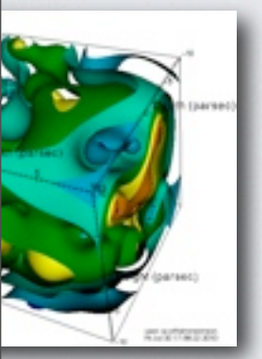
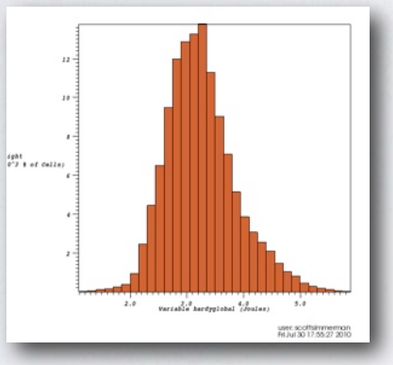
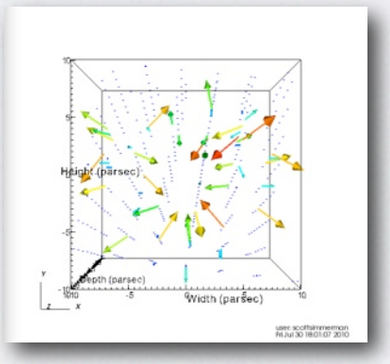
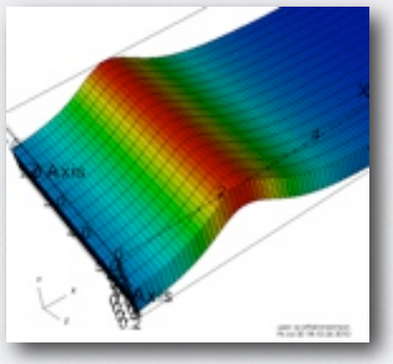
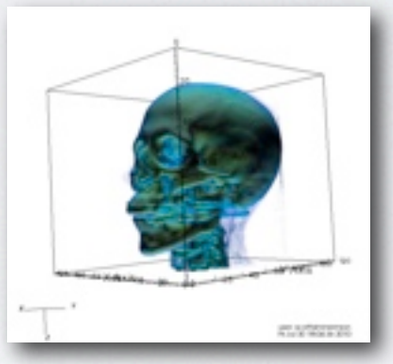
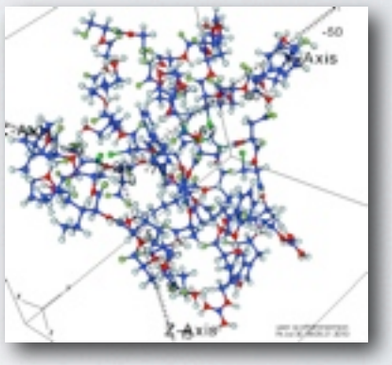
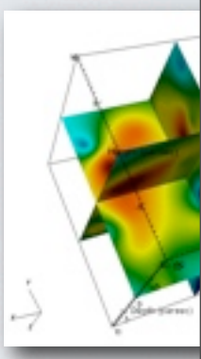
# Scientific Visualization

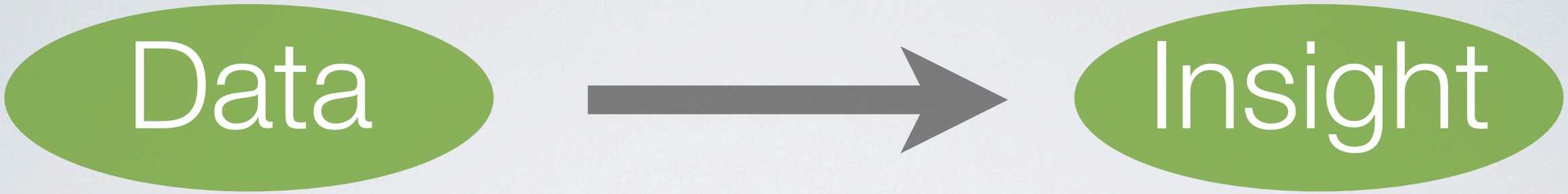




## Scott Simmerman - NICS RDAV

# Scientific Visualization




"The purpose of computing is insight, not numbers."

- Richard Hamming (1962)

# Scientific Visualization

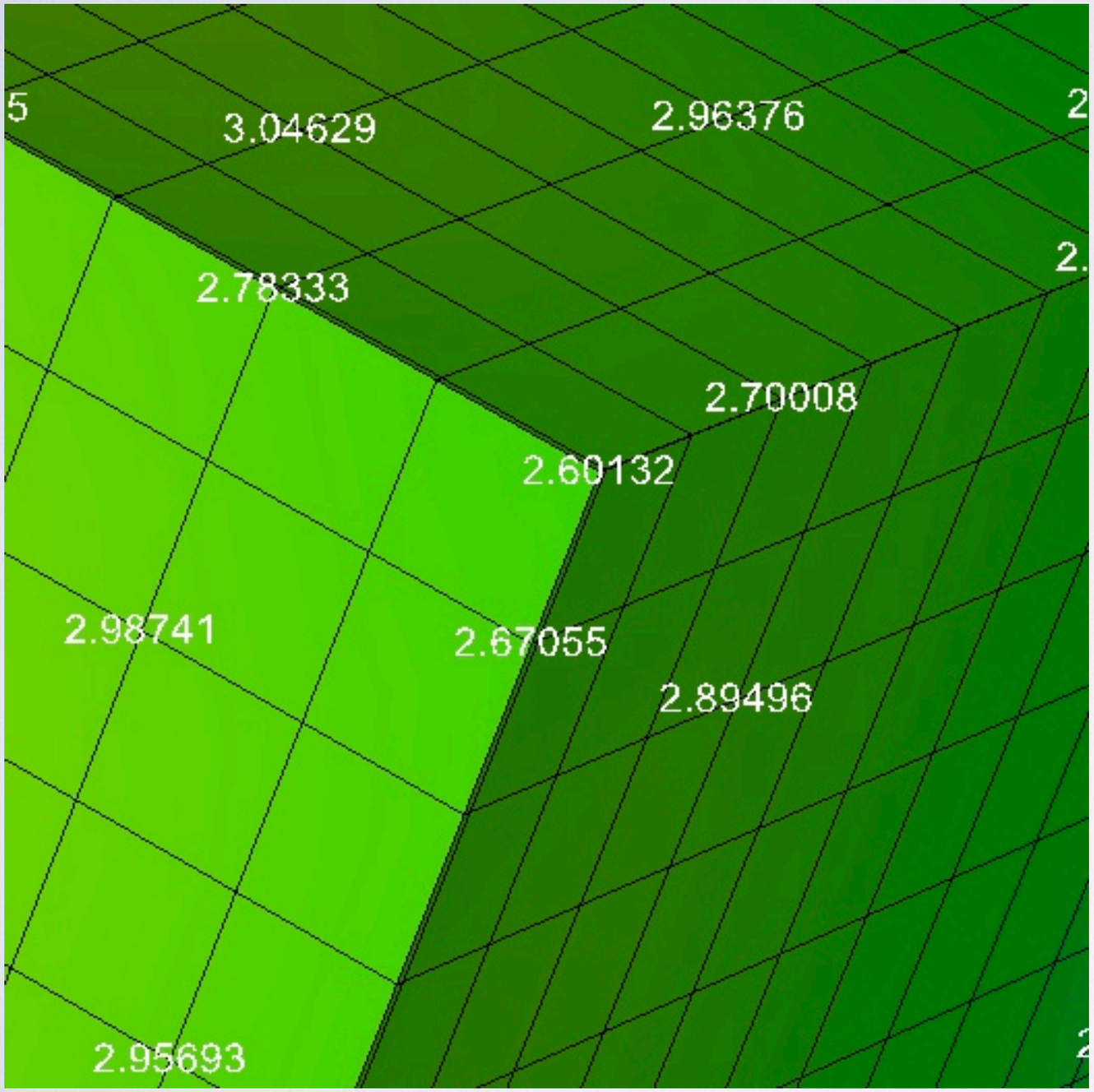
- Different from ‘InfoVis’ or ‘Statistical Graphics’


- Not just ‘Computer Graphics’

# Scientific Data

Sources: simulation, physical experiment, observations, instrument readings, etc.

# Scientific Data - Structure



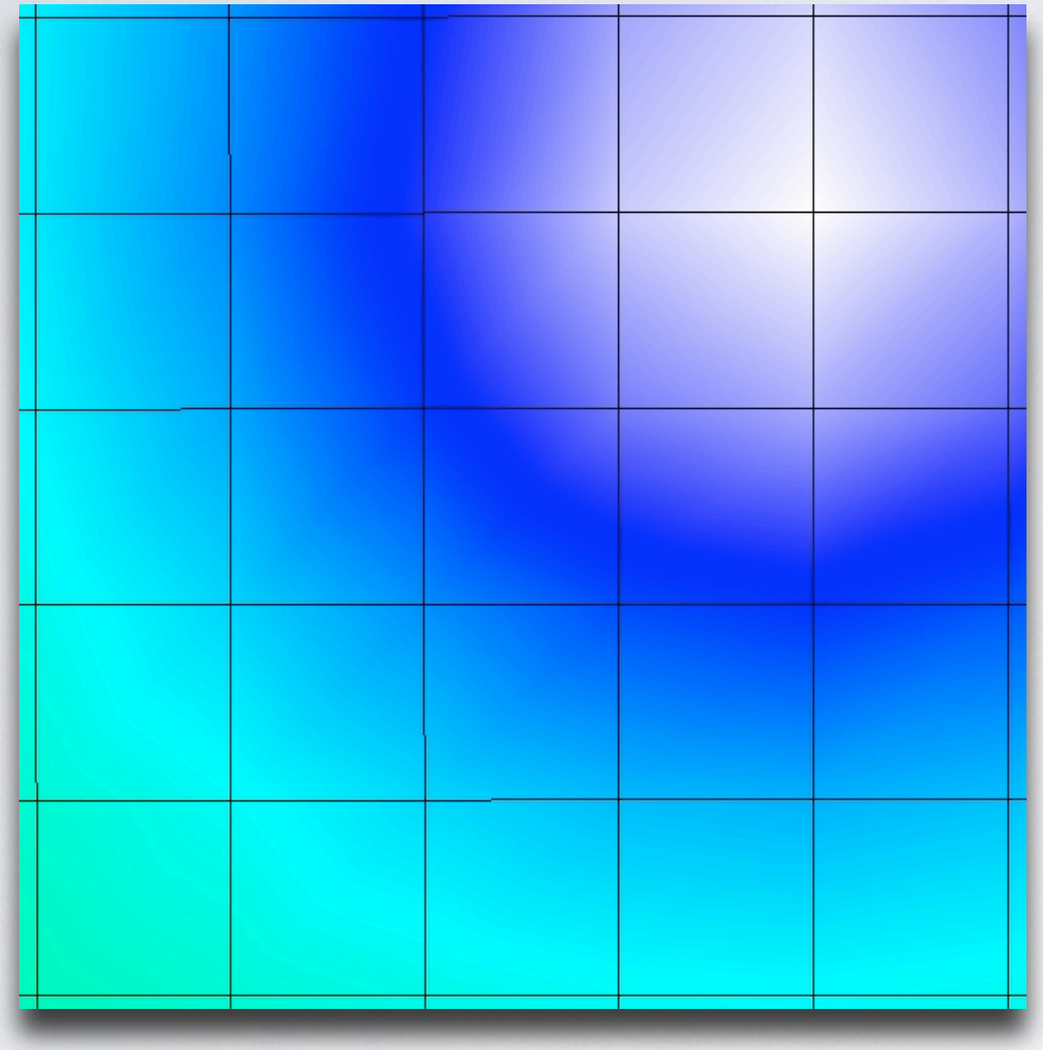

**Meshes**

- Dimensions (1,2,3,4)
- Implicit or explicit
- Regular or Unstructured
- Mesh blocks
- AMR

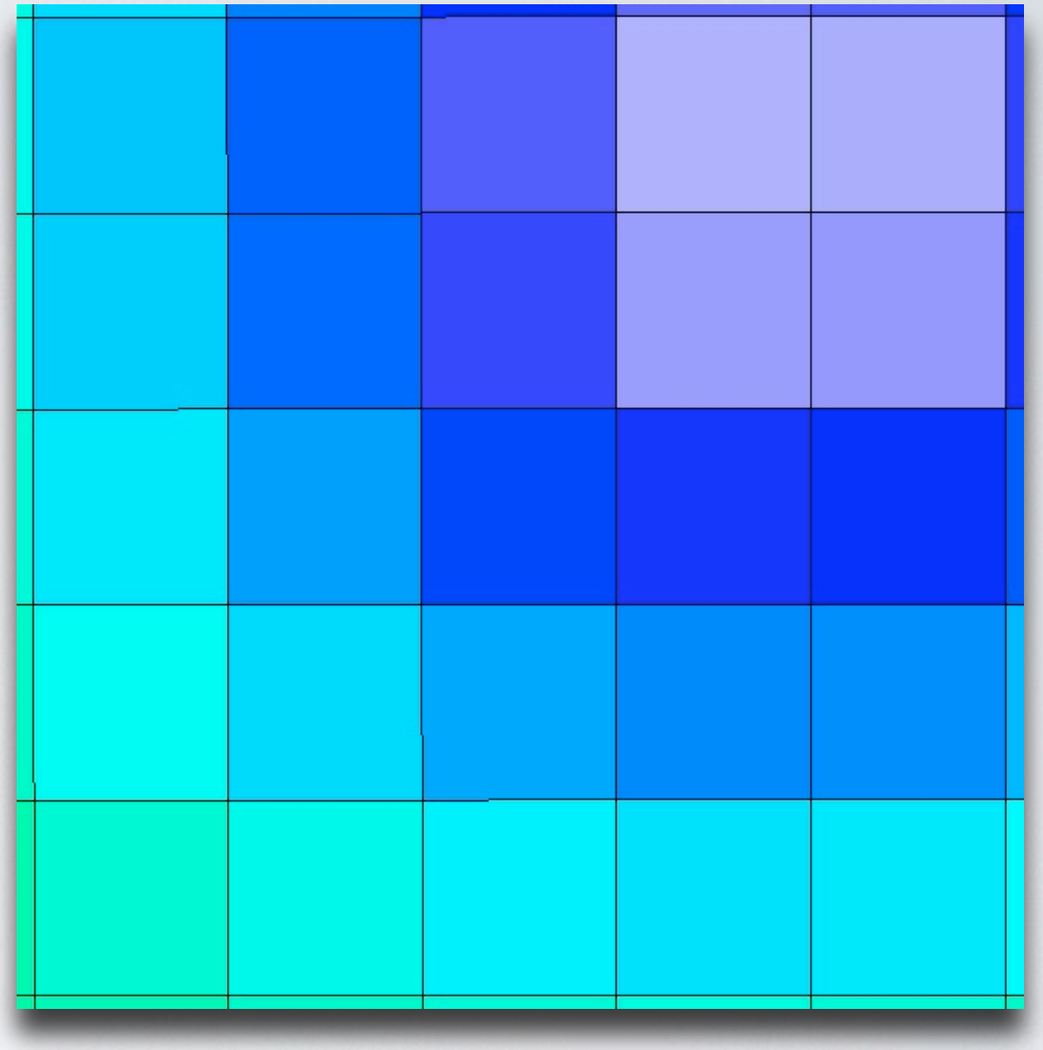
**Variables**

- Scalars, Vectors, or Tensors

# Data Interpolation

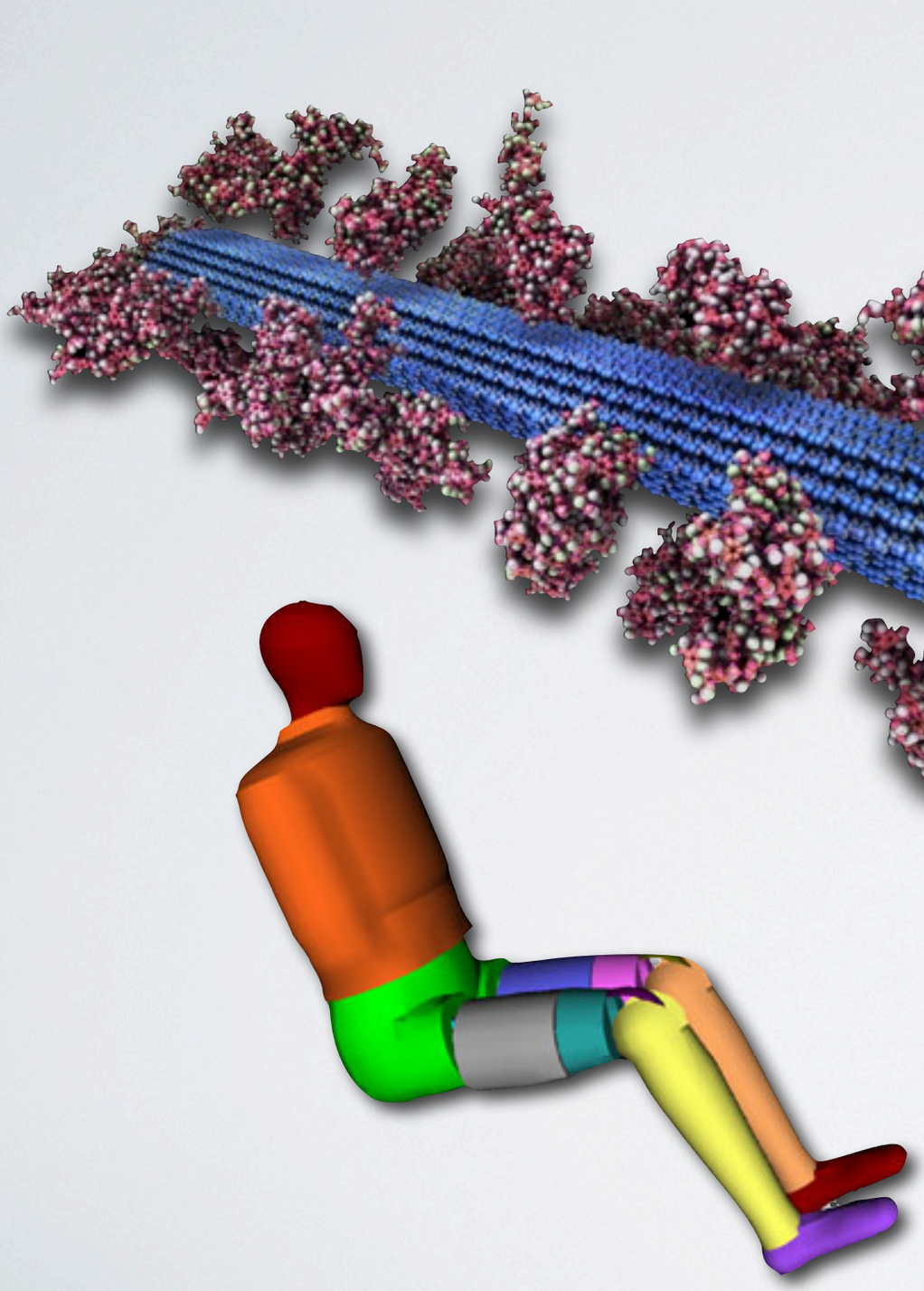


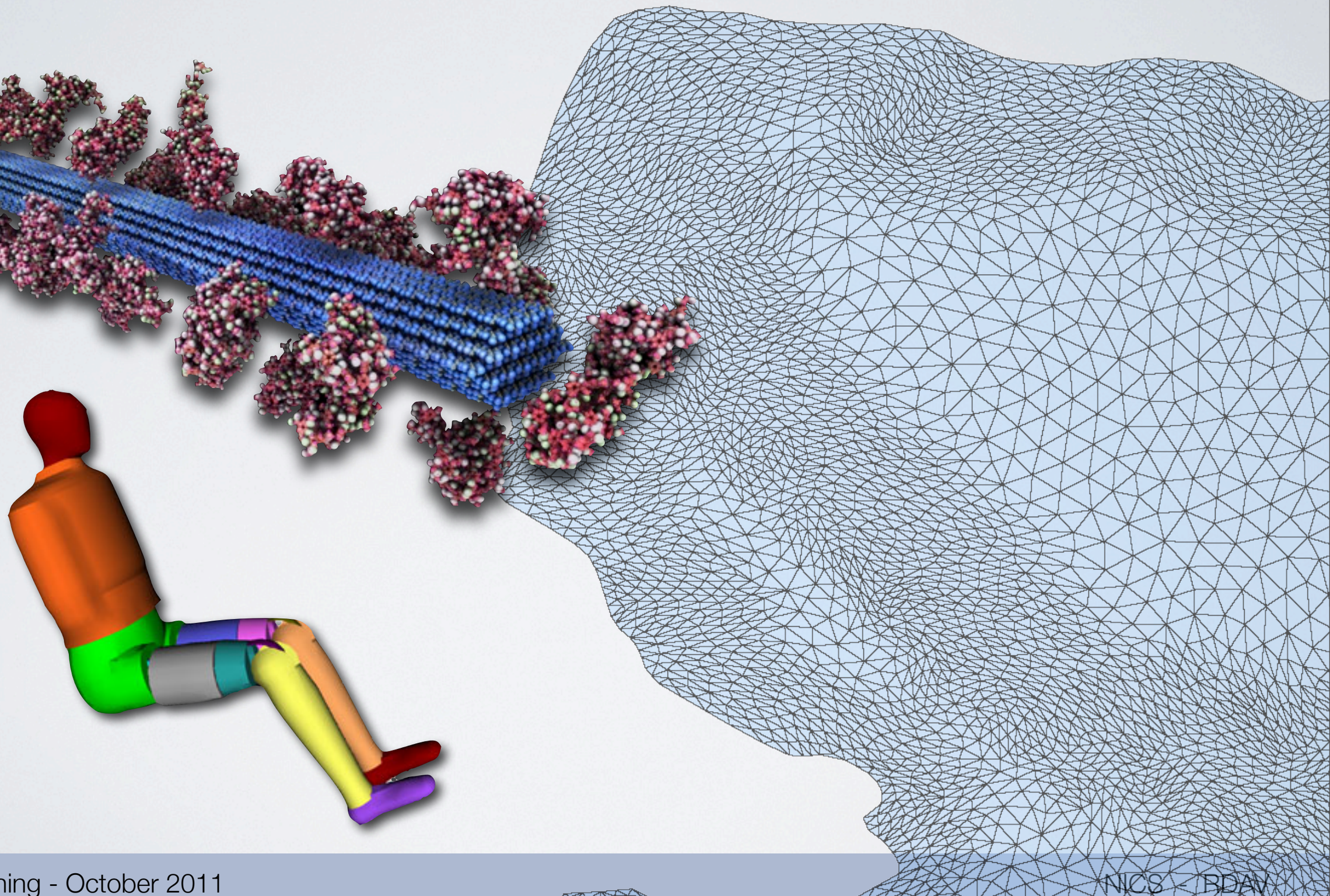
Nodal



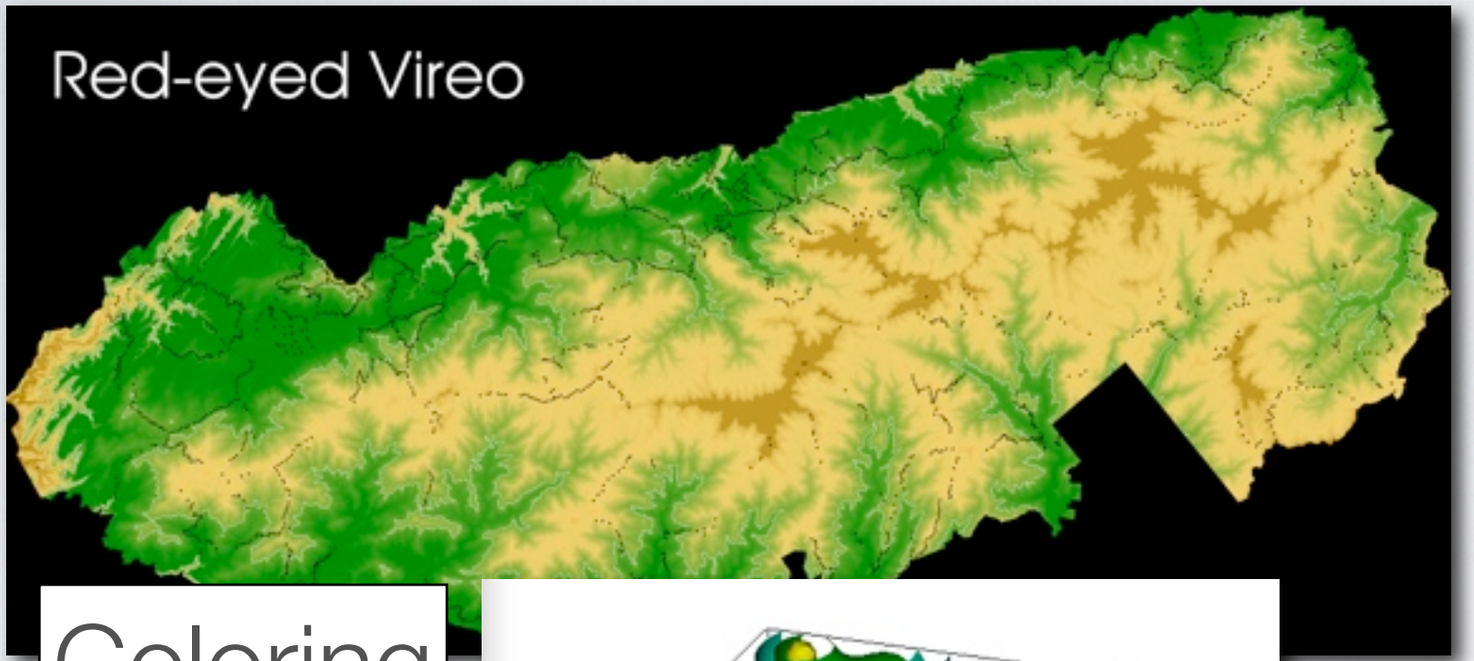
Zonal

# Mesh Visualization

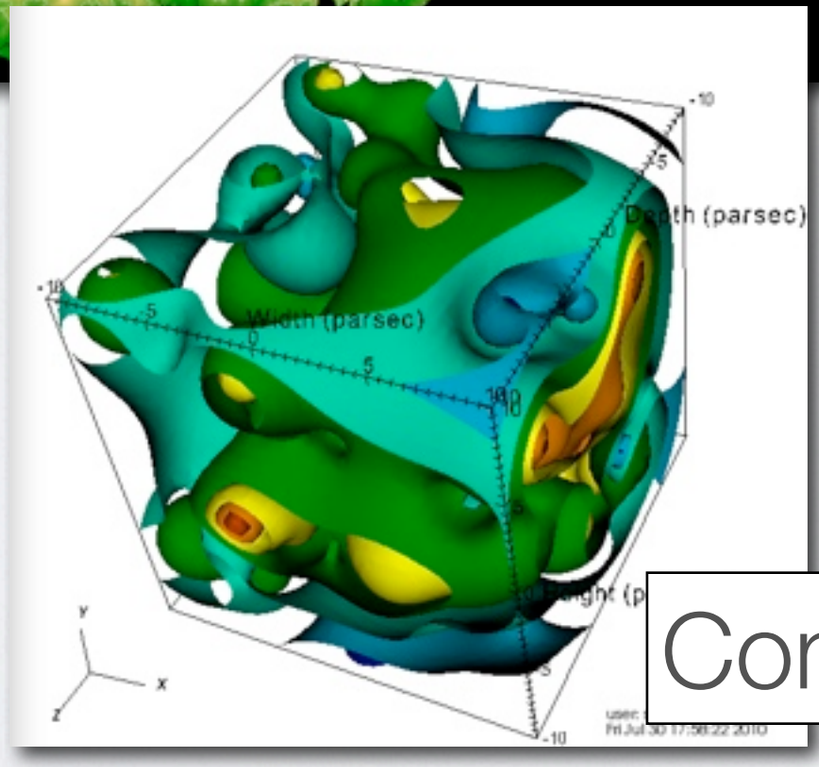




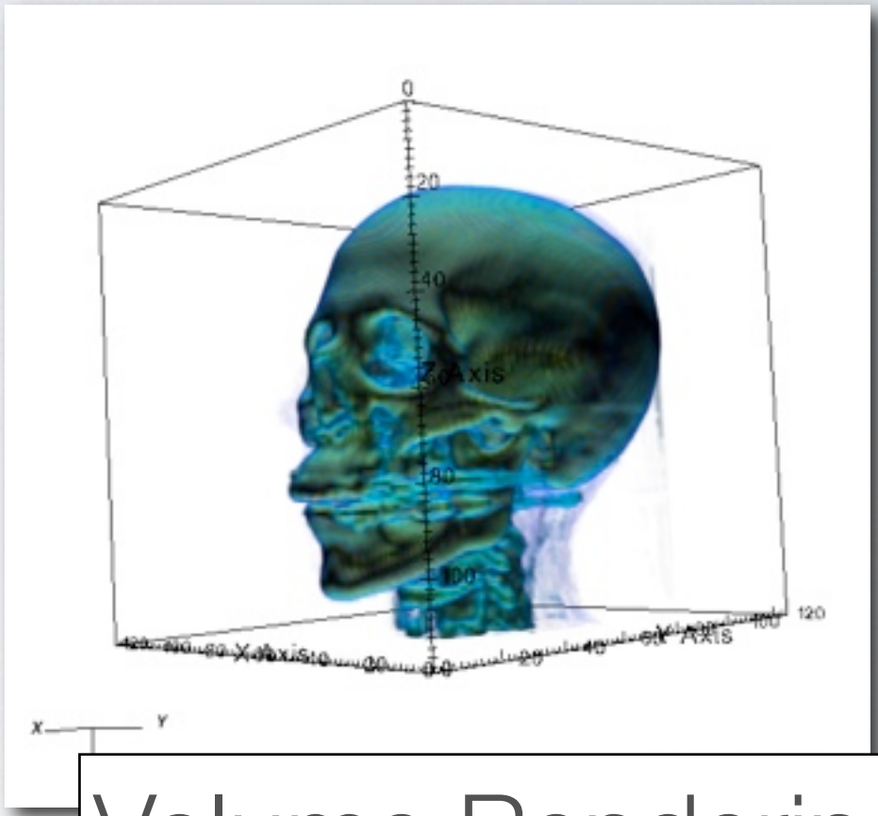
# Scalar Visualization




Coloring



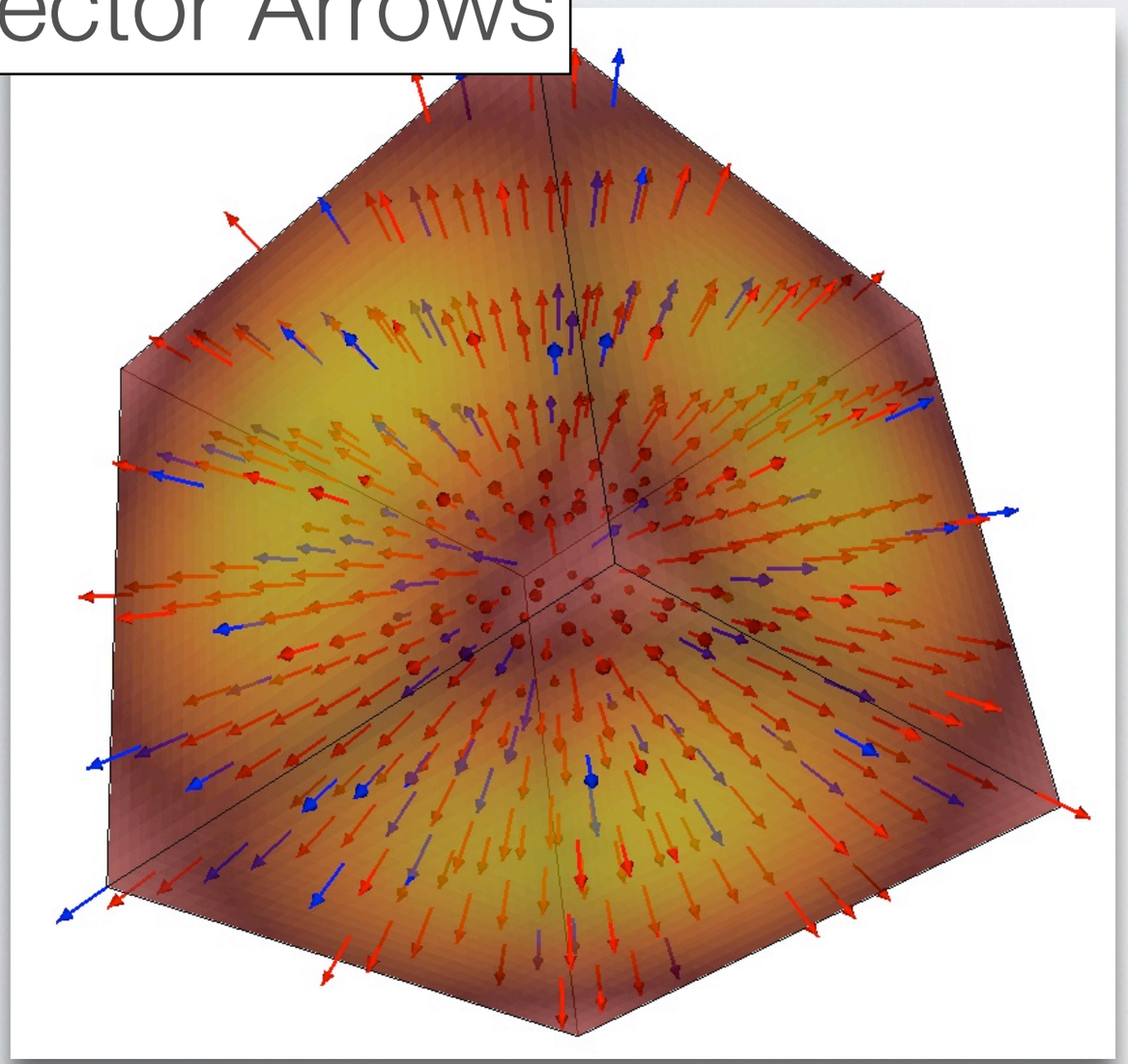

Contours/Isosurfaces




Volume Rendering

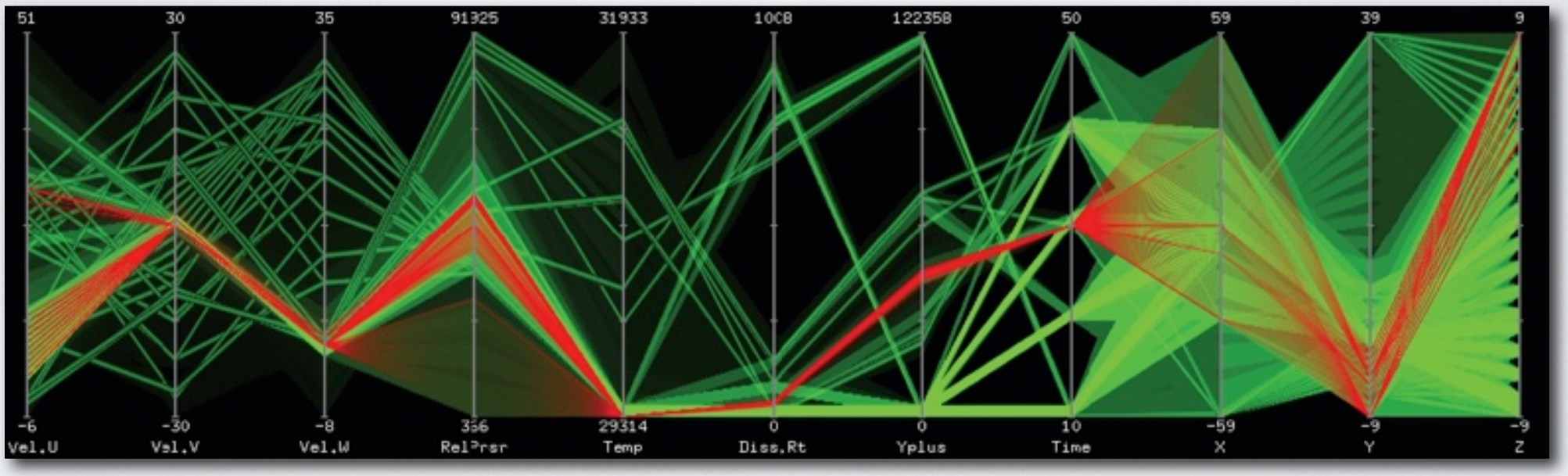
# Vector Visualization

Vector Arrows



Streamlines

# Multivariate Visualization

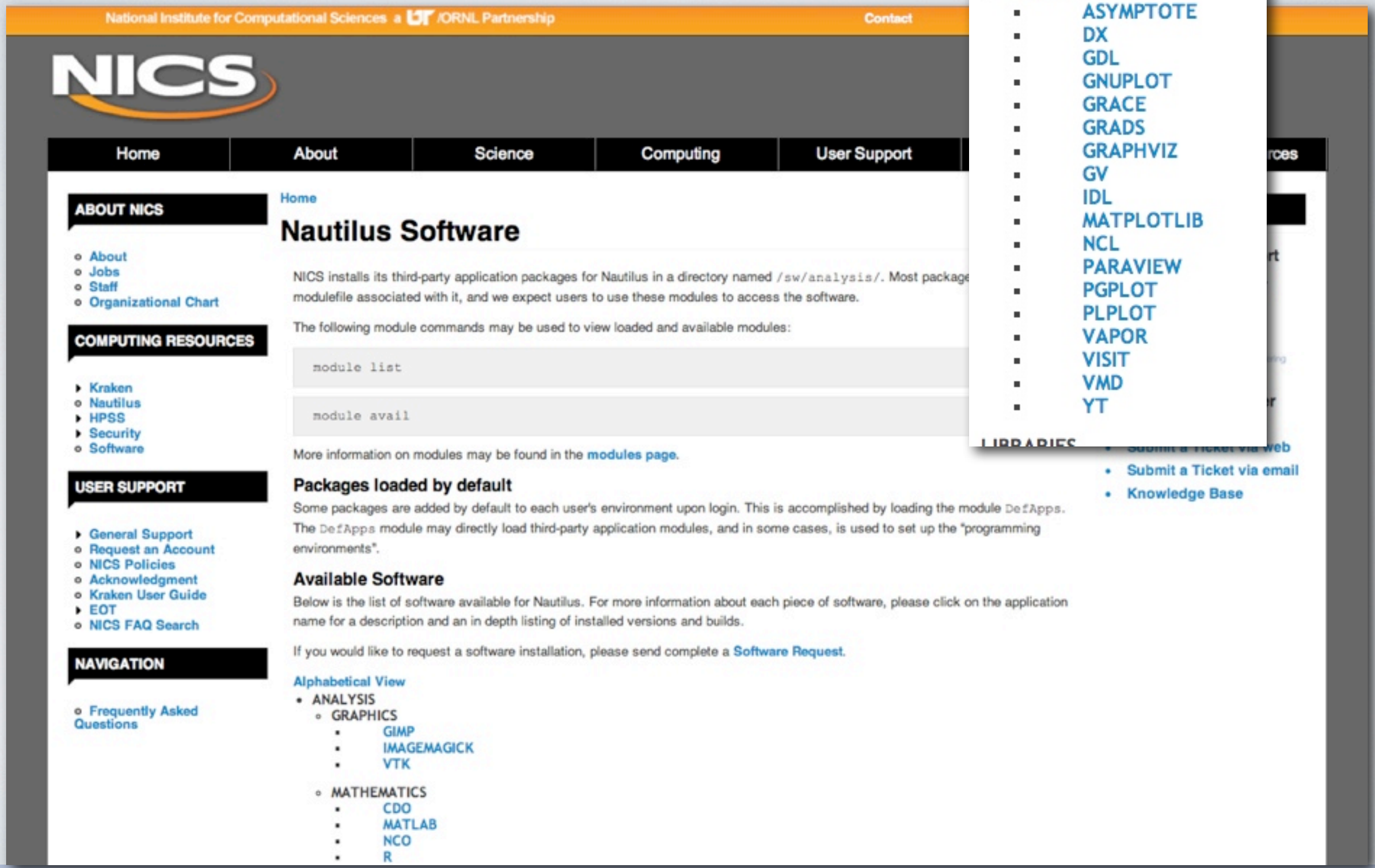



Parallel Coordinates



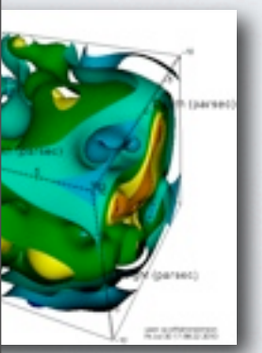
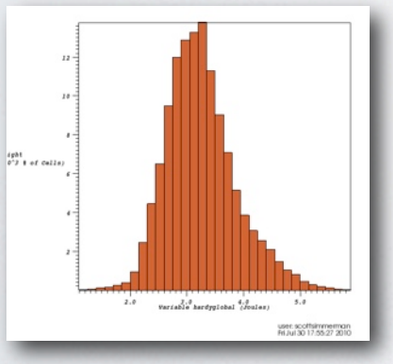
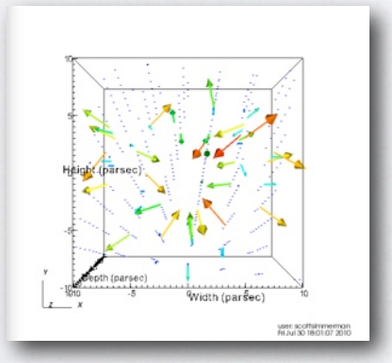
# Scientific Visualization Tools

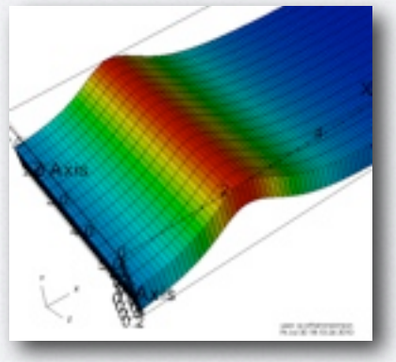
# http://www.nics.tennessee.edu/computing-resources/nautilus/software

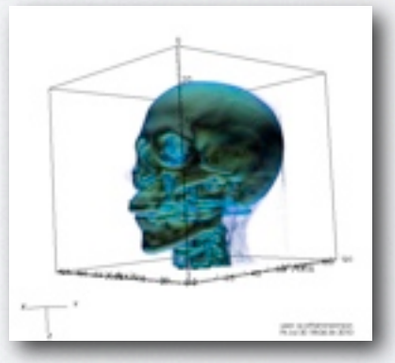
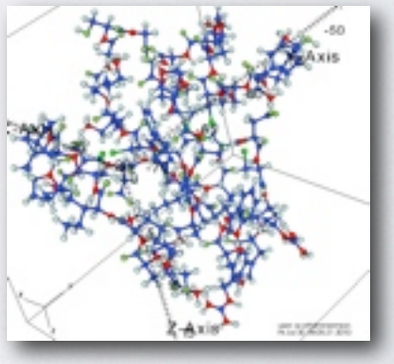


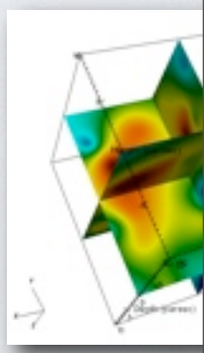
# What is VisIt?

- Open source visualization tool for scientific data
- Uses VTK, Qt and Python
- Supports over 100 different file formats
- Handles large data in parallel
- Used and supported at all major HPC centers
- Active developers spread over 5+ institutions





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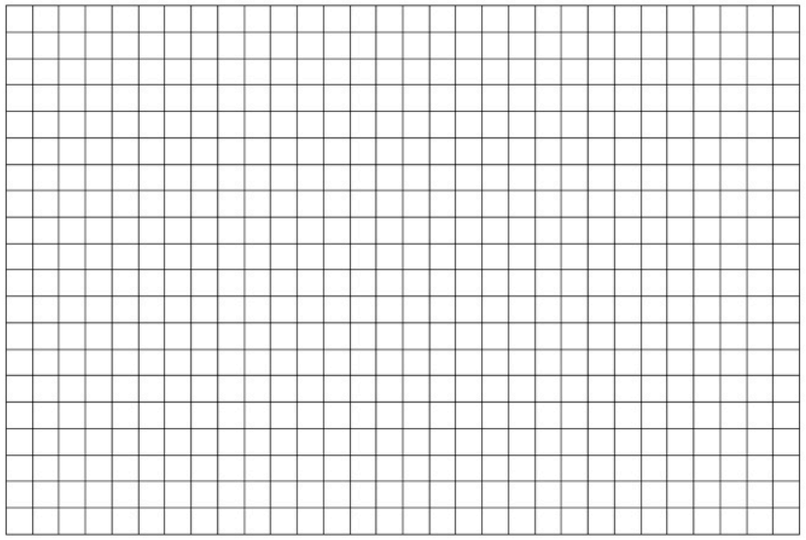
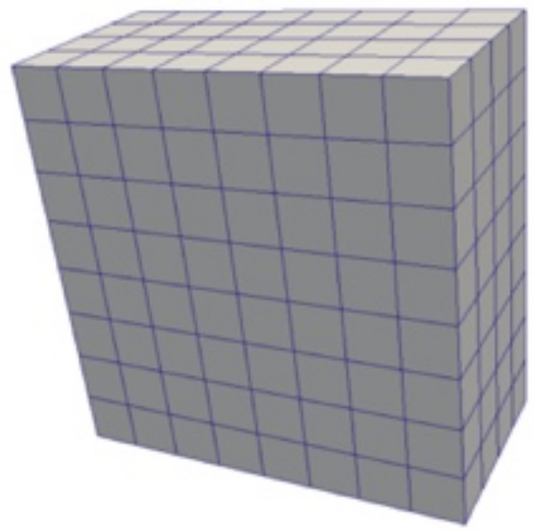
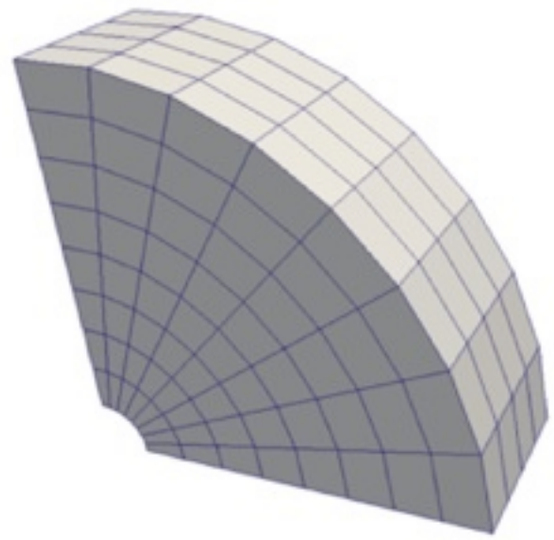




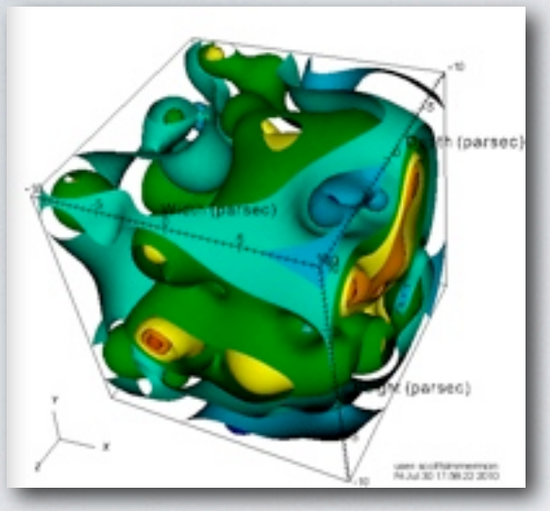


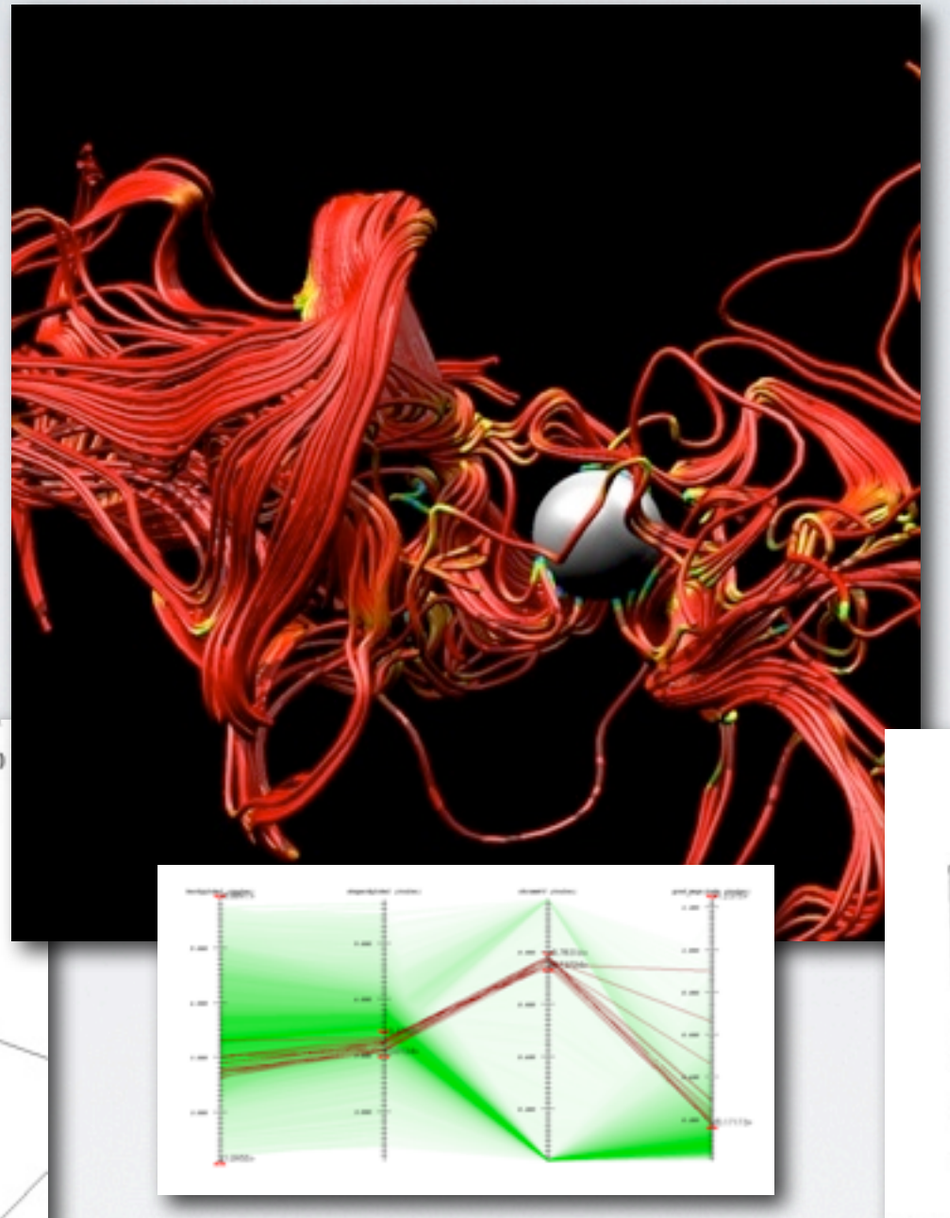
# Data On Mesh

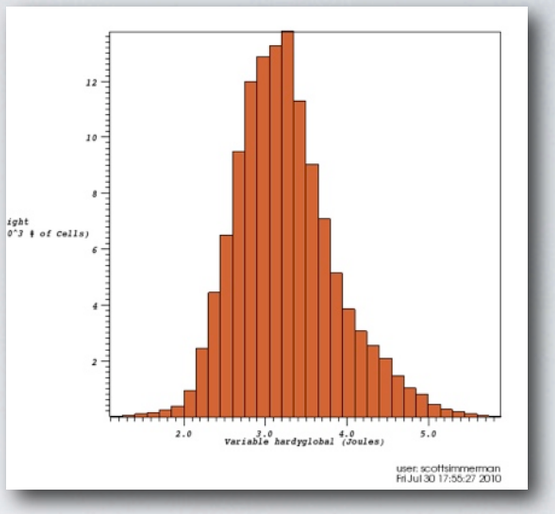
rectilinear, curvilinear, unstructured, point, AMR

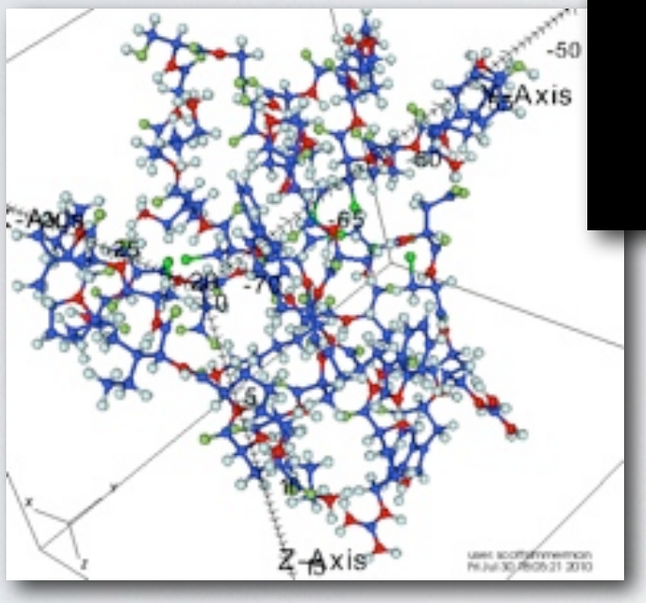
# Supported File Formats

- General Graphics: Image (jpeg, png, etc.), RAW, STL
- General ASCII: PlainText, Curve2D, Point3D
- Visualization: BOV, EnSight, PLOT2D/3D, VTK, Tecplot
- General Scientific: Exodus, HDF5, NetCDF, PDB, Silo
- Application Codes/Toolkits: Boxlib, Chombo, OpenFOAM, SAMRAI, Enzo, FLASH, LAMMPS, NASTRAN, Pixie

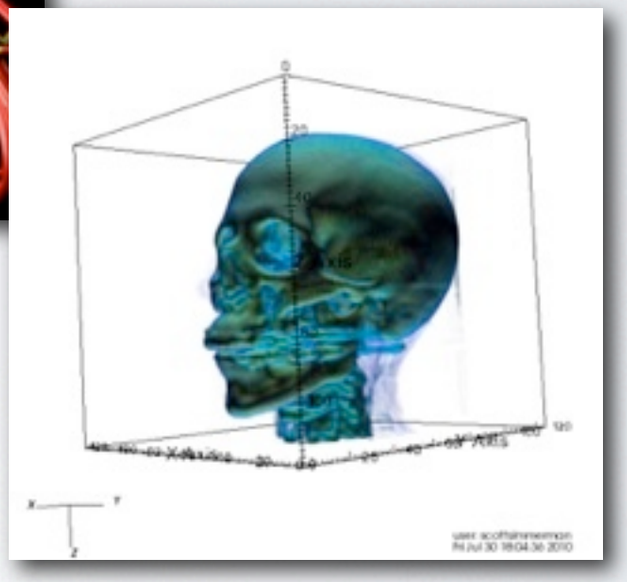






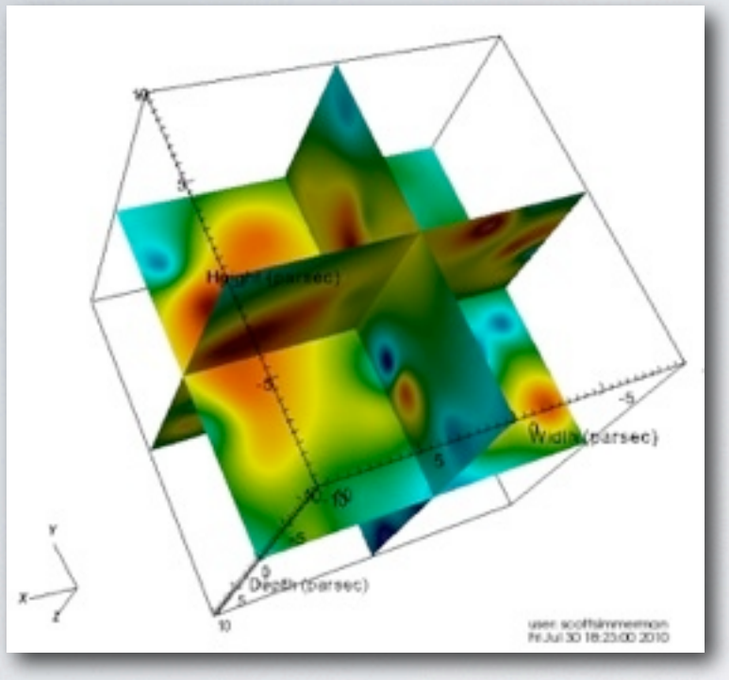



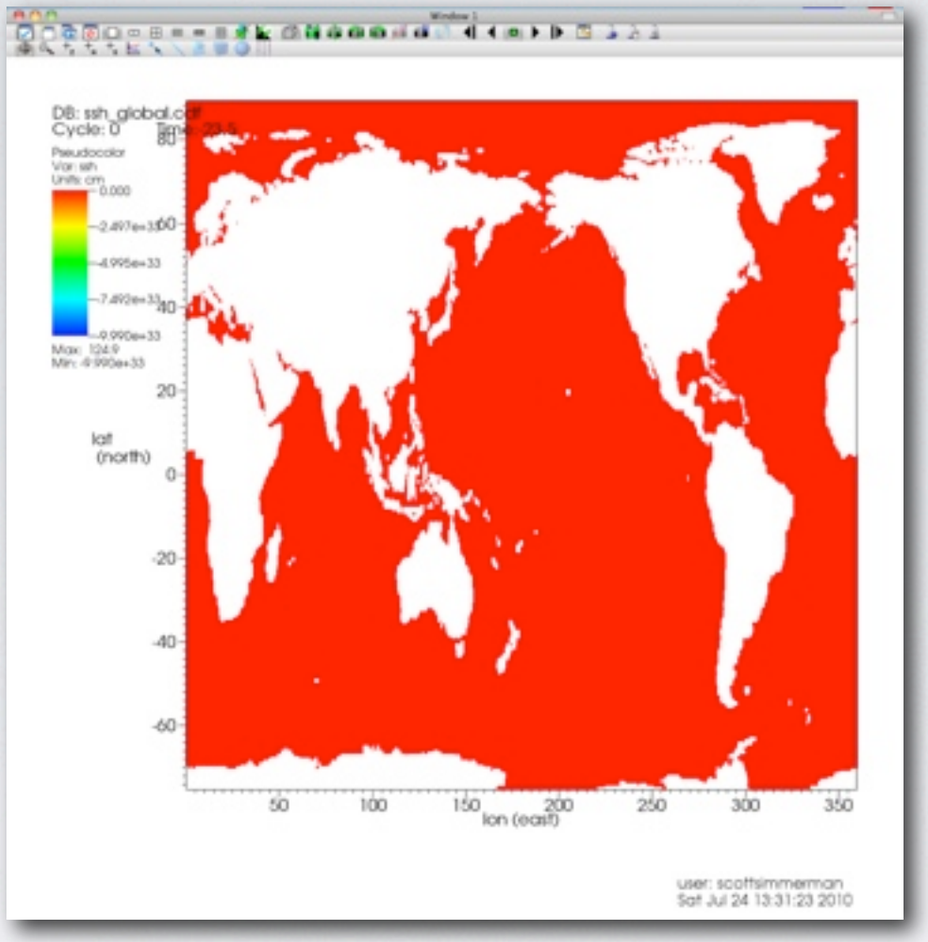


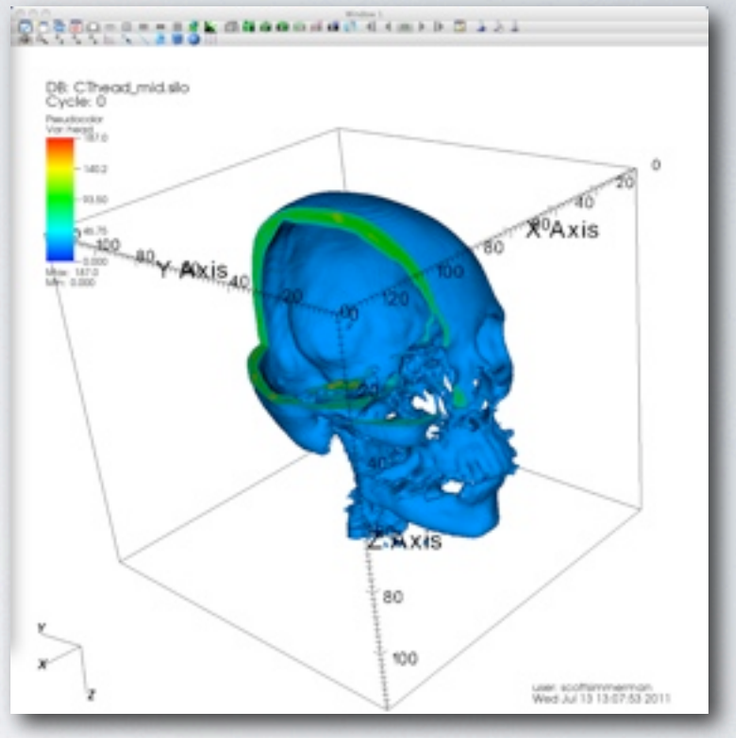



# Plots

volume, pseudocolor, parallel coordinates, molecule, streamlines

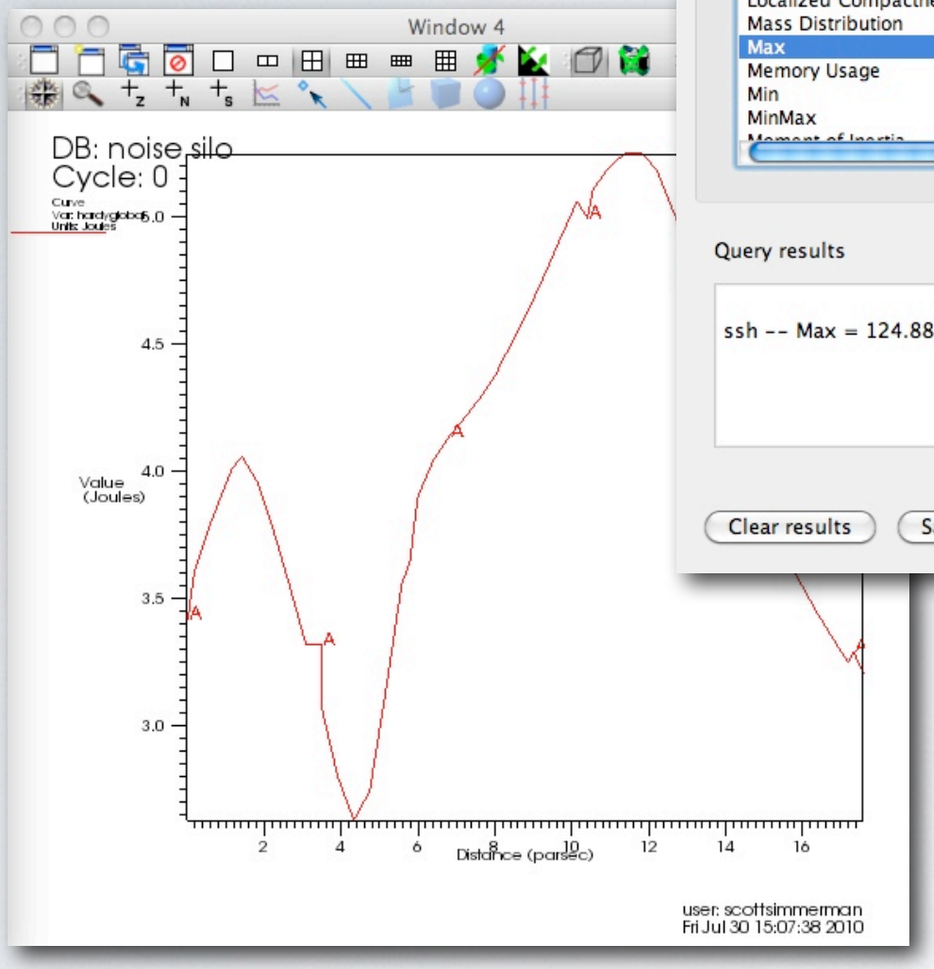


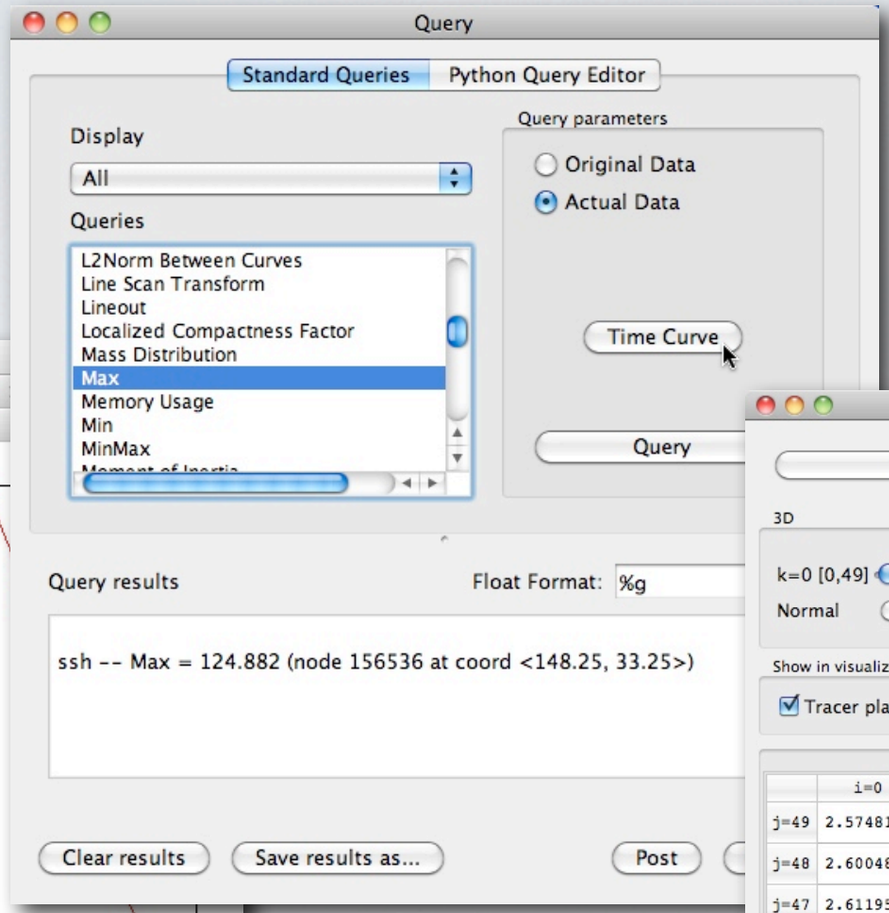



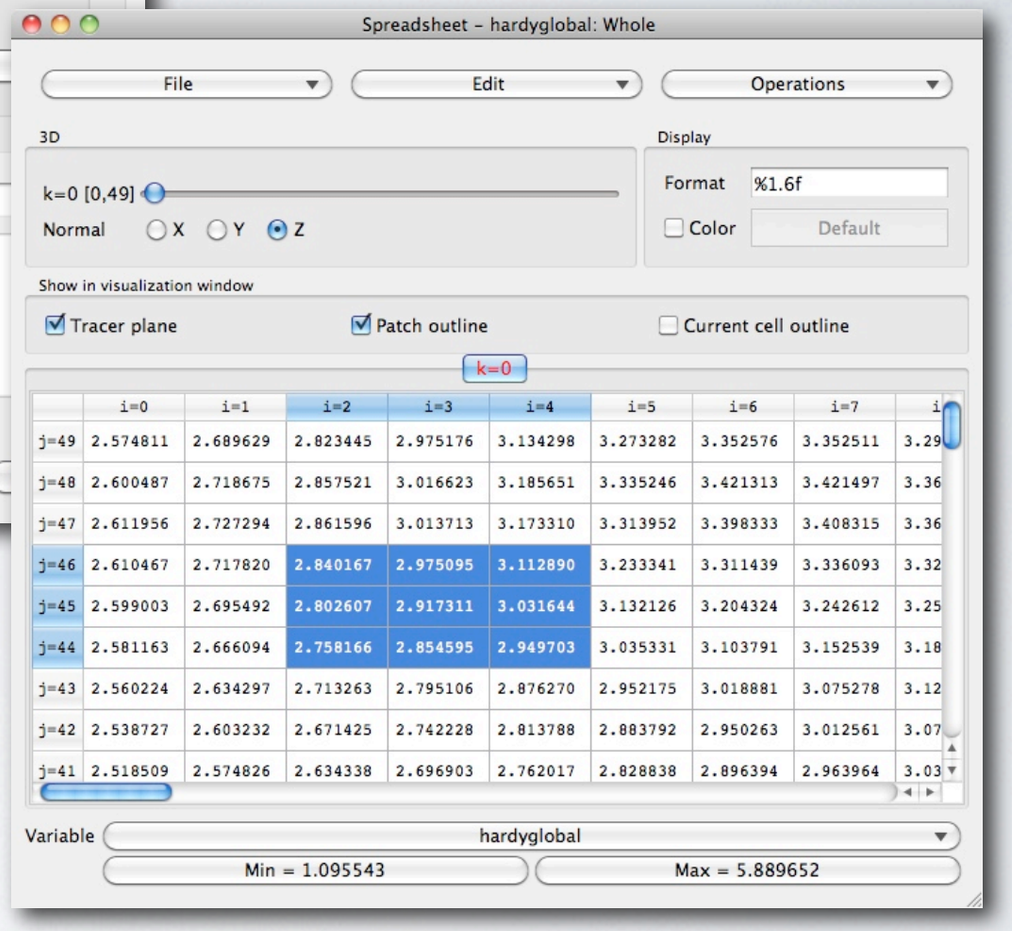




# Operators

slice, clip, contour, threshold, elevate, transform



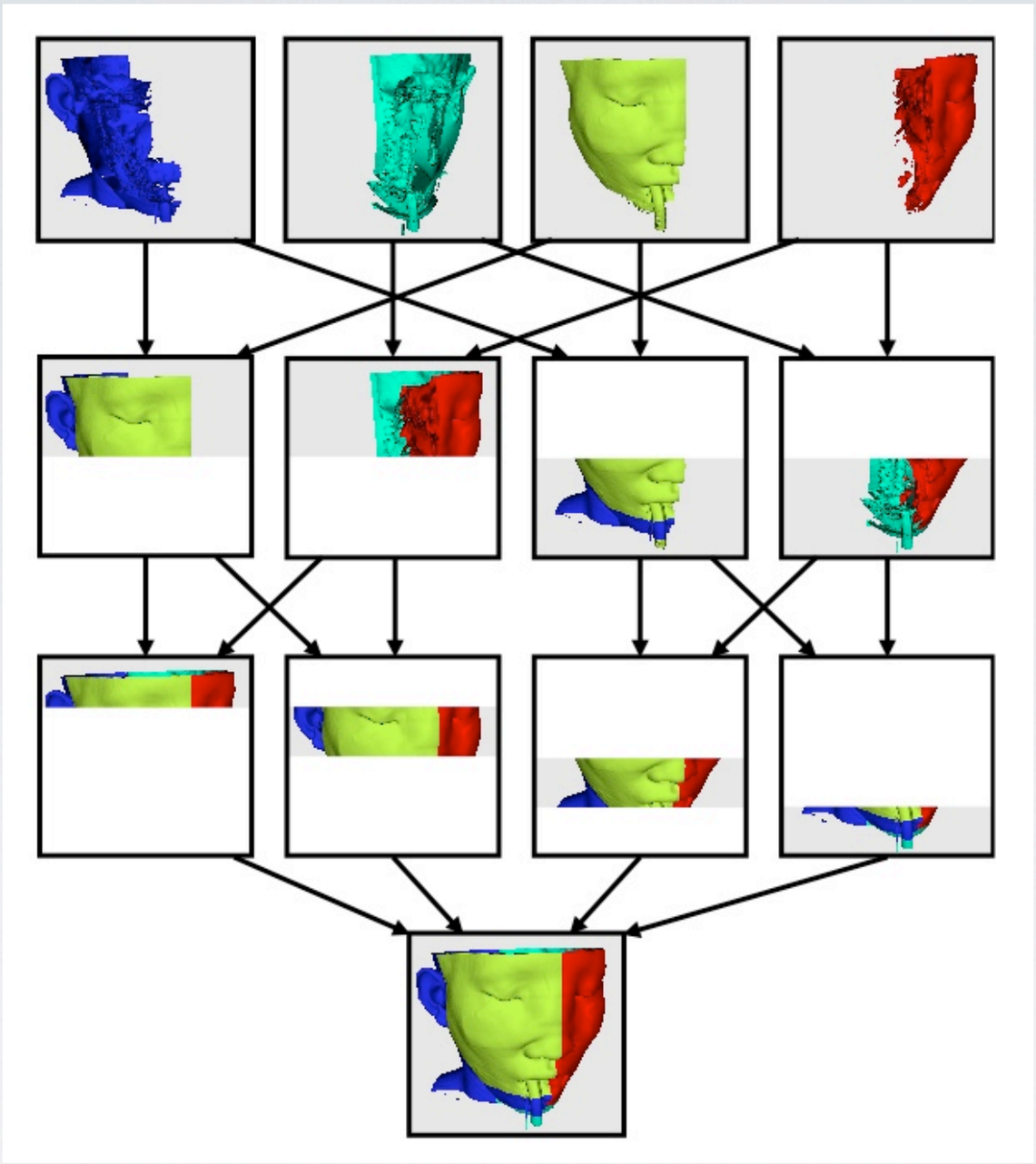




| | i=0 | i=1 | i=2 | i=3 | i=4 | i=5 | i=6 | i=7 | i |
|---|---|---|---|---|---|---|---|---|---|
| j=49 | 2.574811 | 2.689629 | 2.823445 | 2.975176 | 3.134298 | 3.273282 | 3.352576 | 3.352511 | 3.29 |
| j=48 | 2.600487 | 2.718675 | 2.857521 | 3.016623 | 3.185651 | 3.335246 | 3.421313 | 3.421497 | 3.36 |
| j=47 | 2.611956 | 2.727294 | 2.861596 | 3.013713 | 3.173310 | 3.313952 | 3.398333 | 3.408315 | 3.36 |
| j=46 | 2.610467 | 2.717820 | 2.840167 | 2.975095 | 3.112890 | 3.233341 | 3.311439 | 3.336093 | 3.32 |
| j=45 | 2.599003 | 2.695492 | 2.802607 | 2.917311 | 3.031644 | 3.132126 | 3.204324 | 3.242612 | 3.25 |
| j=44 | 2.581163 | 2.666094 | 2.758166 | 2.854595 | 2.949703 | 3.035331 | 3.103791 | 3.152539 | 3.18 |
| j=43 | 2.560224 | 2.634297 | 2.713263 | 2.795106 | 2.876270 | 2.952175 | 3.018881 | 3.075278 | 3.12 |
| j=42 | 2.538727 | 2.603232 | 2.671425 | 2.742228 | 2.813788 | 2.883792 | 2.950263 | 3.012561 | 3.07 |
| j=41 | 2.518509 | 2.574826 | 2.634338 | 2.696903 | 2.762017 | 2.828838 | 2.896394 | 2.963964 | 3.03 |

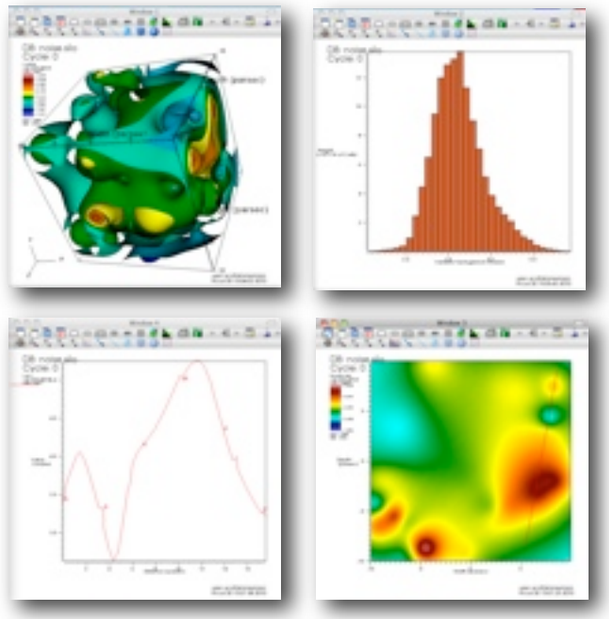
# Data Analysis

query, lineout, spreadsheet, picks



# Handles Large Data in Parallel

**GUI** - user interface

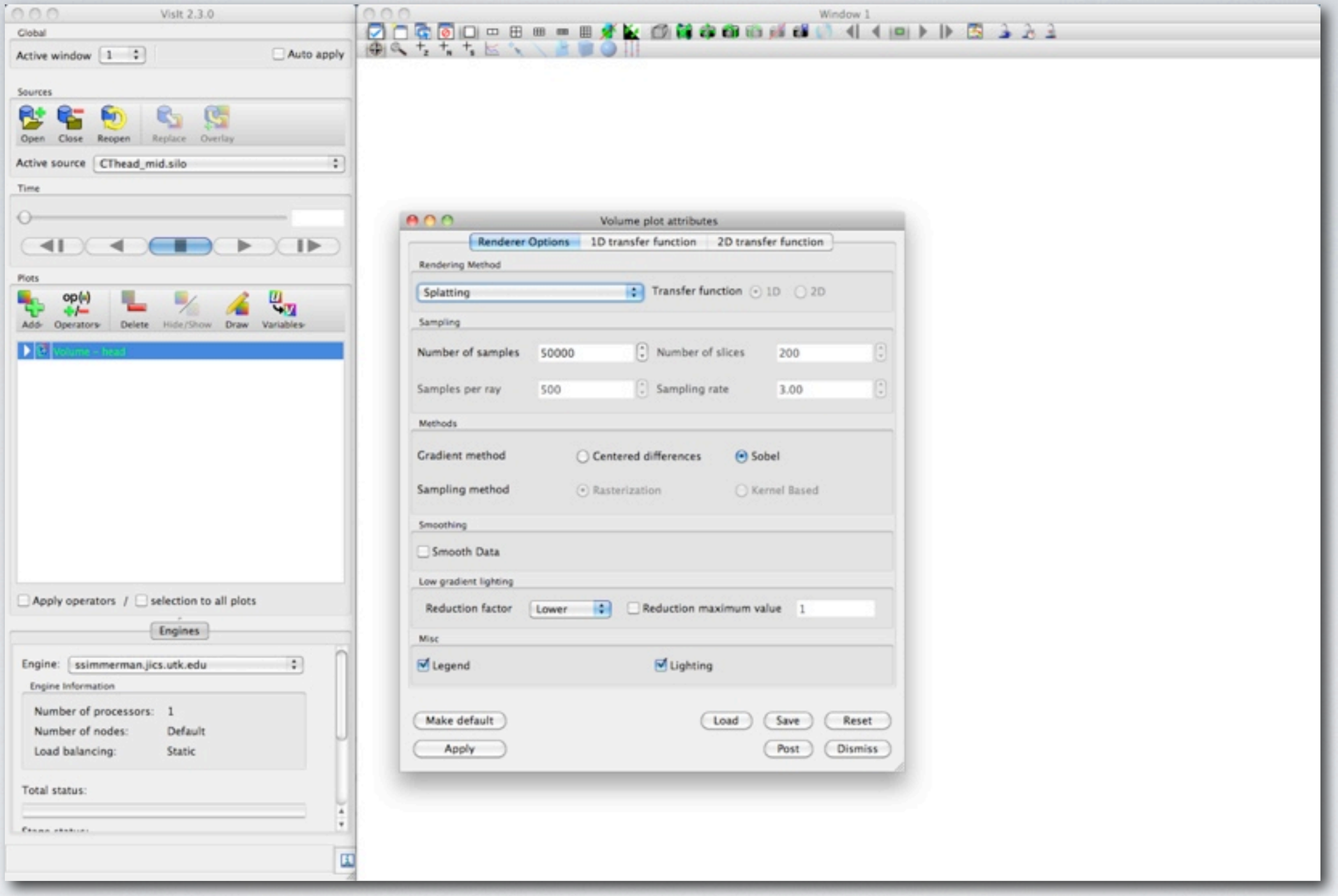


**Viewer** - manages vis windows

**Database Server** - connects to file system; reads metadata

**Compute Engine** - reads and processes data; sends geometry or images to viewer

# Client/Server Architecture




# VisIt GUI and Viewer

# Using VisIt - 3 Ways

- Run VisIt with GUI on Nautilus (X forwarding or VNC)
- Run VisIt without GUI in batch mode via Python scripting
- Run VisIt client locally and connect to server on Nautilus

# VisIt Demo

VisIt Website:

**http://visit.llnl.gov**

VisIt Wiki:

**http://visitusers.org**

RDAV Website:

**http://rdav.nics.tennessee.edu**

# Questions?