



Sandia
National
Laboratories

SAND2011-8579P



National Nuclear Security Administration

Flexible In Situ with ParaView

2011 Workshop on Ultrascale Visualization

November 13, 2011

Kenneth Moreland (SNL), Nathan Fabian (SNL), Scott Klasky (ORNL),
Berk Geveci (Kitware)

Release Marking (e.g. Not Approved for Release, SAND XXXX, etc.)

Collaborators

- **Sandia National Laboratories**

- Kenneth Moreland
- Nathan Fabian
- David Thompson
- Ron Oldfield

- **Los Alamos National Laboratories**

- James Ahrens
- Jonathan Woodring

- **Oak Ridge National Laboratory**

- Scott Klasky
- Norbert Podhorszki

- **Argonne National Laboratory**

- Venkatram Vishwanath
- Mark Hereld
- Michael E. Papka

- **Kitware, Inc.**

- Berk Geveci
- Utkarsh Ayachit
- Andrew C. Bauer
- Pat Marion
- Sebastien Jourdain
- David DeMarle

- **University of Colorado at Boulder**

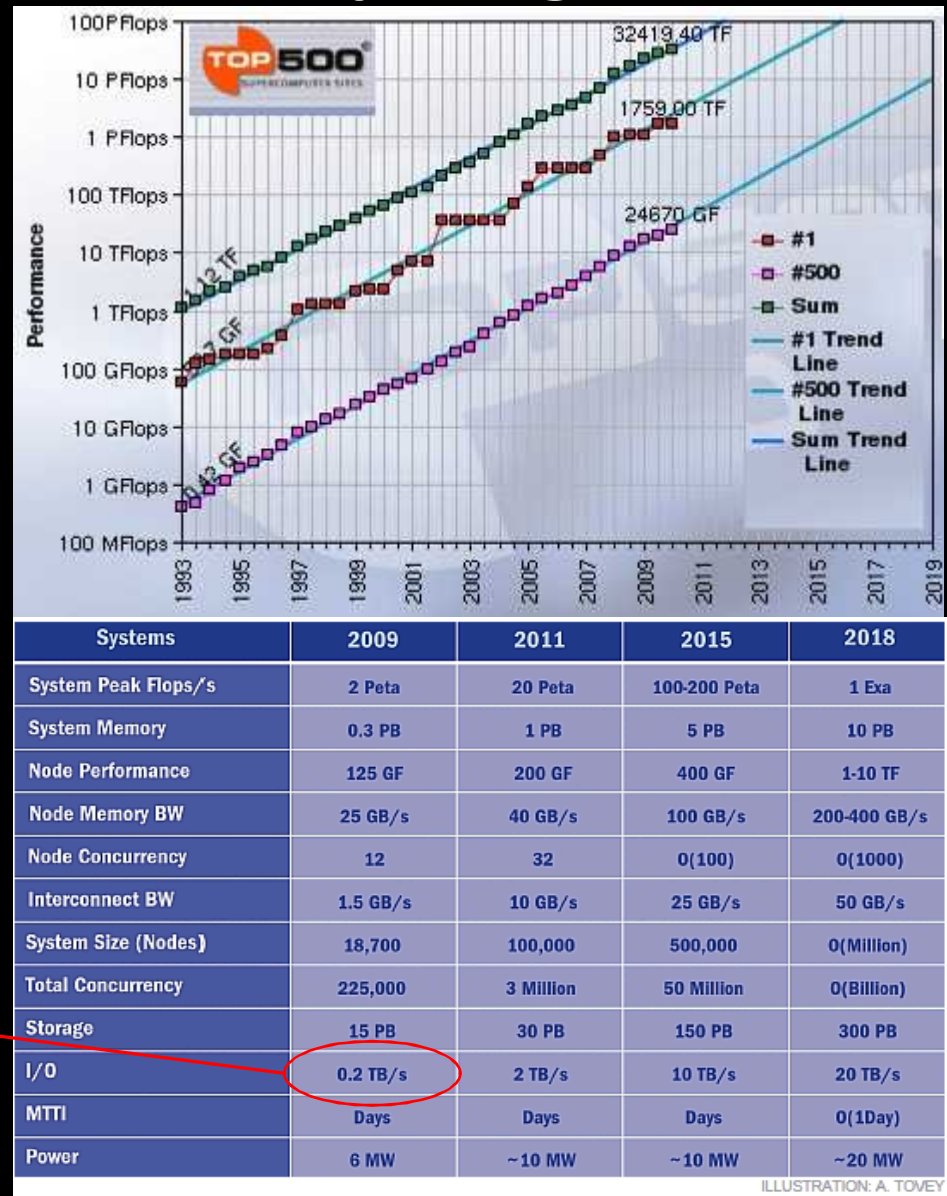
- Michel Rasquin
- Kenneth E. Jansen

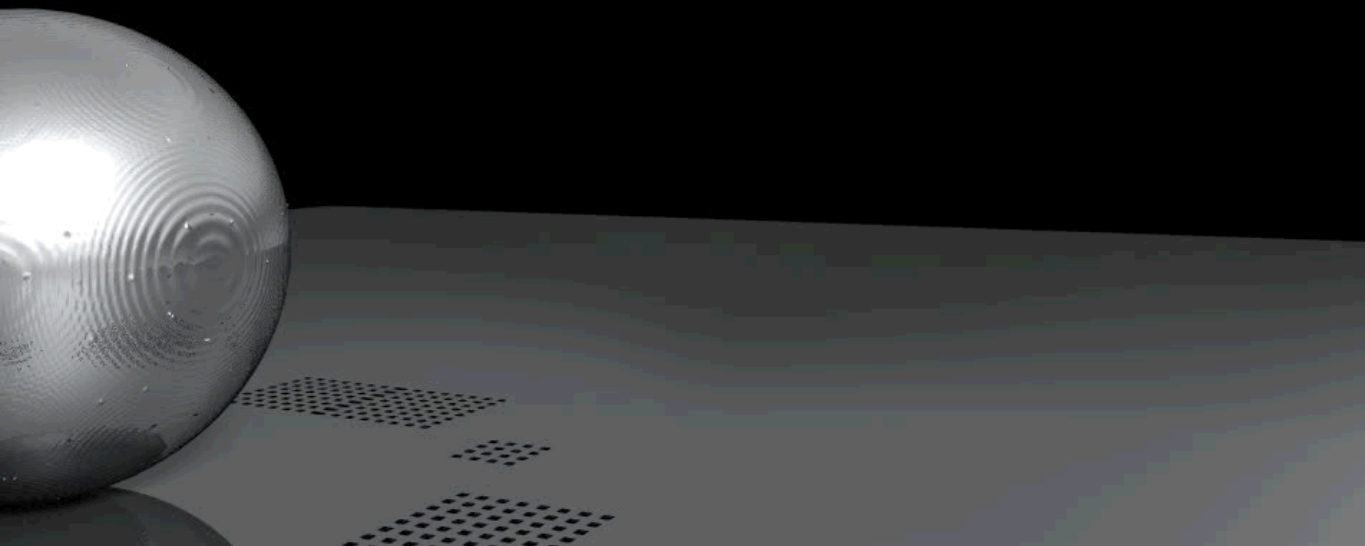
- **Rutgers University**

- Ciprian Docan
- Manish Parashar

Extreme scale computing

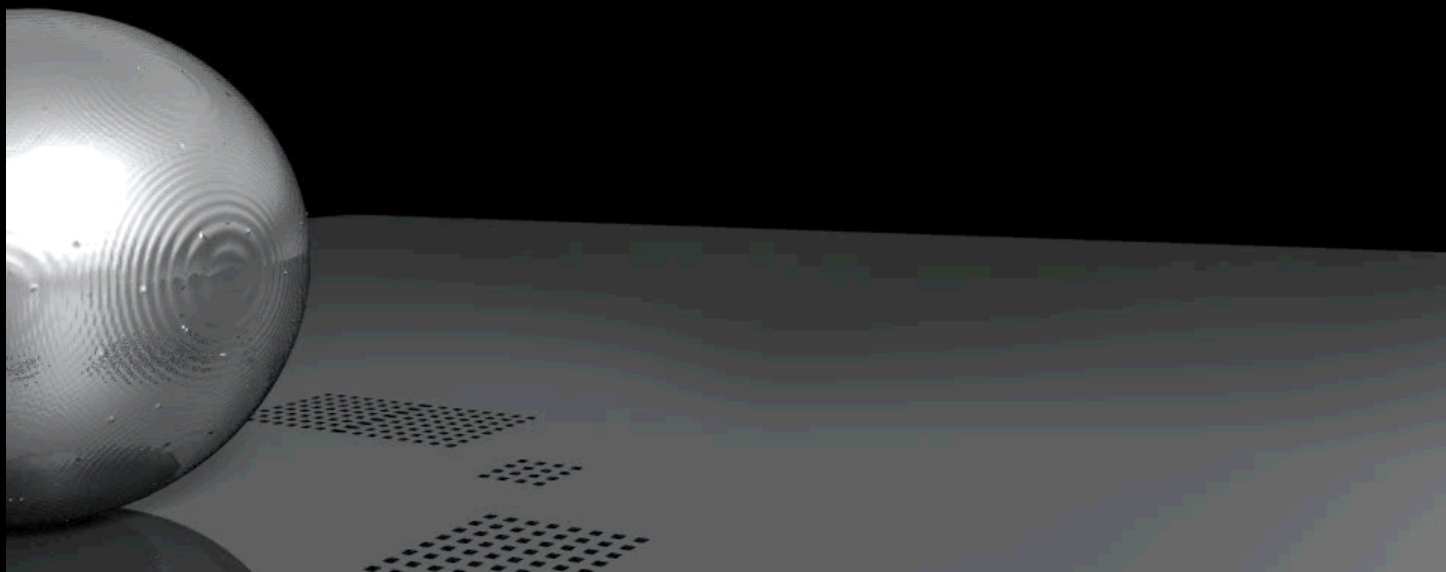
- Trends
 - More FLOPS
 - More concurrency
 - Comparatively less storage, I/O bandwidth
- ASCI purple (49 TB/140 GB/s) – JaguarPF (300 TB/200 GB/s)
 - Most people get < 5 GB/sec at scale





1 frame per 100 steps
~1% write time

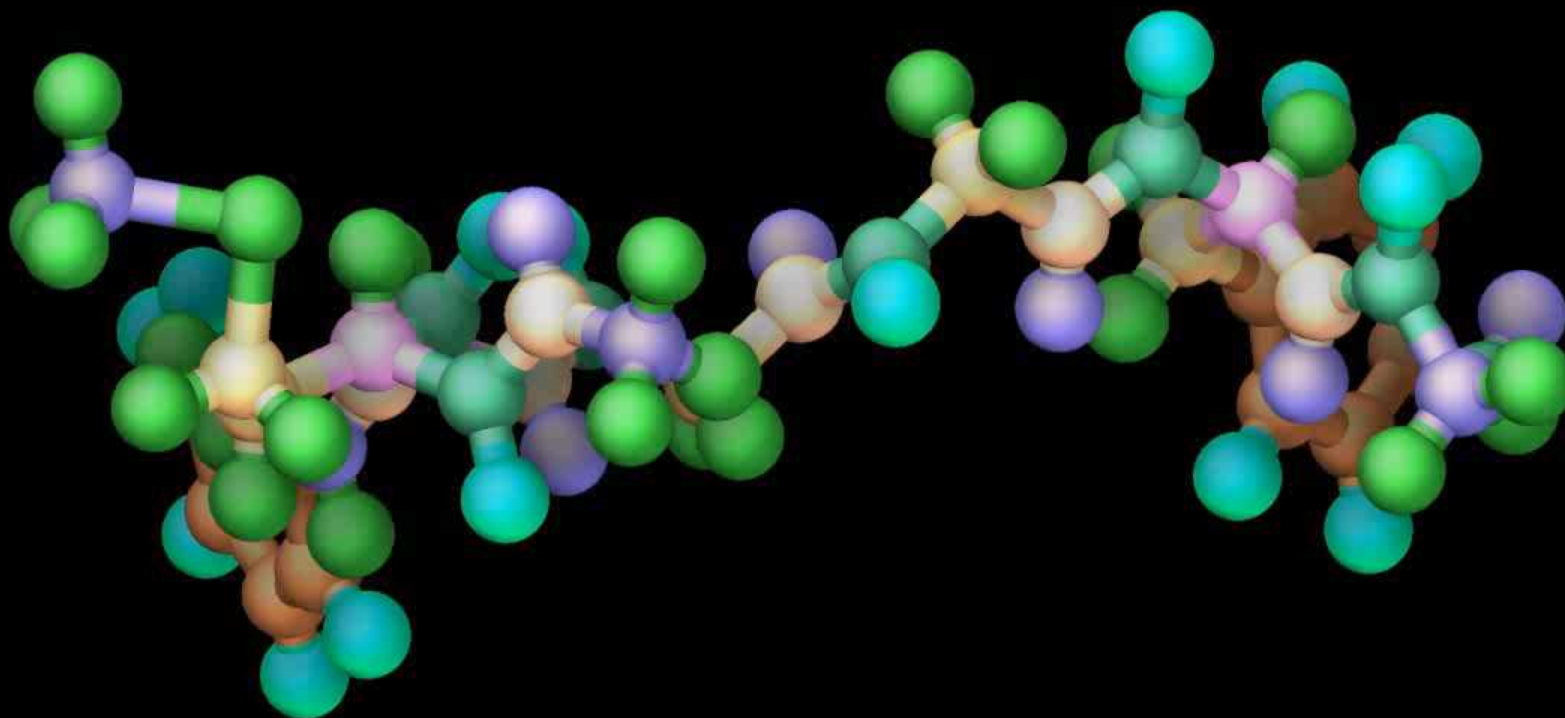
1 frame per 1 step
~0.1% write time



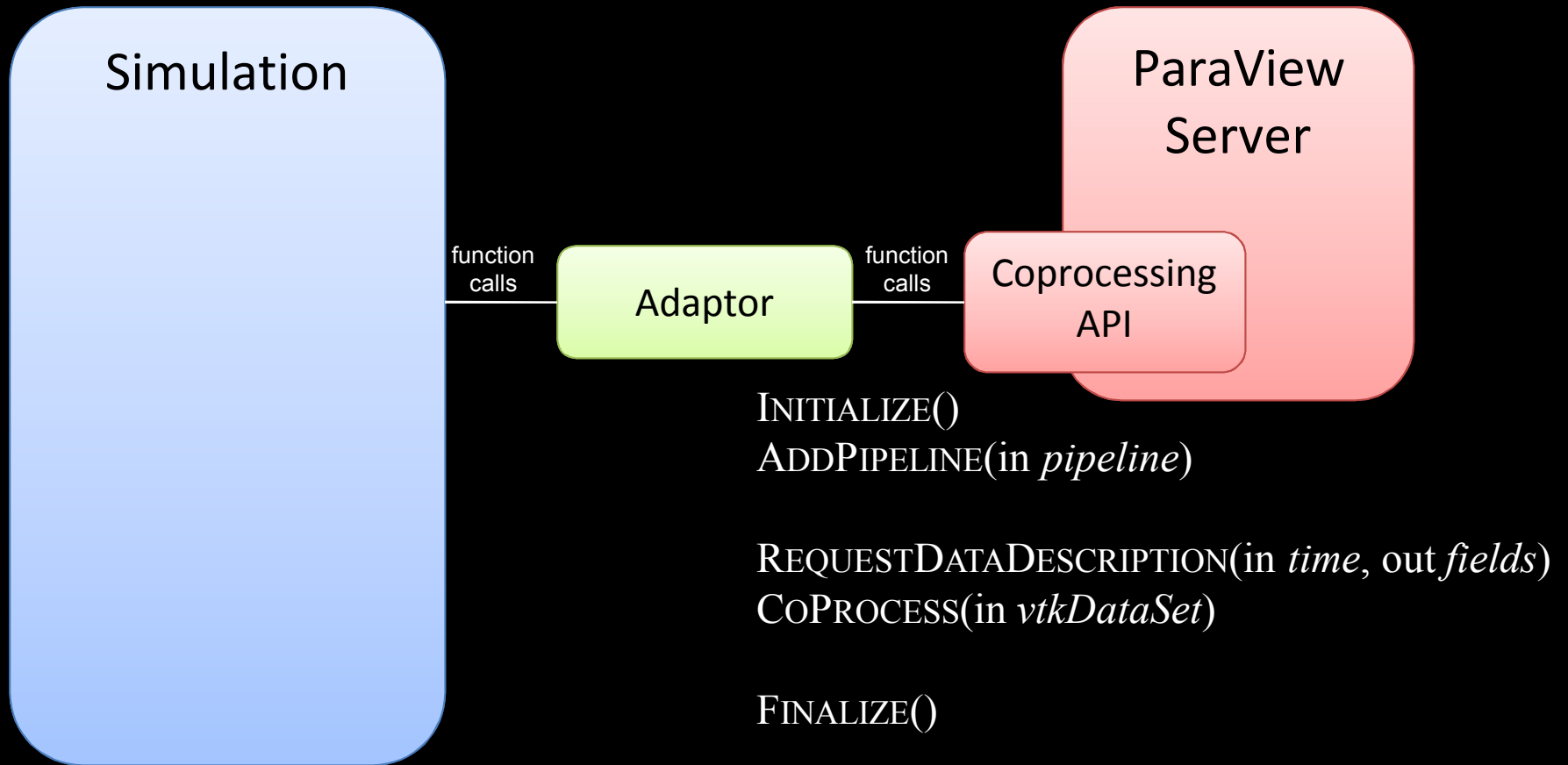
Space of Solutions

	Capability	Coupling	Footprint	Transfer	Interactive
Custom	Low	Tight	Low	None	No
ParaView In Situ, In Core	High	Tight	High	Possible memcpy	No
ParaView In Situ, Multi-Job	High	Tight	Medium	Subset Hi Speed Transfer	Yes
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes
File-based Post Process	High	Loose	None	Slow Disk, Archive Cost	Yes

	Capability	Coupling	Footprint	Transfer	Interactive
Custom	Low	Tight	Low	None	No



	Capability	Coupling	Footprint	Transfer	Interactive
ParaView In Situ, In Core	High	Tight	High	Possible memcpy	No



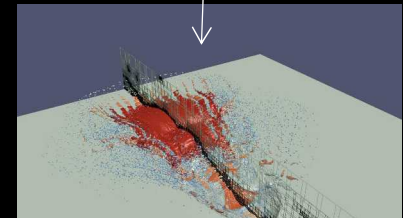
Simulation

ParaView
Coproprocessing

Simulation

ParaView
Coproprocessing

Output
Processed
Data



Rendered Images

Simulation

ParaView Coproprocessing

Simulation

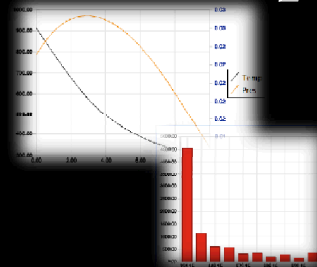
ParaView Coproprocessing

Simulation

ParaView Coproprocessing

A 3D visualization of a crack in a material. A white arrow points down towards a crack that has formed in a grey, textured material. The crack is filled with a red, fibrous or granular substance, suggesting a fracture process or a specific material property along the crack line.

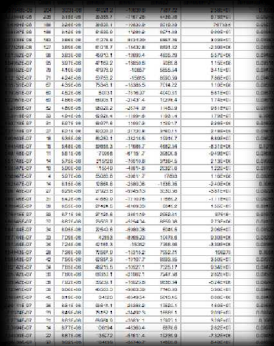
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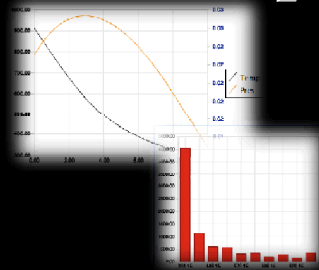
Augmented
script in input
deck.

ParaView Coproprocessing

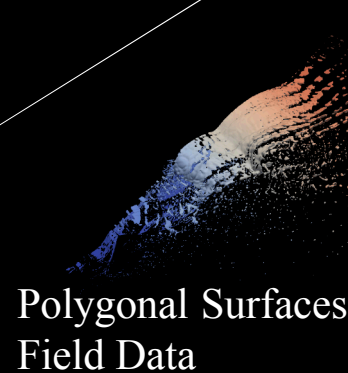
Output
Processed
Data



Statistics

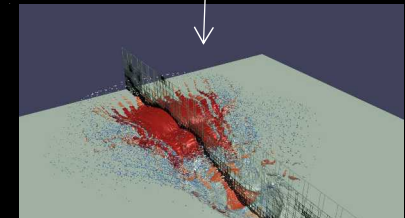


Line Series

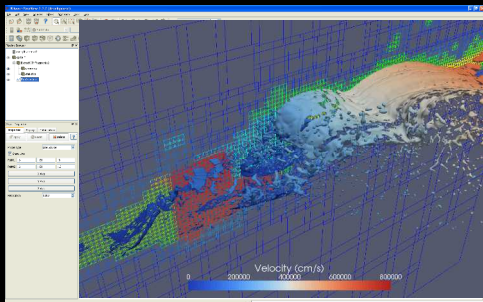


Polygonal Surfaces

Field Data



Rendered Images



Script Export

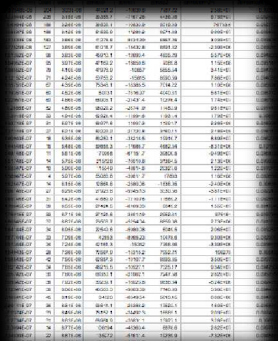
```
# Create the reader and set the filename.
reader = servermanager.sources.Reader(FileNames=path)
view = servermanager.CreateRenderView()
repr = servermanager.CreateRepresentation(reader, view)
reader.UpdatePipeline()
dataInfo = reader.GetDataInformation()
pDInfo = dataInfo.GetPointDataInformation()
arrayInfo = pDInfo.GetArrayInformation("displacement9")
if arrayInfo:
    # get the range for the magnitude of displacement9
    range = arrayInfo.GetComponentRange(-1)
    lut = servermanager.rendering.PVLookupTable()
    lut.RGBPoints = [range[0], 0.0, 0.0, 1.0,
                    range[1], 1.0, 0.0, 0.0]
    lut.VectorMode = "Magnitude"
    repr.LookupTable = lut
    repr.ColorArrayName = "displacement9"
    repr.ColorAttributeType = "POINT_DATA"
```

Augmented
script in input
deck.

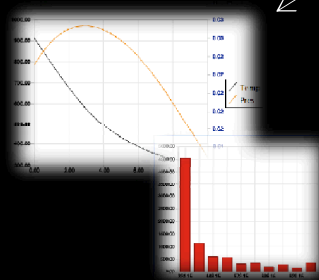
Simulation

ParaView
Coproprocessing

Output
Processed
Data

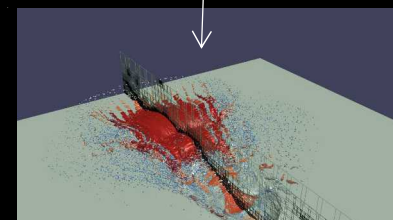


Statistics

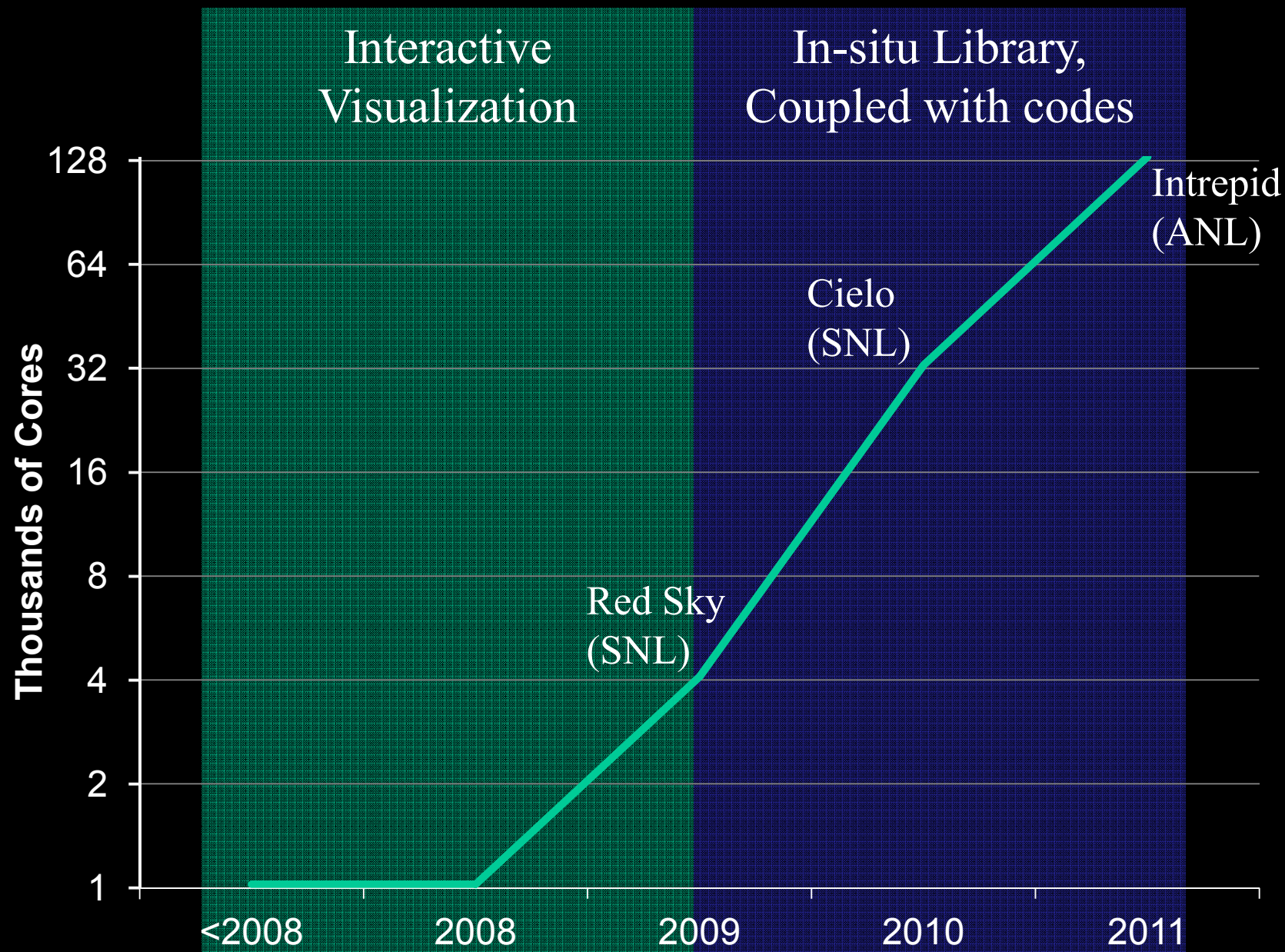


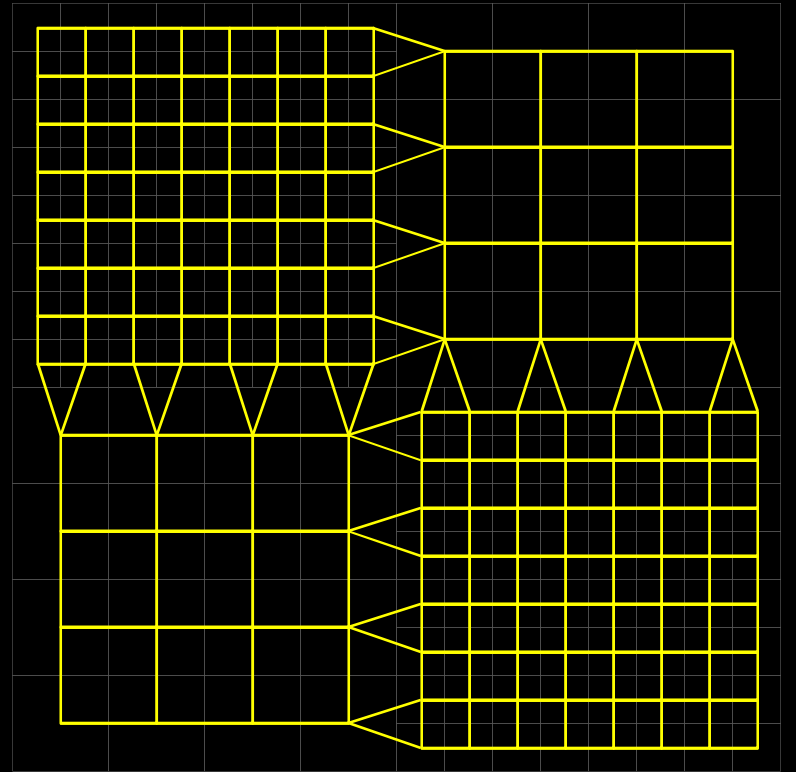
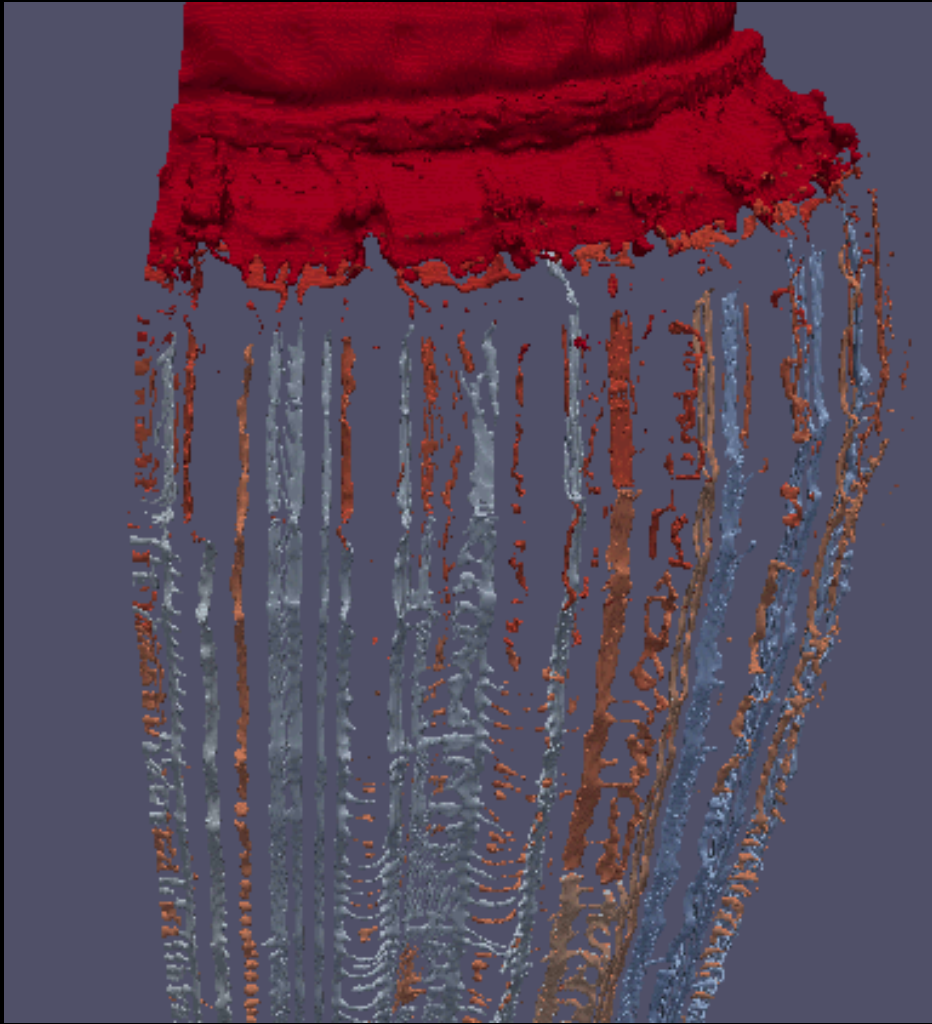
Line Series

Polygonal Surfaces
Field Data



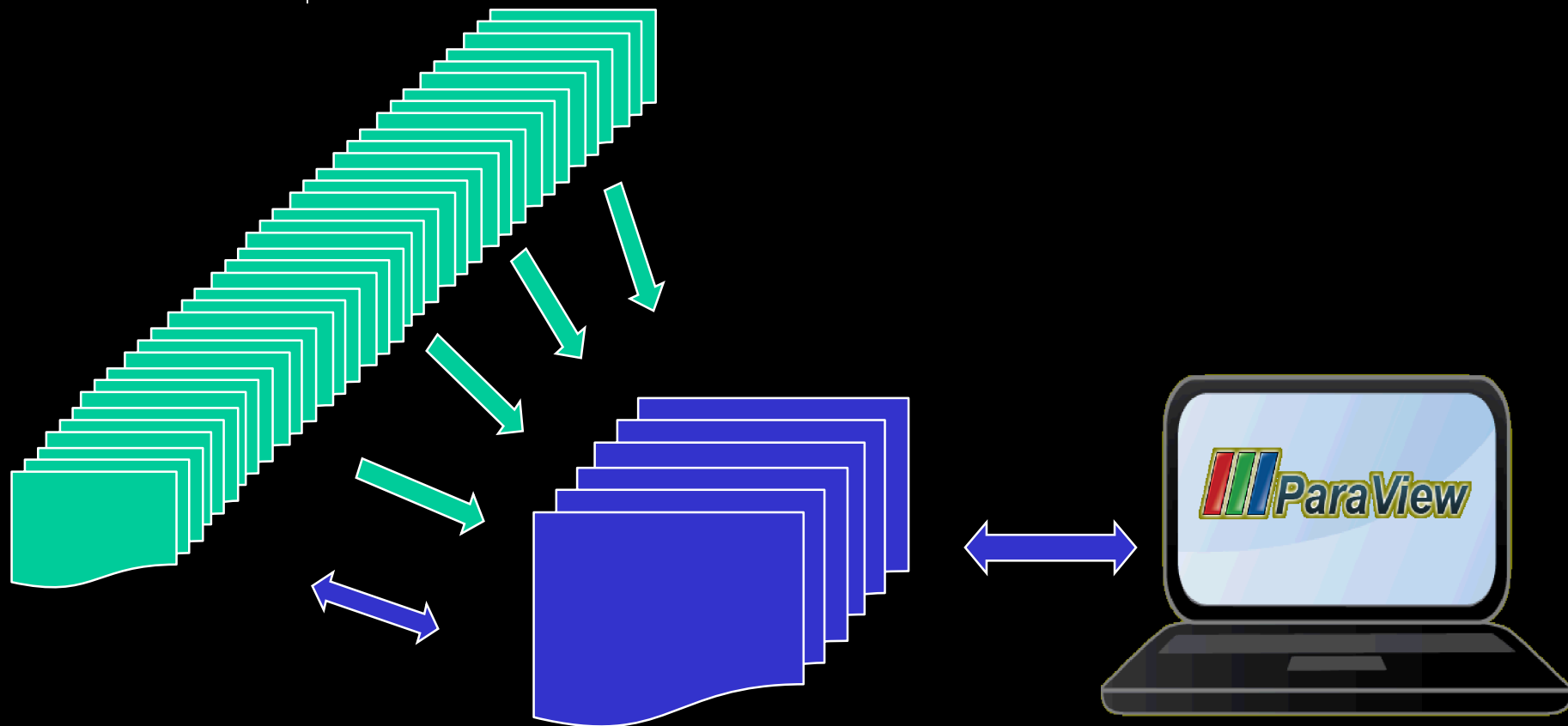
Rendered Images





	Capability	Coupling	Footprint	Transfer	Interactive
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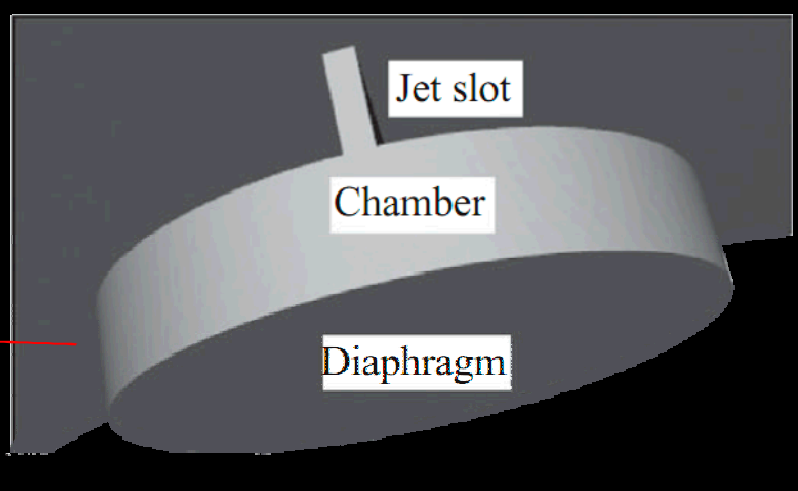
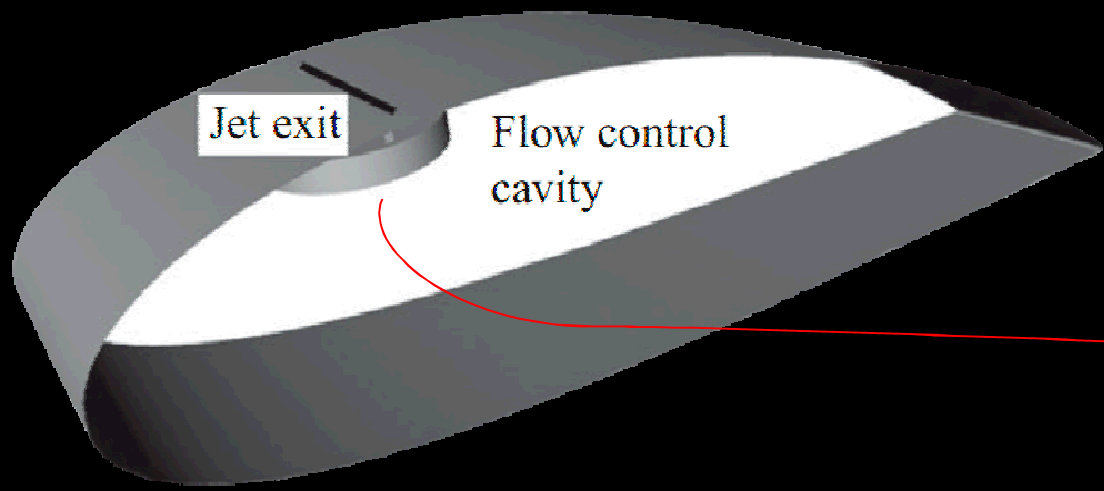
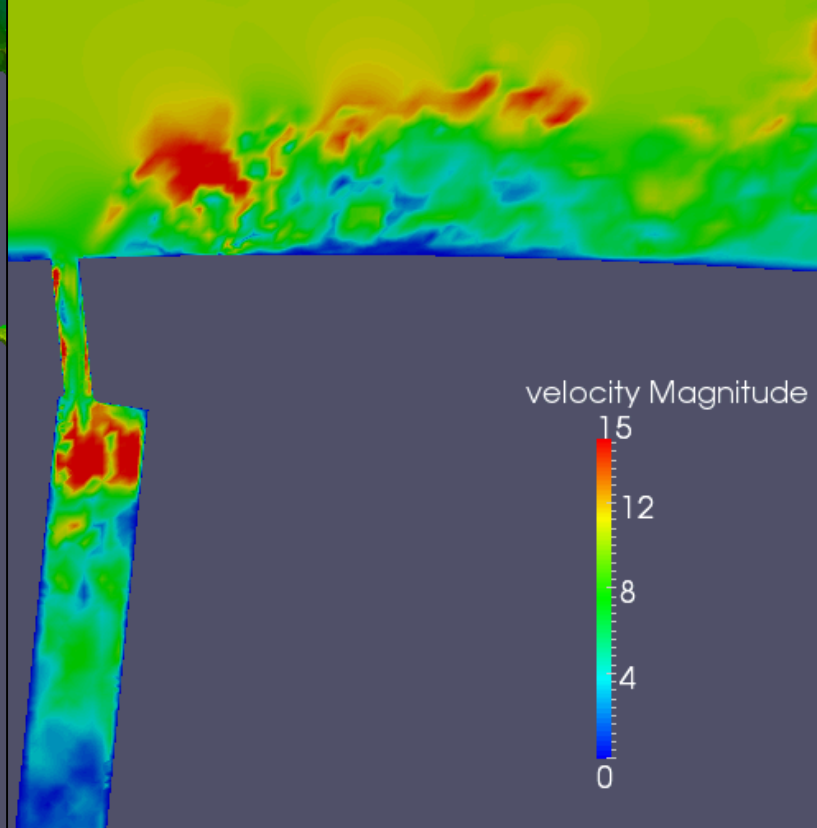
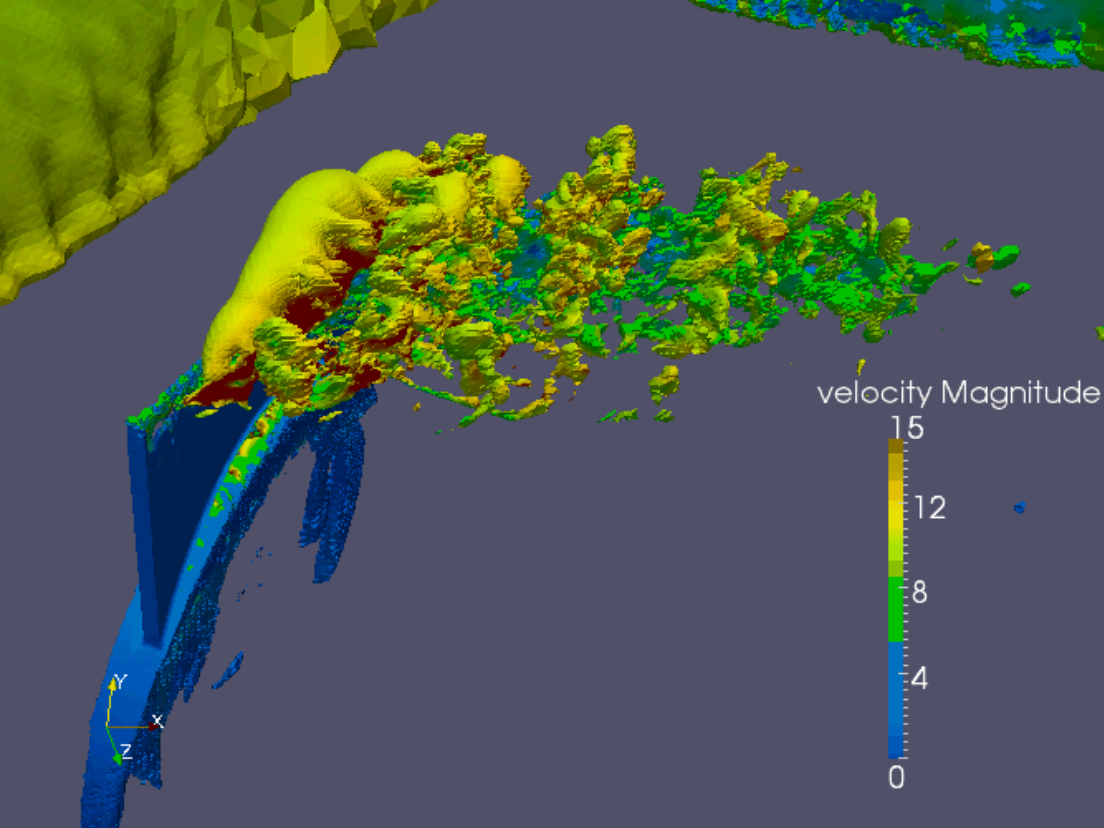
ParaView In Situ, Multi-Job	High	Tight	Medium	Subset Hi Speed Transfer	Yes
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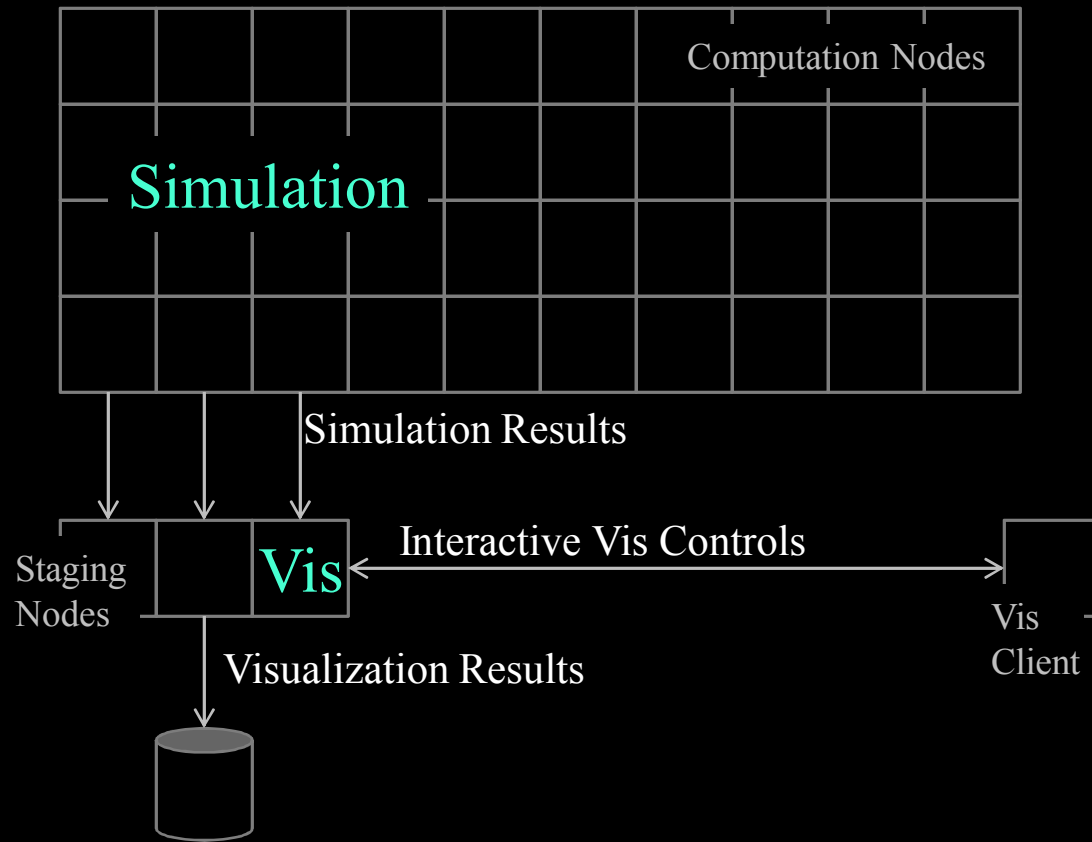
Full scale
Simulation
w/ In situ

Smaller scale
Covisualization

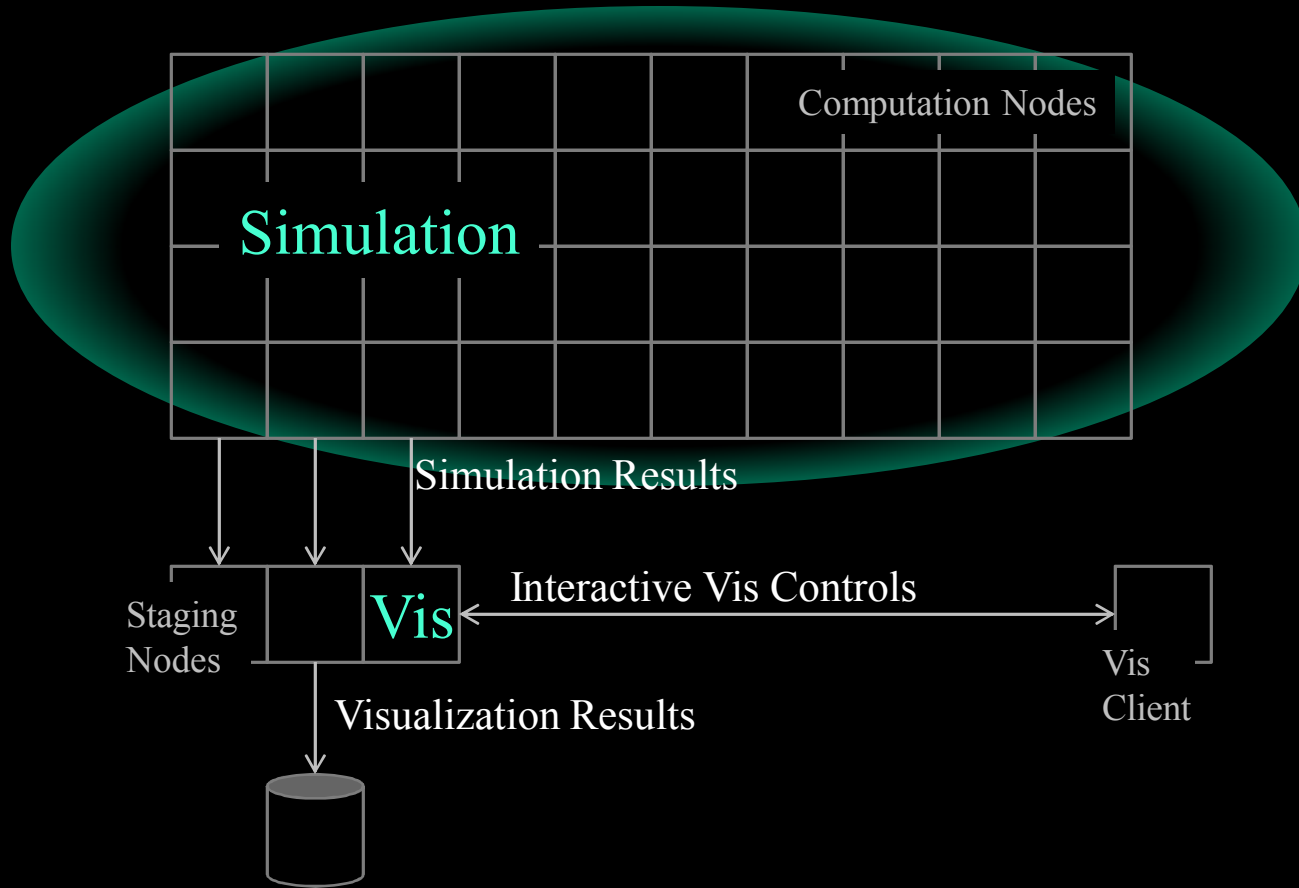
Interactive Client



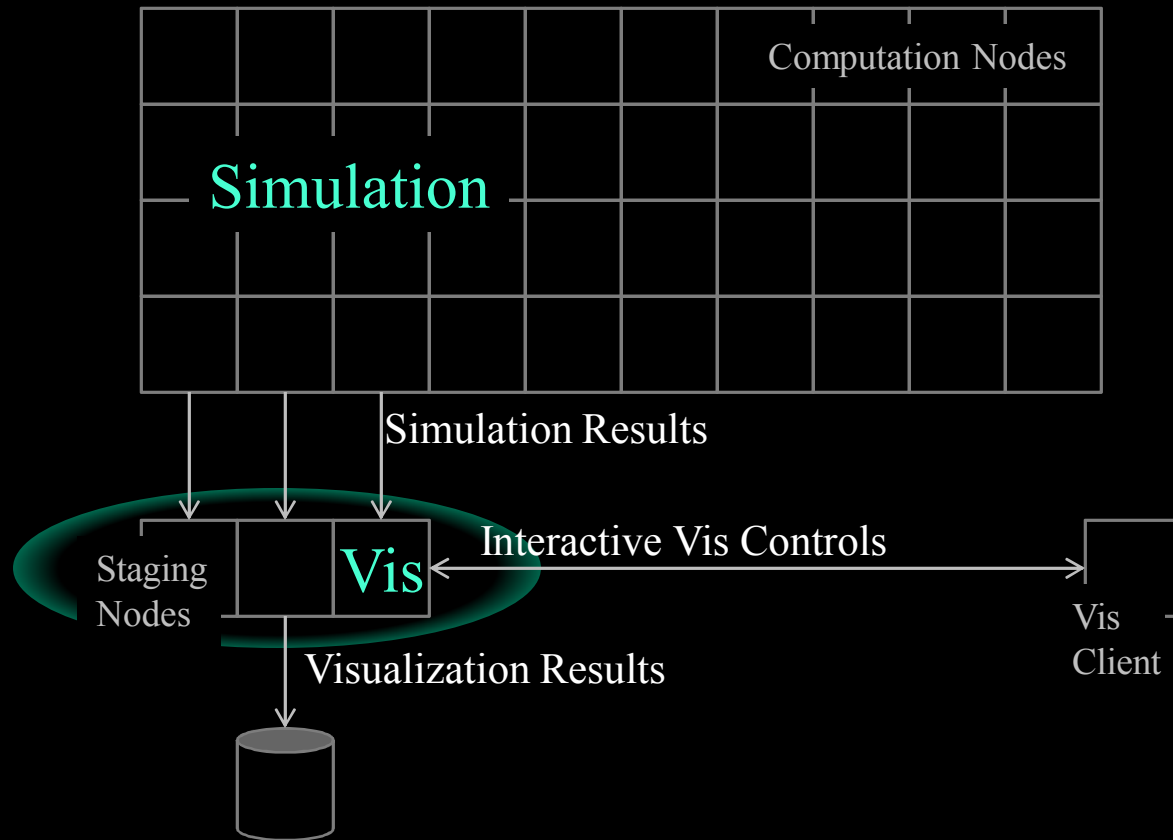
	Capability	Coupling	Footprint	Transfer	Interactive
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes



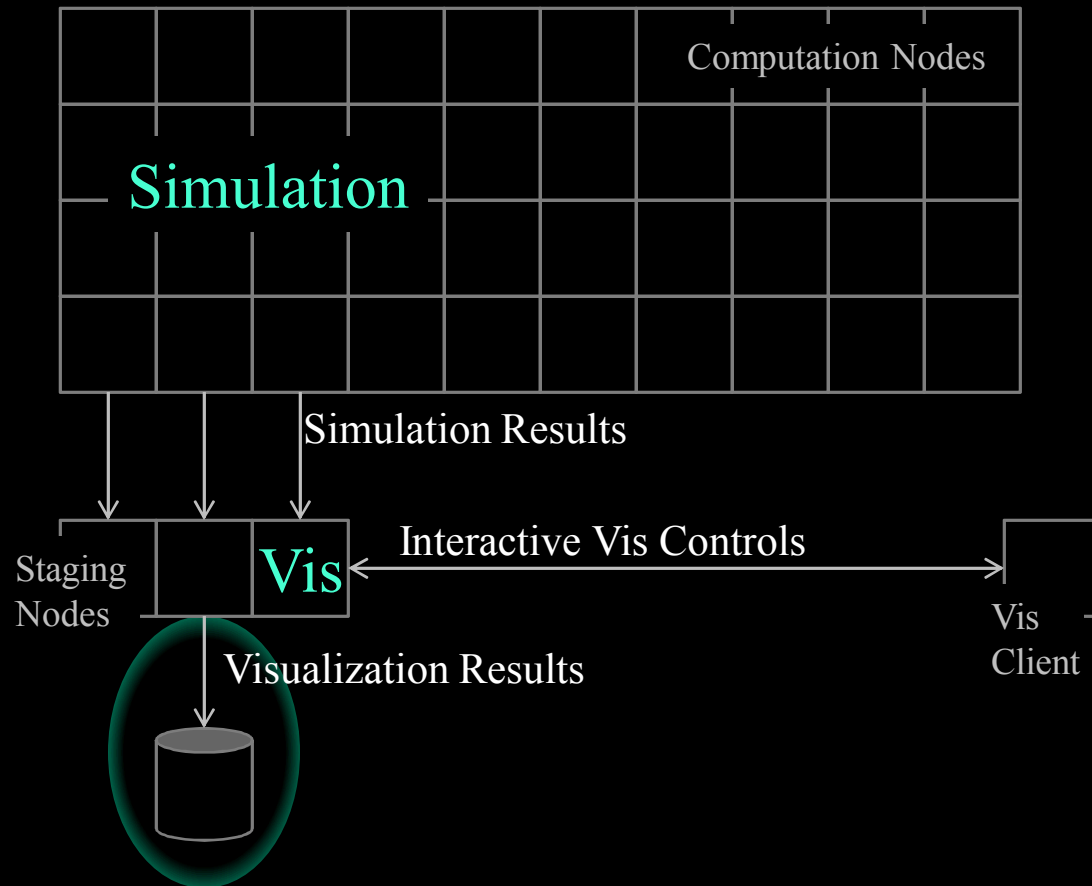
	Capability	Coupling	Footprint	Transfer	Interactive
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes



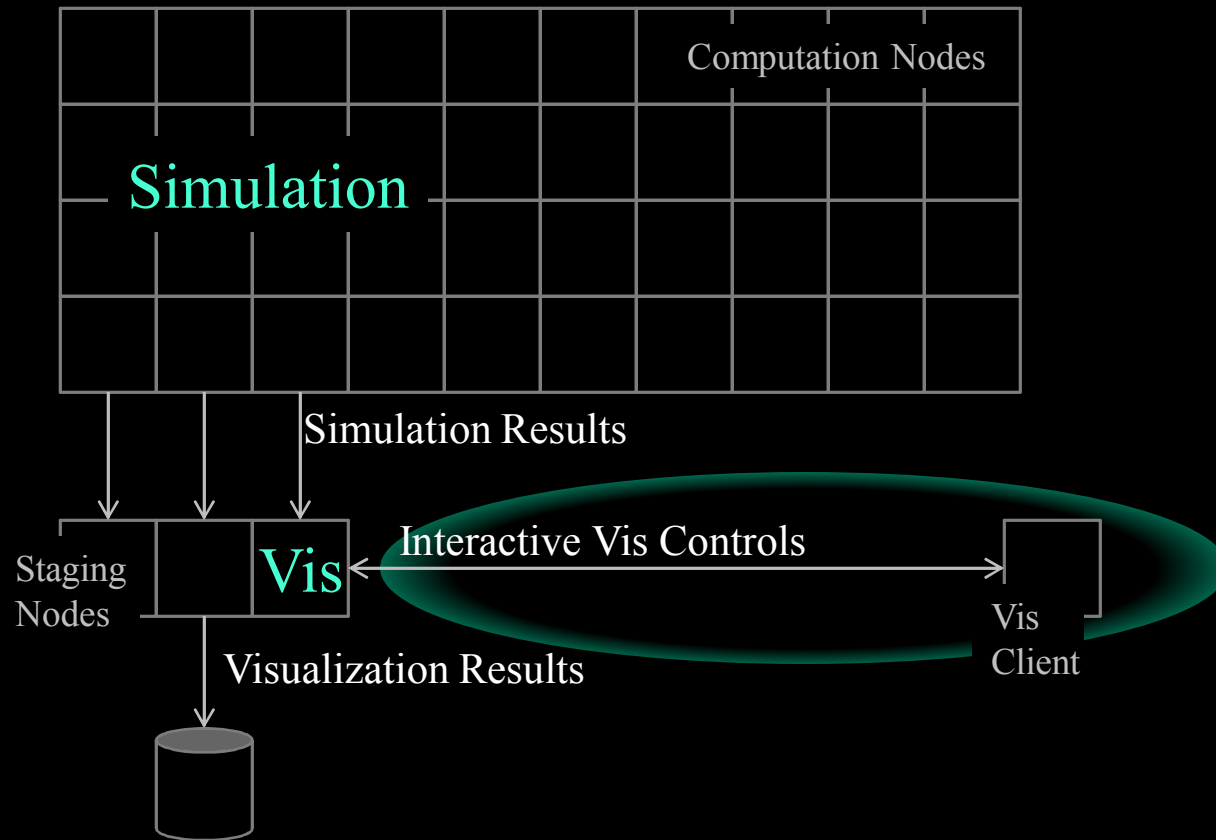
	Capability	Coupling	Footprint	Transfer	Interactive
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes

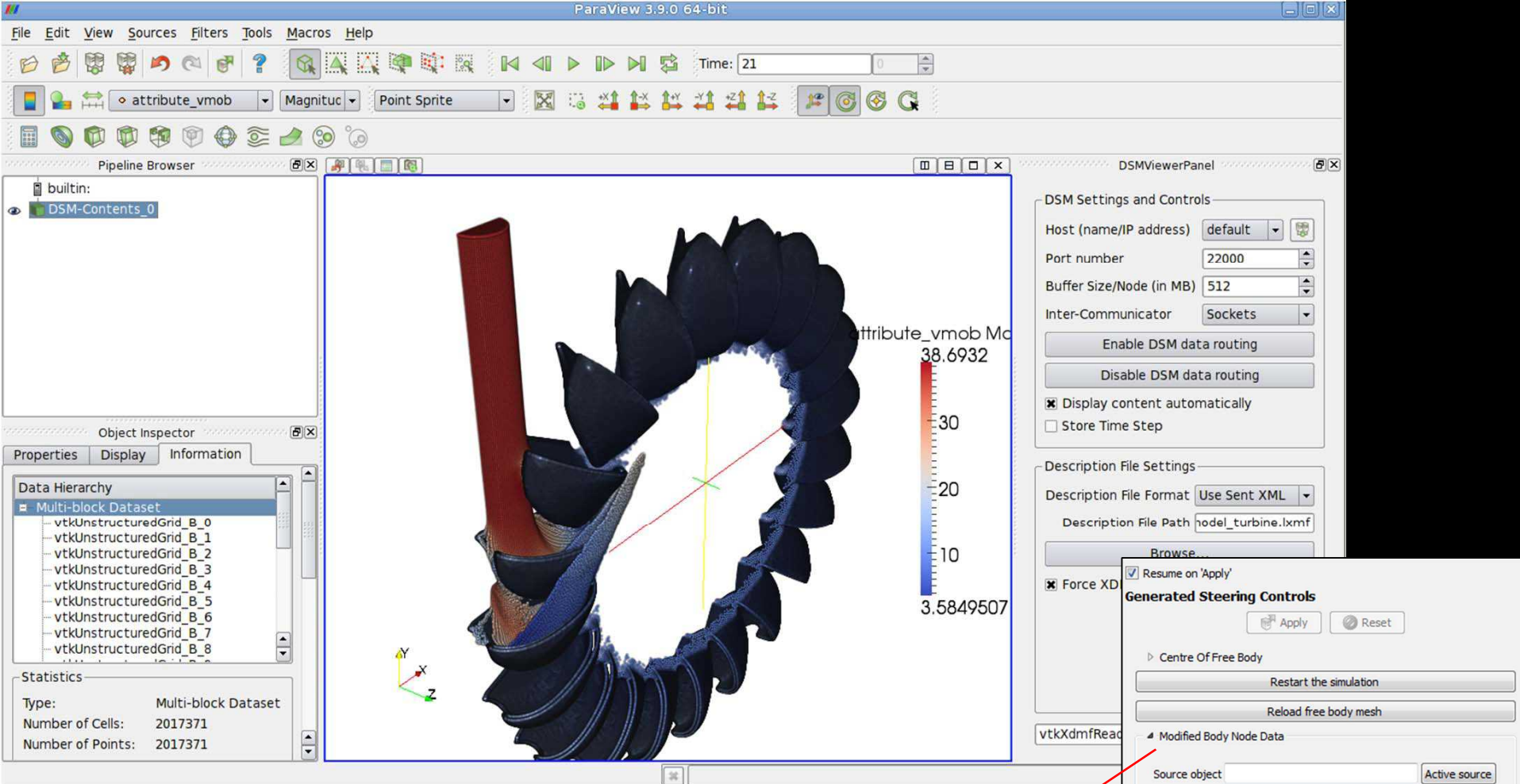


	Capability	Coupling	Footprint	Transfer	Interactive
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes

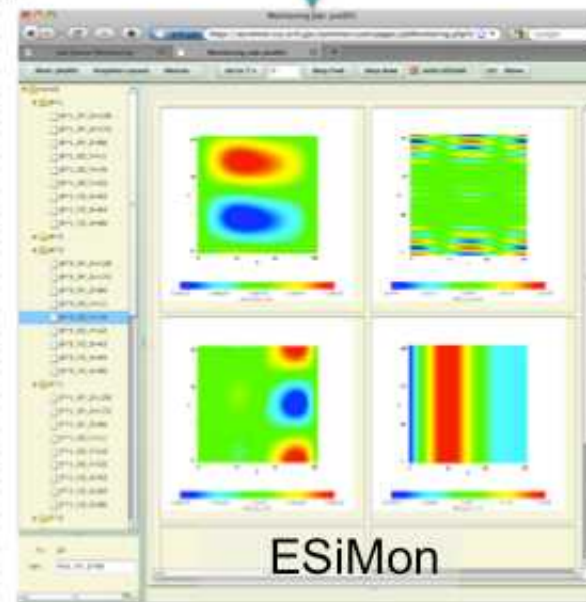
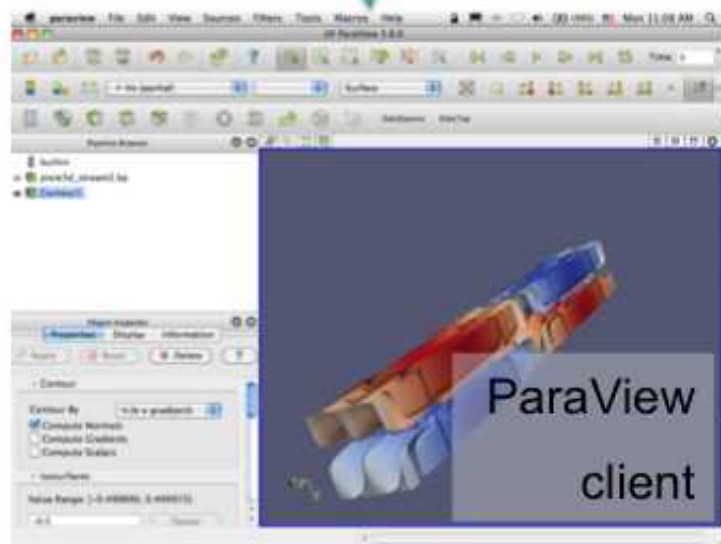
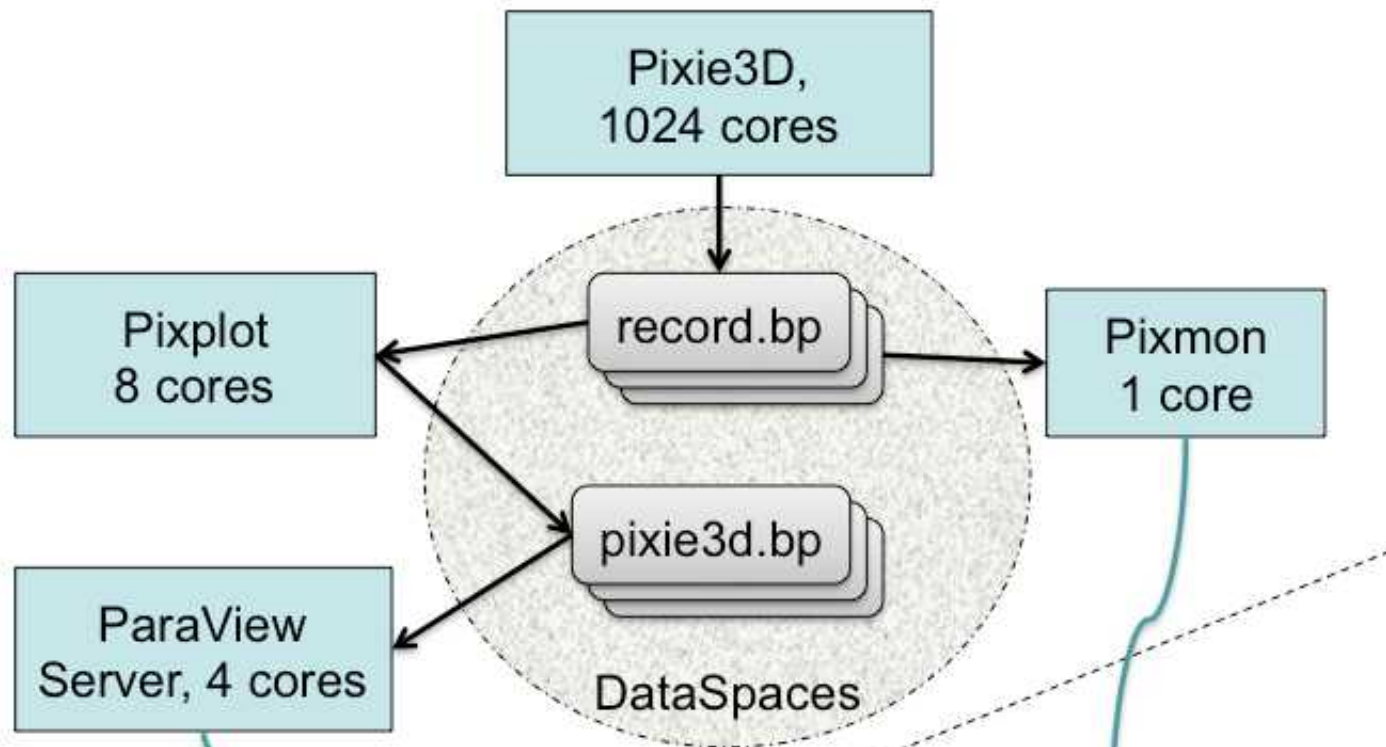


	Capability	Coupling	Footprint	Transfer	Interactive
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes





```
<DataExportProperty name="ModifiedBodyNodes"
  command="SetSteeringArray"
  label="Modified Body Node Data">
  <DataExportDomain name="data_export"
    full_path="/Mesh_DataSet"
    geometry_path="/Mesh_Nodes#1/NewXYZ"
    topology_path="/Mesh_Nodes#1/NewCo..."
    command_property="ReloadFreeBodyMesh" />
</DataExportProperty>
```



Space of Solutions

	Capability	Coupling	Footprint	Transfer	Interactive
Custom	Low	Tight	Low	None	No
ParaView In Situ, In Core	High	Tight	High	Possible memcpy	No
ParaView In Situ, Multi-Job	High	Tight	Medium	Subset Hi Speed Transfer	Yes
ParaView In Transit	High	Loose	~5% Extra Nodes	Hi Speed Transfer	Yes
File-based Post Process	High	Loose	None	Slow Disk, Archive Cost	Yes