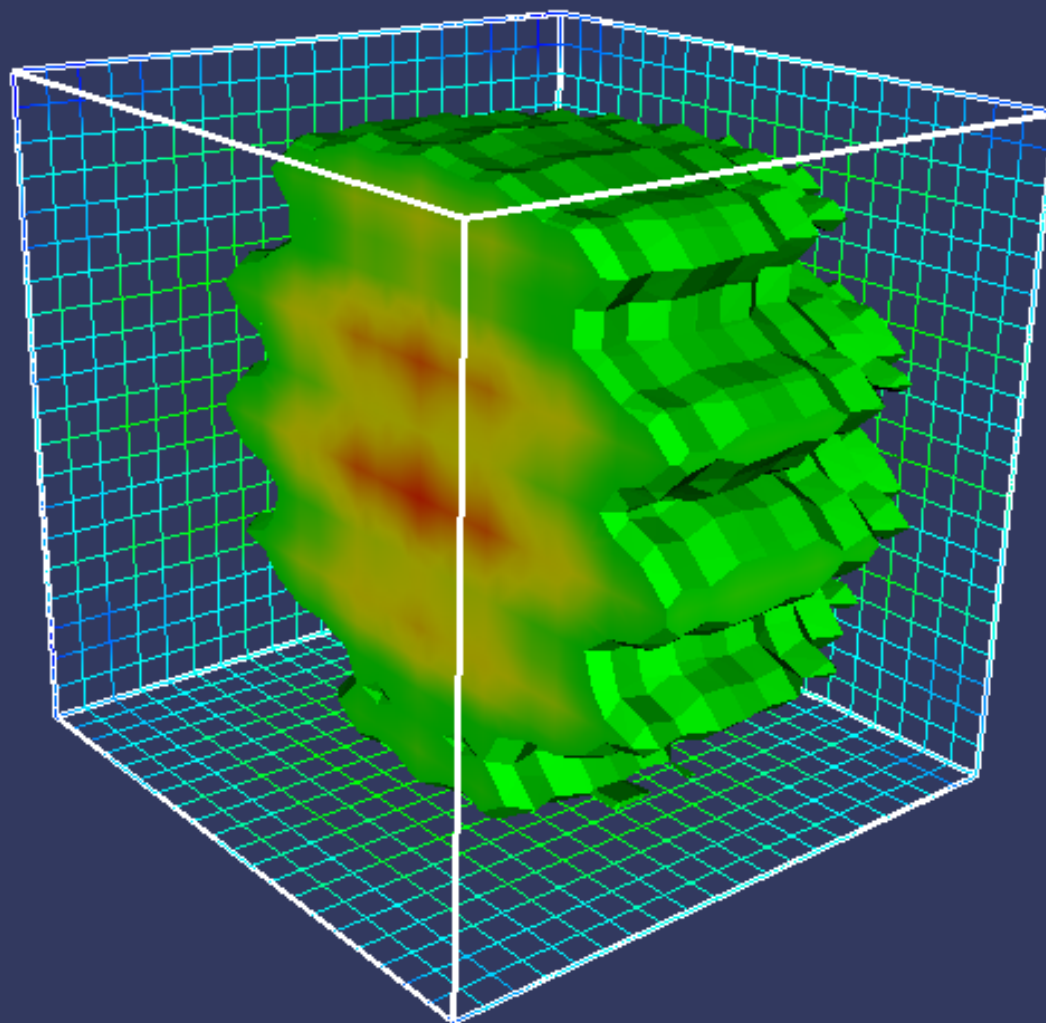


Clip (scalars)



2004
VIS
austin, texas

Parameters	Display	Information
Name: Clip1		
Class: vtkPVClipDataSet		
Label: Clip1		
Description: Clip with an implicit plane, sphere or with scalars. Clipping does not reduce the dimensionality of the data set. This output data type of this filter is always an unstructured grid.		
<div>Accept</div> <div>Reset</div> <div>Delete</div>		
Input <div>Threshold0</div>		
Input bounds ✕		
X range: -10.000 to 10.000 (delta: 20.000)		
Y range: -10.000 to 9.000 (delta: 19.000)		
Z range: -10.000 to 10.000 (delta: 20.000)		
Clip function ✕		
<div>Scalars</div>		
Scalar Range: 104.978706 to 276.828827		
Scalars	<div>RTData</div>	
Clip value	<div>160</div>	
Inside Out	<input type="checkbox"/>	



Contour



20
VIS04
austin, texas

Parameters

Display

Information

Name: **Contour1**

Class: vtkPVKitwareContourFilter

Label: Contour1

Description: Generate isolines or isosurfaces using point scalars.

Accept

Reset

Delete

Input

RTSource0

Scalars

RTData

Scalar Range: 37.353104 to 276.828827

Contour Values

160

200

240

New Value:

Add

Delete

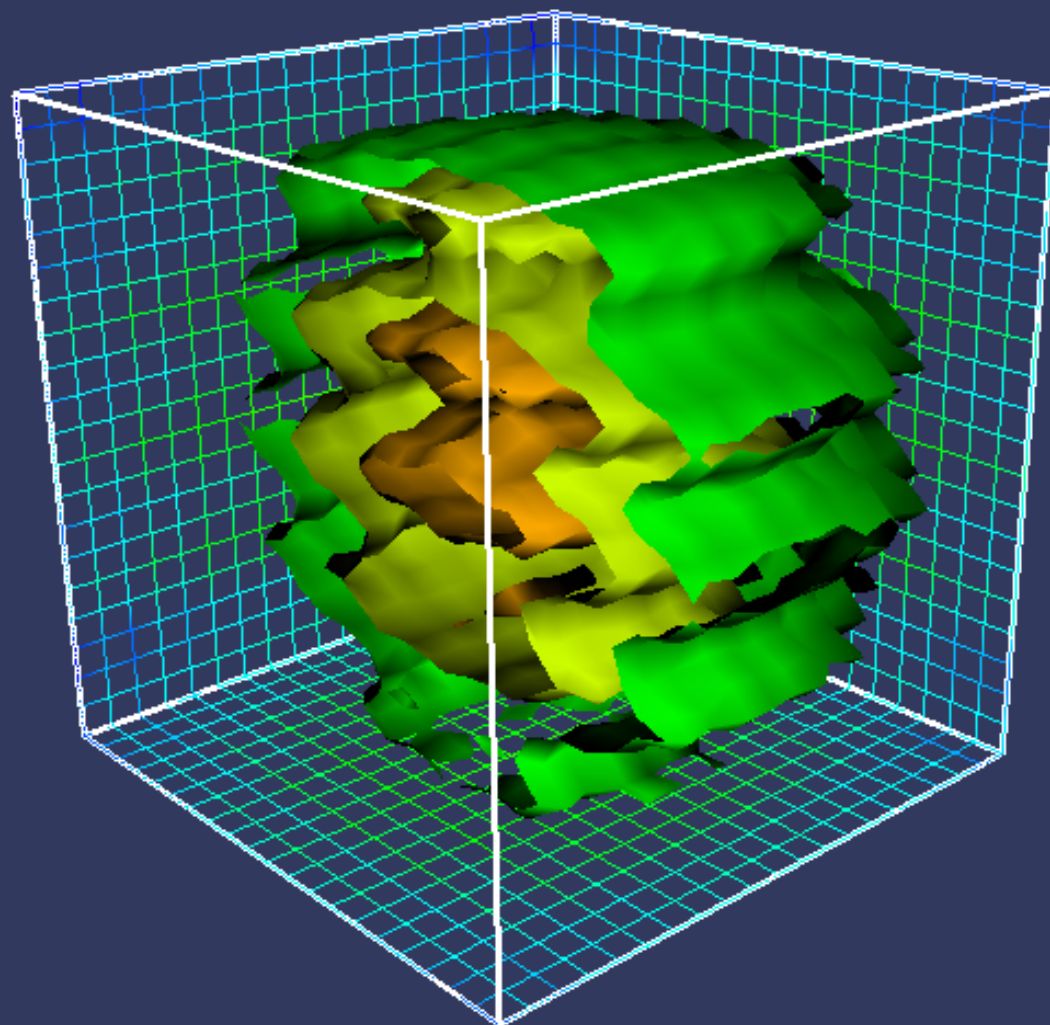
Compute Normals



Compute Gradients



Compute Scalars



Clip (plane)



20
VIS04
austin, texas

Parameters | Display | Information

Name: **Clip1**
Class: vtkPVClipDataSet
Label: Clip1

Description: Clip with an implicit plane, sphere or with scalars. Clipping does not reduce the dimensionality of the data set. This output data type of this filter is always an unstructured grid.

Accept Reset Delete

Input: RTSource0

Input bounds ✕
X range: -10.000 to 10.000 (delta: 20.000)
Y range: -10.000 to 10.000 (delta: 20.000)
Z range: -10.000 to 10.000 (delta: 20.000)

Clip function ✕
Plane

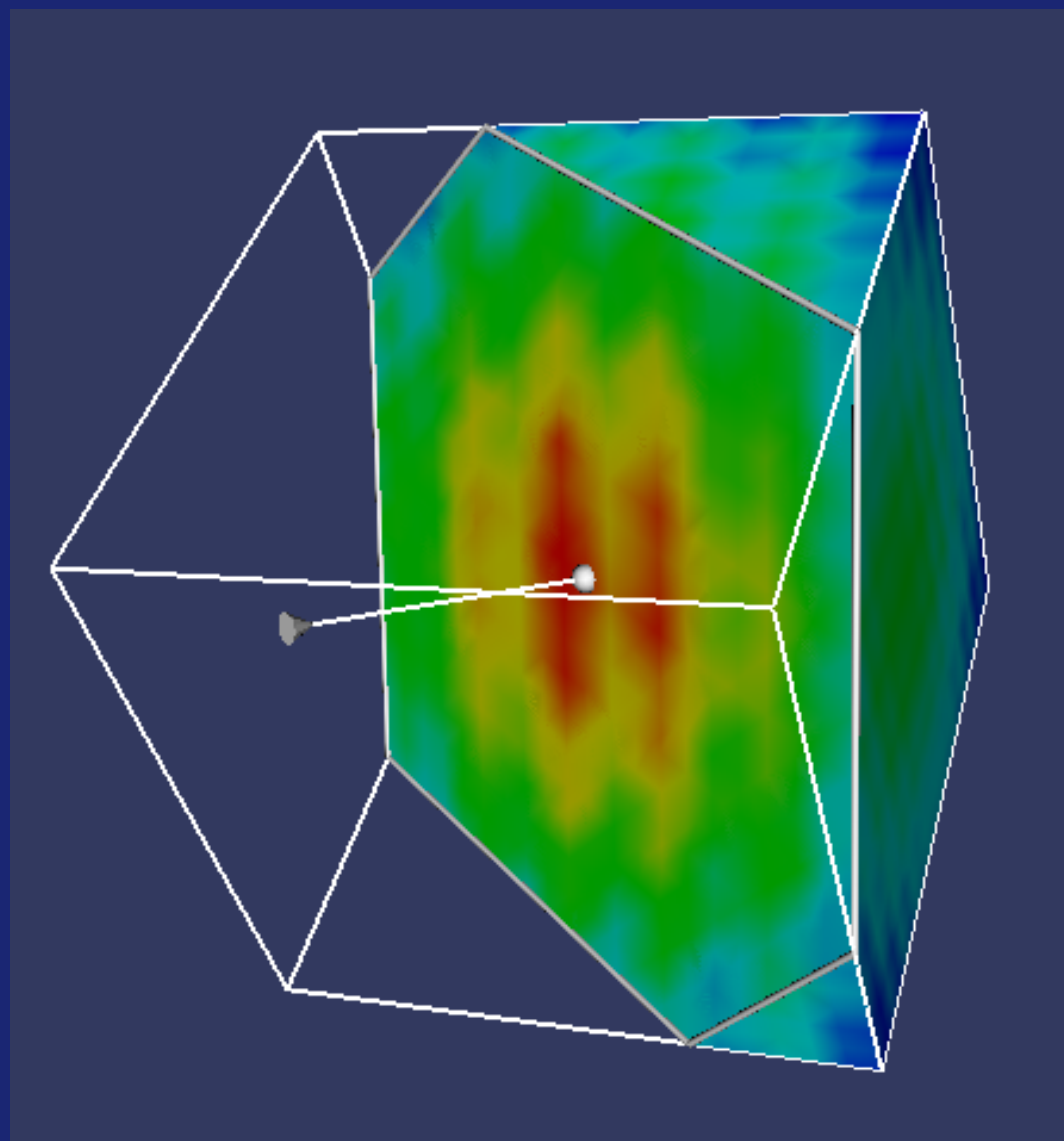
	x	y	z
Center	0.000	0.000	0.000
Normal	-0.700	0.500	-0.500

Set Plane Center to Center of Bounds

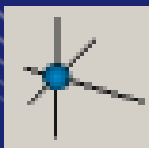
Use Camera Normal X Normal Y Normal Z Normal

☒ Visibility

Inside Out ☐



Probe



2004
VIS04
austin, texas

Parameters | Display | Information

Name: **Probe0**
Class: vtkPPProbeFilter
Label: Probe0

Description: Sample data attributes at a point or along a line. Probed lines will be displayed in a graph of the attributes.

Accept Reset Delete

Probe object ✕

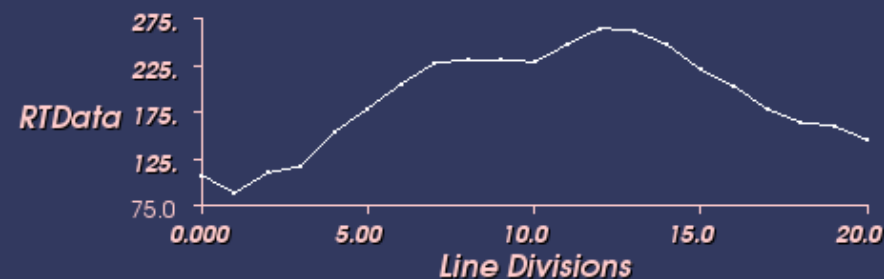
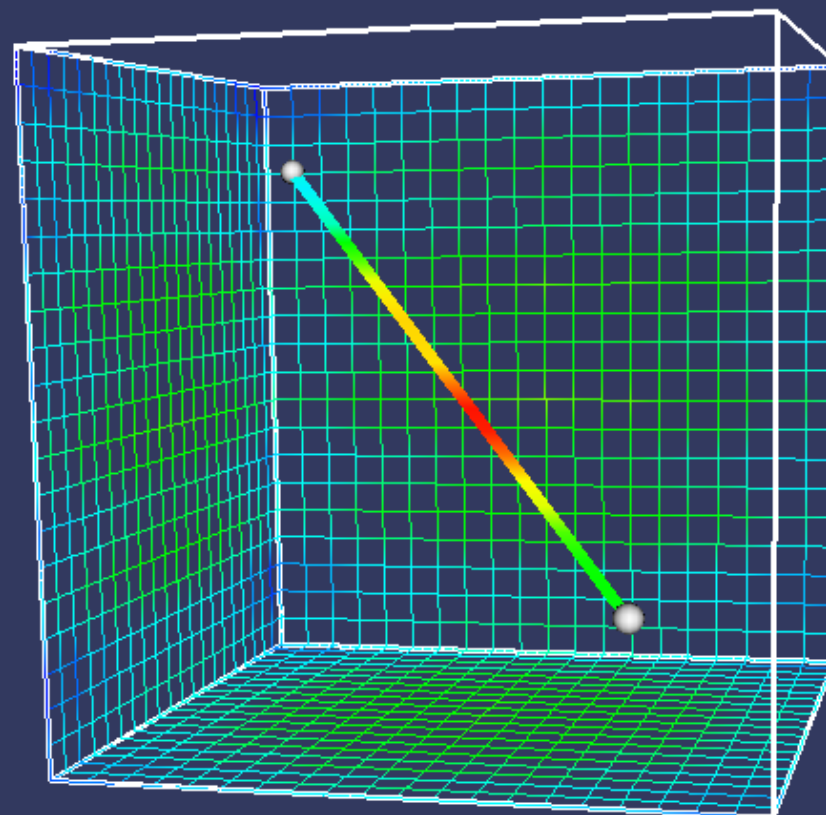
Line

	x	y	z
Point 1	9.98275	7.05446	-9.04862
Point 2	-8.27055	-5.26606	6.00344

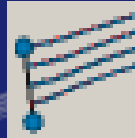
Resolution 20

☒ Visibility

☒ Show XY-Plot



Stream Lines



20
VIS04
austin, texas

Parameters | Display | Information

View [X]

☒ Data Set View to Data

☒ Scalar bar

☐ CubeAxes

Color [X]

Color by: Point IntegrationTime

 Actor Color

☒ Map Scalars Edit Color Map...

Display style [X]

Representation: Surface

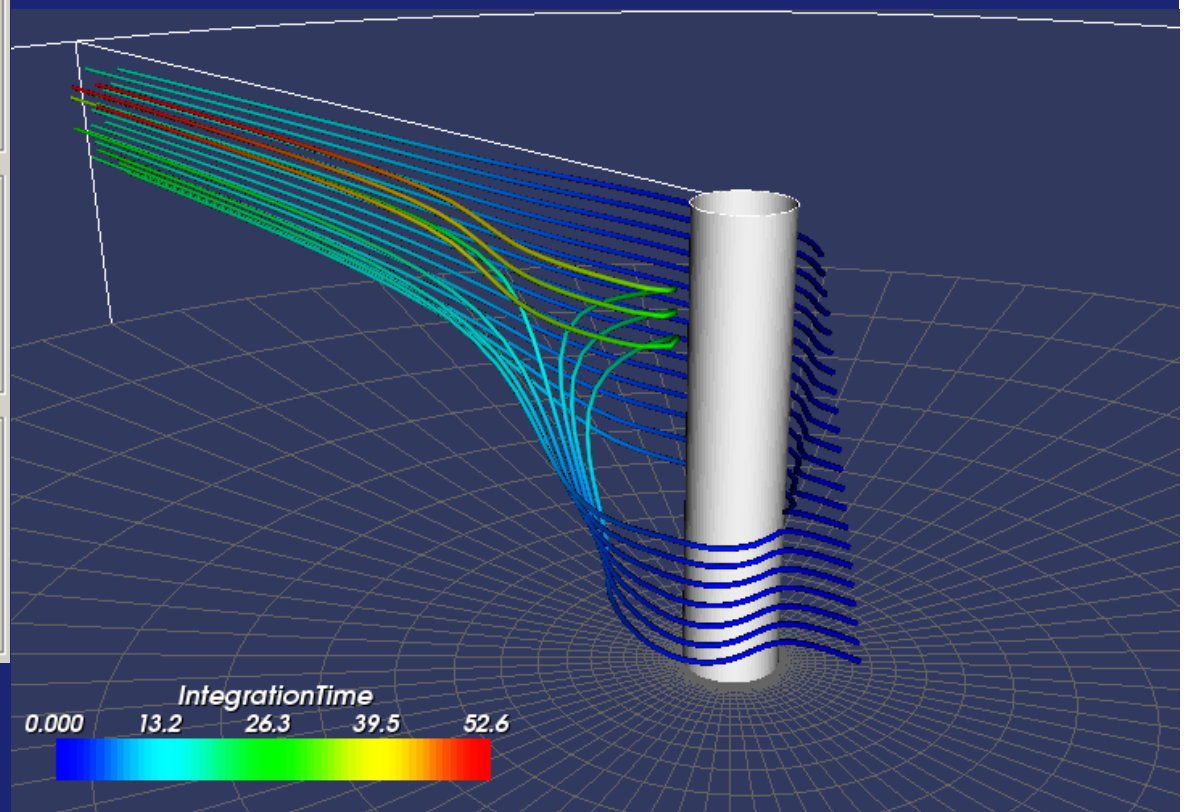
Interpolation: Gouraud

Point size: 1

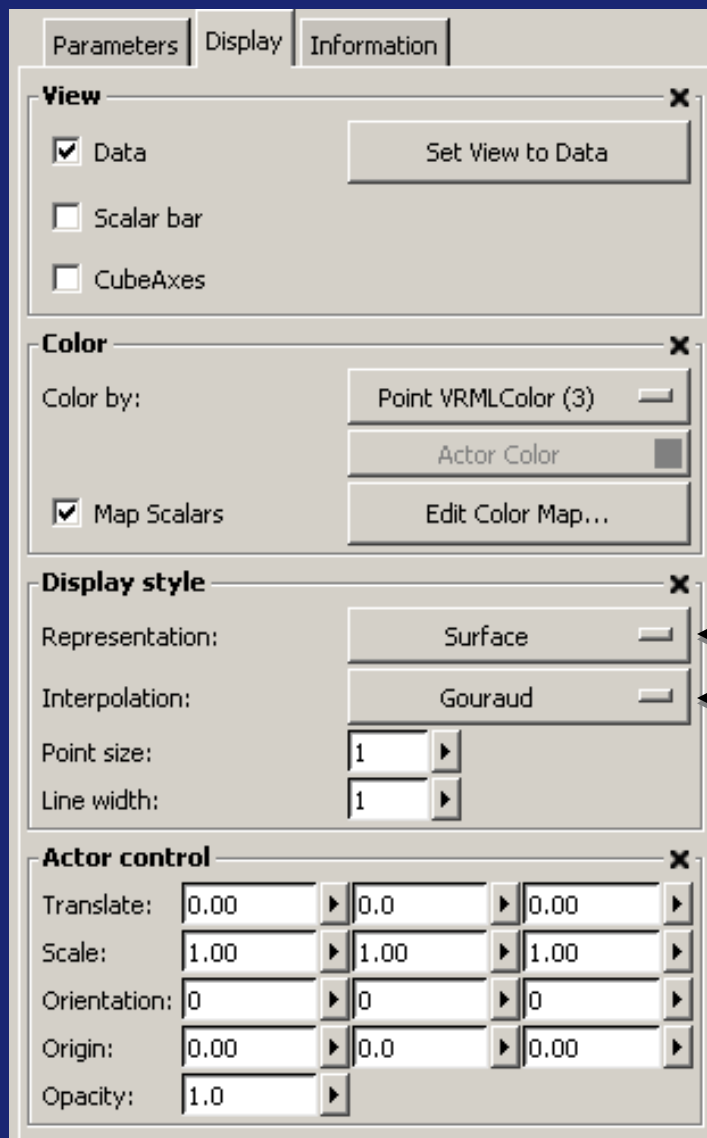
Line width: 1

Actor control [X]

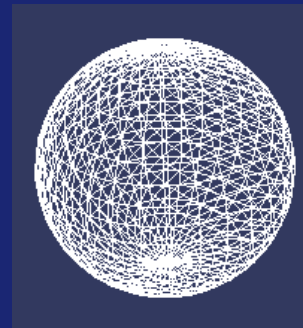
Translate:	0.0	0.00	0.0
Scale:	1.00	1.00	1.00
Orientation:	0	0	0
Origin:	0.0	0.00	0.0
Opacity:	1.0		



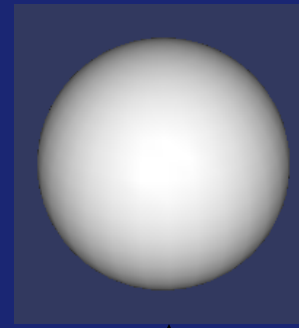
Display Style



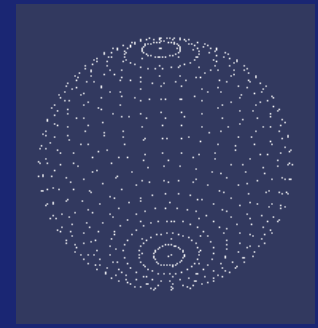
Wireframe



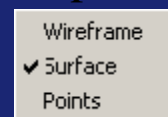
Surface



Points



Representation

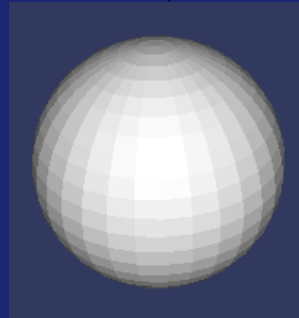


Shading



Gouraud

Flat

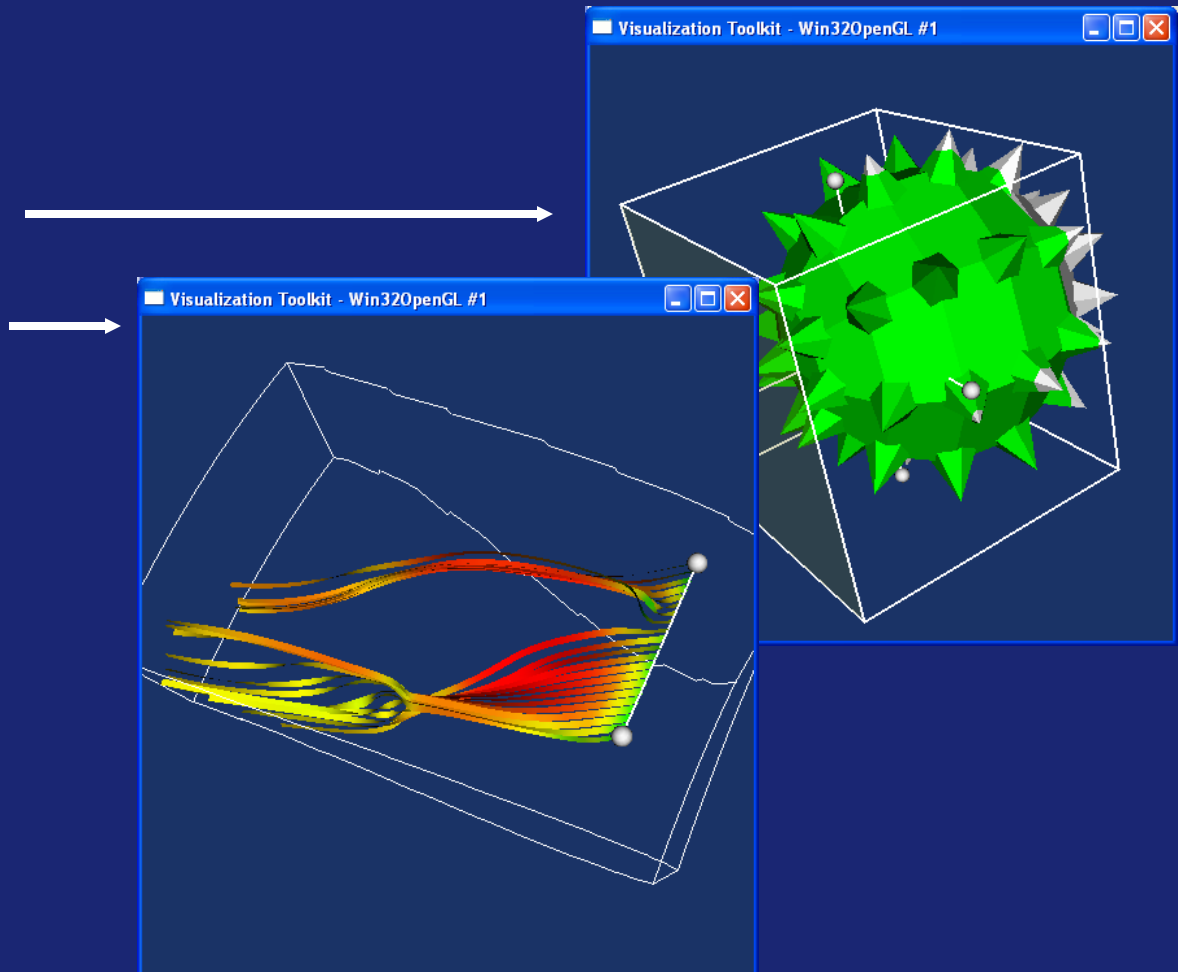


What Comes in The Package?

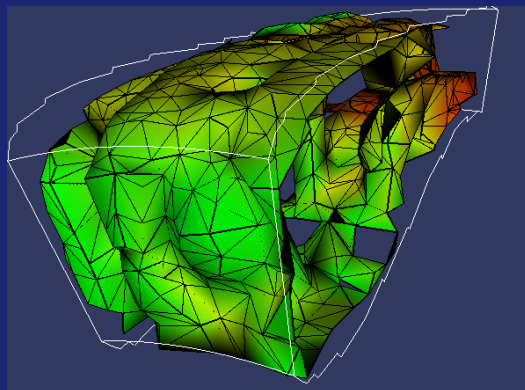
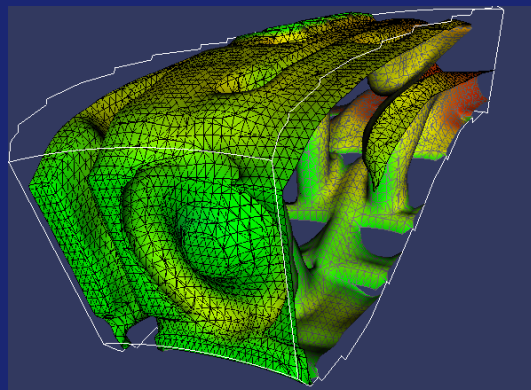
- ParaView client uses Tcl and Tk widgets
- Proxy/Property object API between client and server manager.
- Batch scripting uses this API
- Web-based client is in development

The Package Includes 3D Widgets

- vtkPointWidget
- vtkBoxWidget
- vtkLineWidget
- vtkPlaneWidget
- vtkSphereWidget



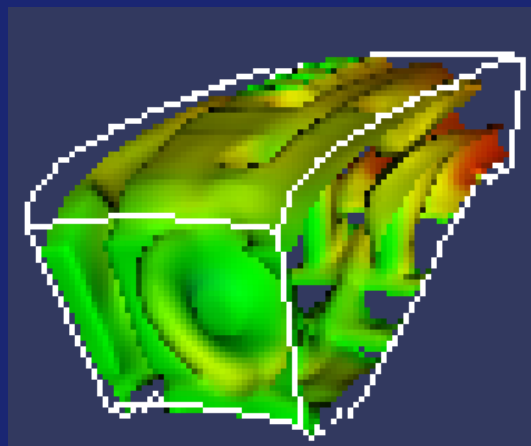
The Package Includes Levels of Detail



Decimation

Distributed / local rendering

Image reduction



General
Annotate
Camera

Colors
Set Background Color

Advanced render parameters
☐ Use parallel projection
☐ Use triangle strips
☒ Use immediate mode rendering

LOD parameters
LOD threshold: ☒ 1.9 MBytes
LOD resolution: 30x30x30
Composite: ☒ Composite above 20.0 MBytes
Subsample Rate: ☒ 2 Pixels
Squirt Compression: ☒ 19 Bits
☒ Allow rendering interrupts

3D interface settings
☒ Display 3D widgets automatically

The Package Also Includes

- Configurable with XML
 - Loading data
 - Filters / toolbar buttons
- Animation editor (with flip book)
- Annotation
- Probing
- Picking

But How Much Does It Cost?

- ParaView is Free!!!
- Developed and supported by:
 - ASCI Views Program
 - Los Alamos National Lab
 - Sandia National Labs
 - Army Research Lab
 - Lawrence Livermore National Lab
 - Kitware Inc.

Get your copy now!!! from www.paraview.org