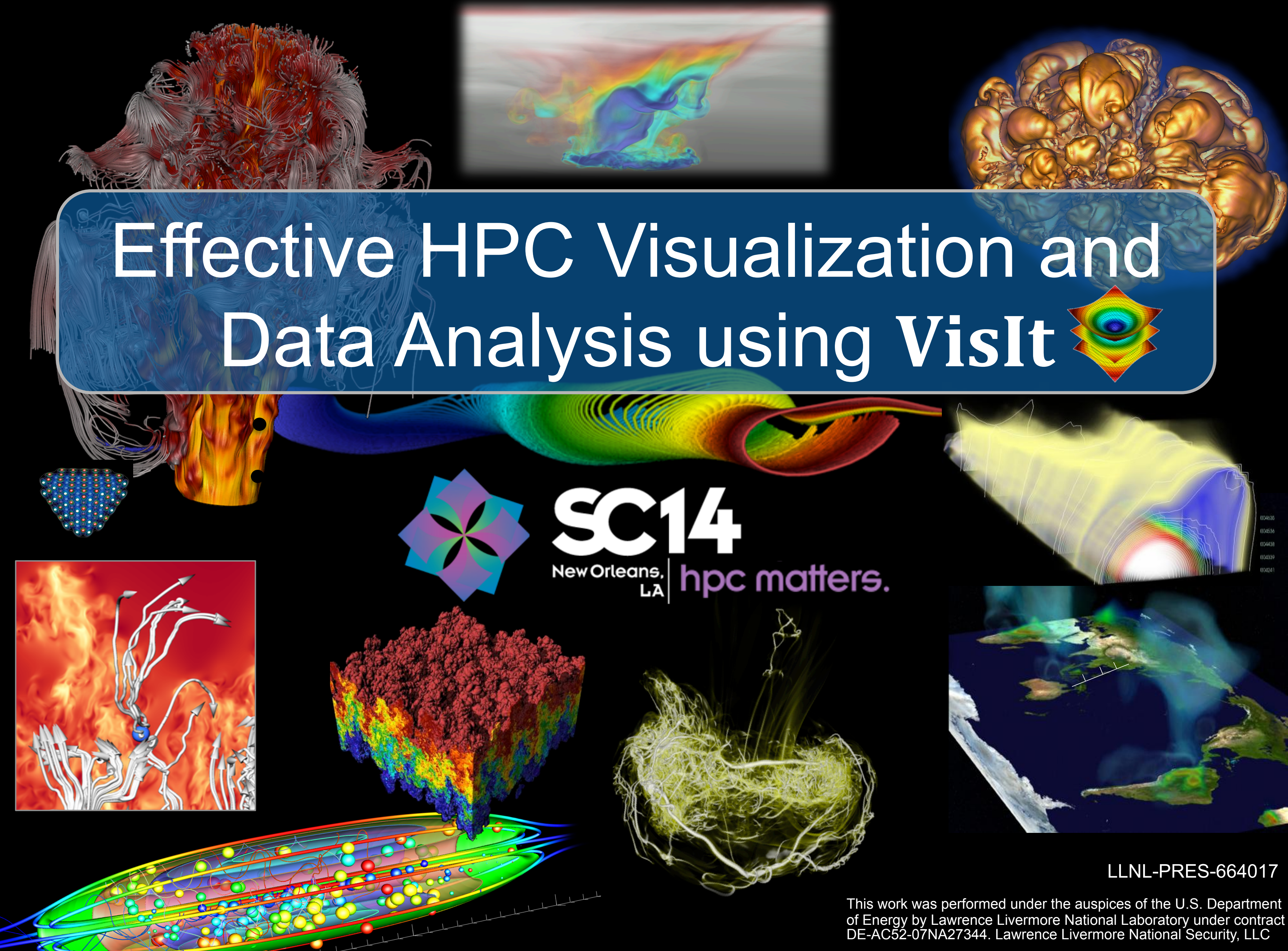


Effective HPC Visualization and Data Analysis using **VisIt**

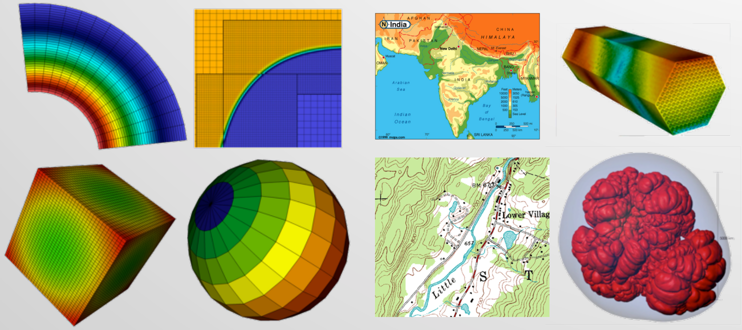
SC14
New Orleans, LA | hpc matters.

LLNL-PRES-664017

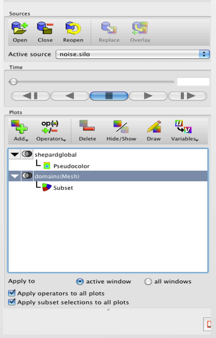
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

Tutorial Topics:

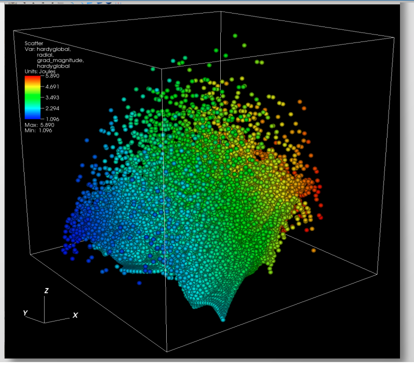
An introduction to Scientific Visualization using VisIt



Scientific Visualization Concepts

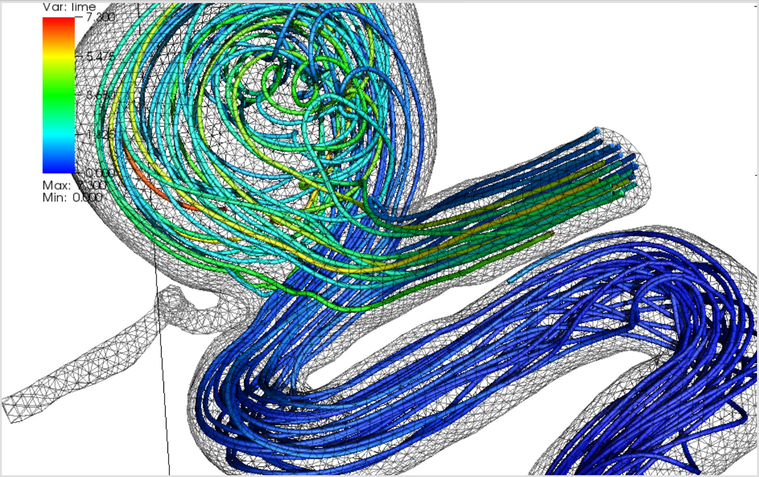


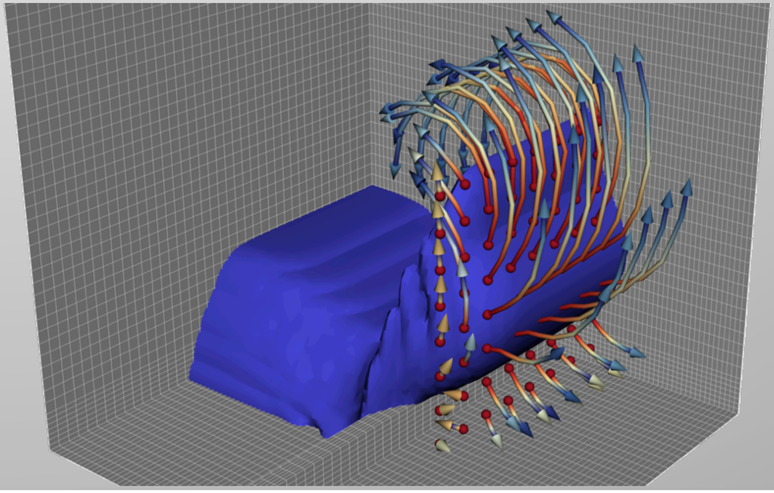
Active window 1
☐ Auto apply
Active source noise.silo
shepardglobal
Pseudocolor
domains(Mesh)
Subset
Apply to ● active window ○ all windows
☑ Apply operators to all plots
☑ Apply subset selections to all plots



Guided Tour of VisIt

With two in-depth / hands-on visualizations:





Aneurysm (Blood Flow) Simulation

Water Flow Simulation

Tutorial Resources

- **Tutorial Information:**

http://visitusers.org/index.php?title=VisIt_Tutorial

- **Tutorial Prep:**

http://visitusers.org/index.php?title=Tutorial_Preparation

- **Example Datasets:**

http://visitusers.org/index.php?title=Tutorial_Data

- **Blood Flow Hands-on:**

http://visitusers.org/index.php?title=Blood_Flow_Aneurysm_Tutorial

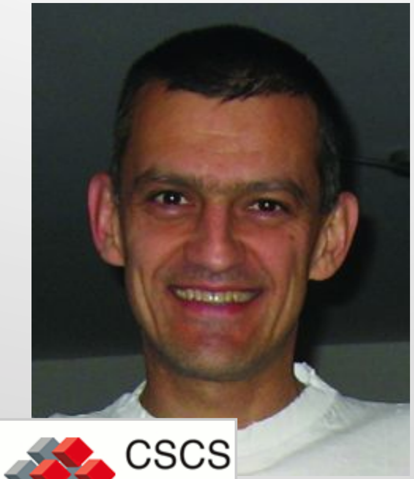
- **Water Flow Hands-on:**

http://visitusers.org/index.php?title=Water_Flow_Tutorial

Tutorial Speakers

Cyrus Harrison

Jean Favre



CSCS

Brad Whitlock

Intelligent Light

David Pugmire

OAK RIDGE
National Laboratory

Robert Sisneros

NCSA

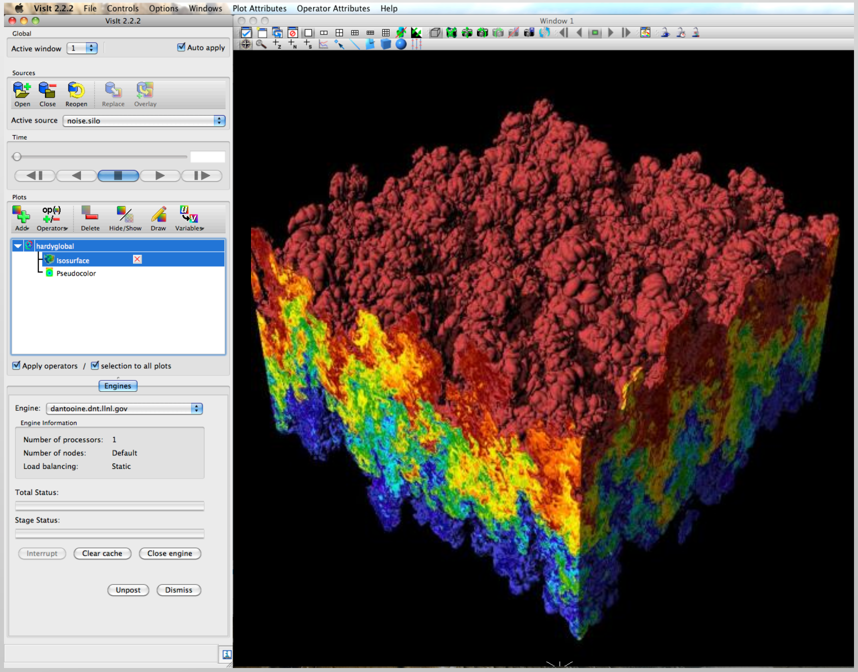
Tutorial Outline

- Intro
- VisIt Project Overview
- Techniques for visualizing mesh-based simulations
- VisIt setup help for attendees
- Guided tour of VisIt
- Showcase of VisIt Visualizations
- *<Break>*
- Hands on demonstrations:
  - Visualization of an Aneurysm (Blood Flow) Simulation
  - Visualization of a Water Flow Simulation
- Practical Tips
- Closing Remarks and Questions

VisIt Project Introduction

VisIt is an open source, turnkey application for data analysis and visualization of mesh-based data.

- Production end-user tool supporting scientific and engineering applications.
- Provides an infrastructure for parallel post-processing that scales from desktops to massive HPC clusters.
- Source released under a BSD style license.



Active window 1

☑ Auto apply

Active source noise.silo

hardyglobal
Isosurface
Pseudocolor

☑ Apply operators / ☑ selection to all plots

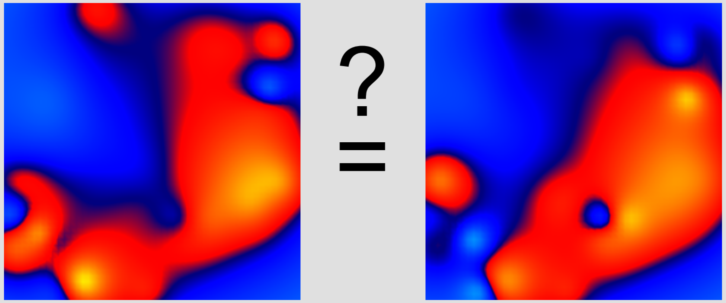
Engine: dantooine.dnt.llnl.gov

Number of processors: 1
Number of nodes: Default
Load balancing: Static

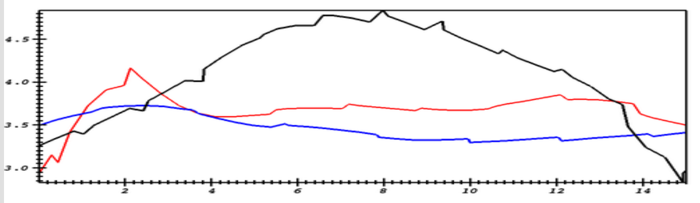
Density Isovolume of a 3K^3 (27 billion cell) dataset

VisIt supports a wide range of use cases.

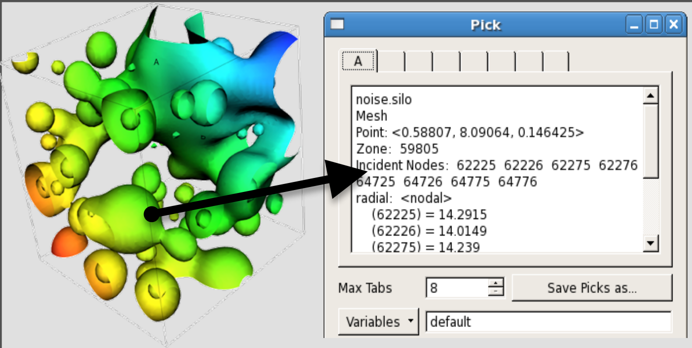
Data Exploration



Comparative Analysis



Quantitative Analysis

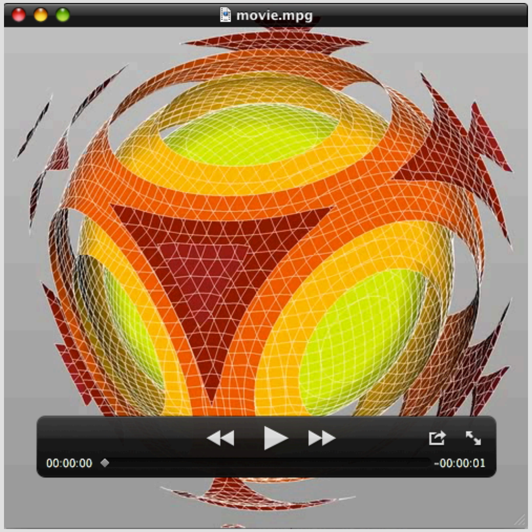


noise.silo
Mesh
Point: <0.58807, 8.09064, 0.146425>
Zone: 59805
Incident Nodes: 62225 62226 62275 62276
64725 64726 64775 64776
radial: <nodal>
(62225) = 14.2915
(62226) = 14.0149
(62275) = 14.239

Max Tabs: 8

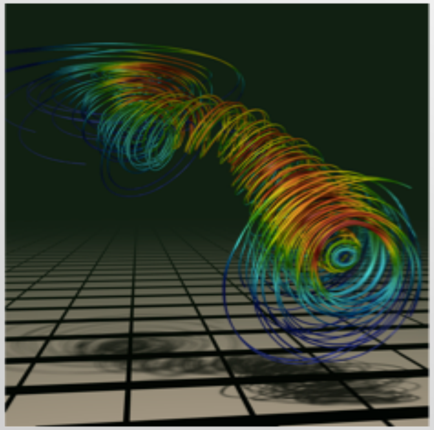
Variables: default

Visual Debugging

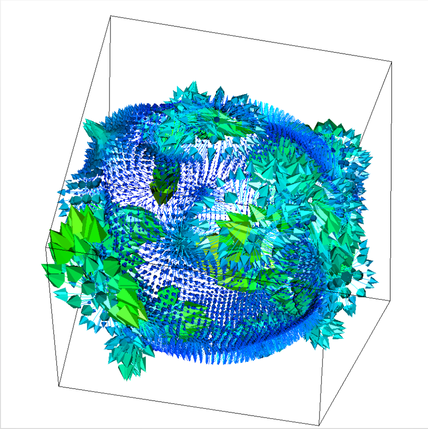


Presentation Graphics

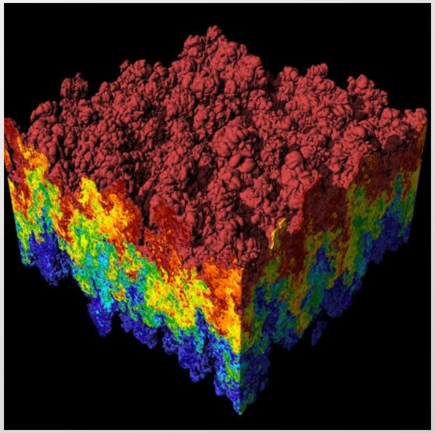
Examples of VisIt's visualization capabilities.



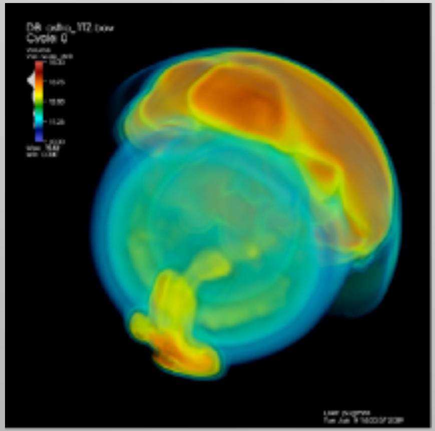
Streamlines



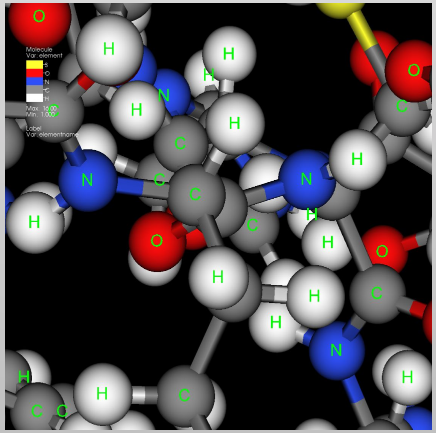
Vector / Tensor Glyphs



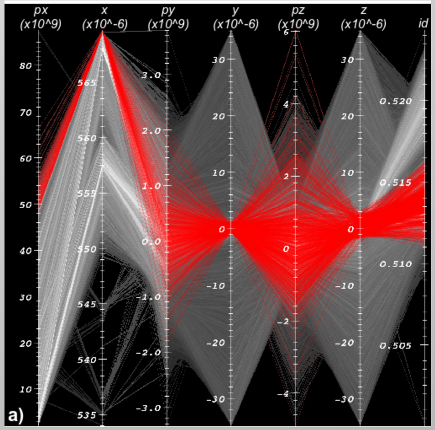
Pseudocolor Rendering



Volume Rendering

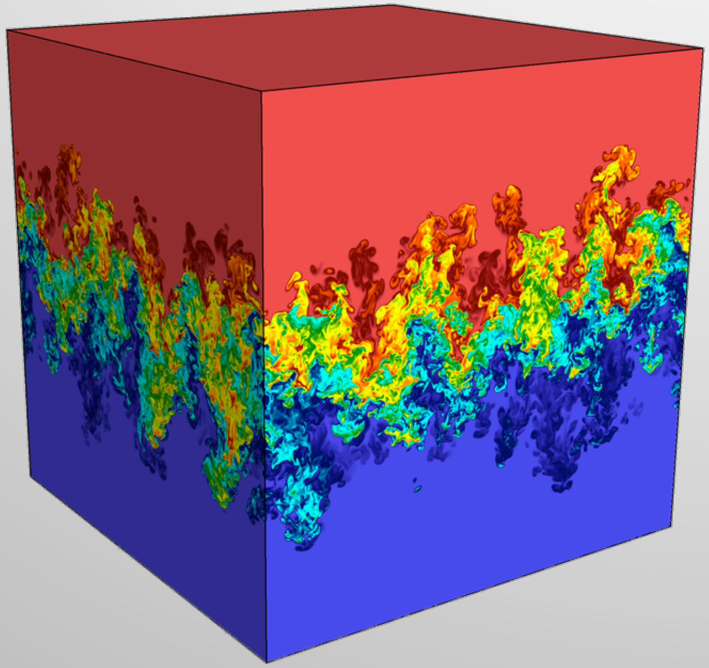


Molecular Visualization

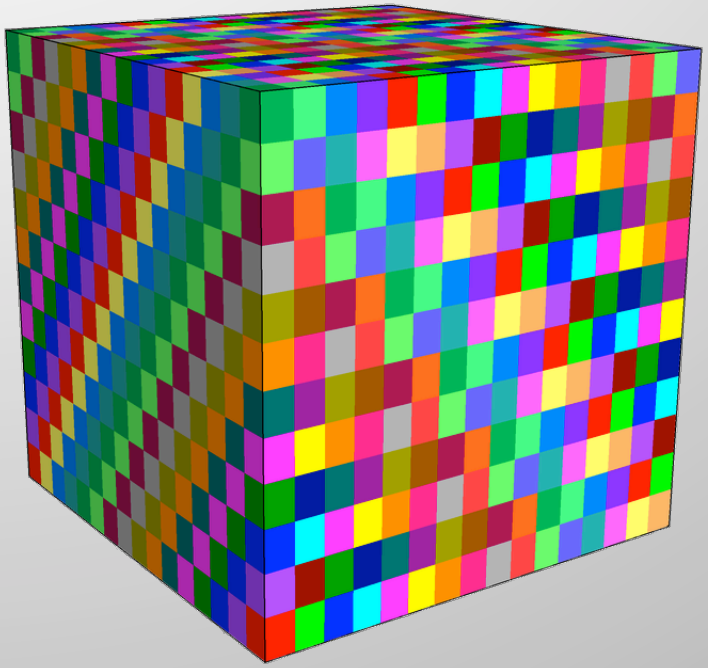


Parallel Coordinates

VisIt uses MPI for distributed-memory parallelism on HPC clusters.



Full Dataset
(27 billion total cells)

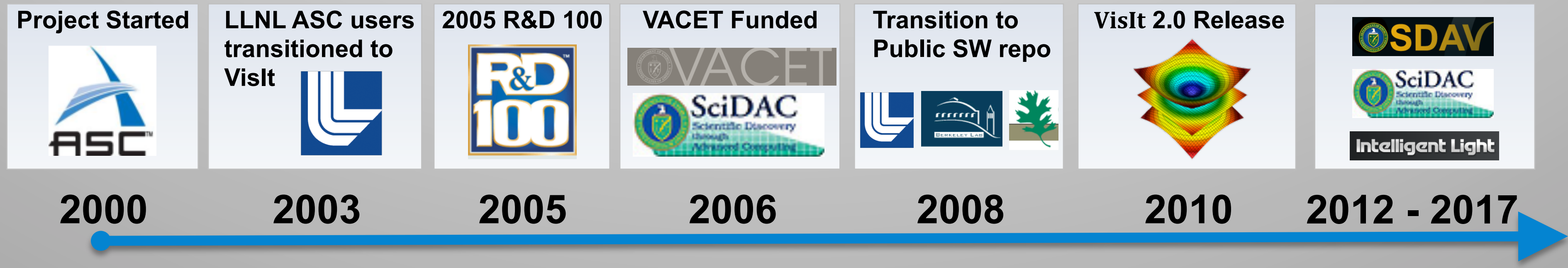


3072 sub-grids
(each 192x129x256 cells)

We are enhancing VisIt's pipeline infrastructure to also support threaded processing.

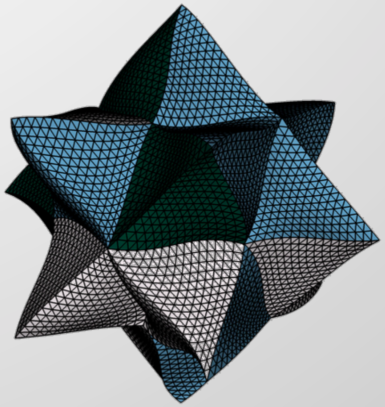
VisIt is a vibrant project with many participants.

- The VisIt project started in 2000 to support LLNL's large scale ASC physics codes.
- The project grew beyond LLNL and ASC with research and development from DOE SciDAC and other efforts.
- VisIt is now supported by multiple organizations:
    - LLNL, LBNL, ORNL, UC Davis, Univ of Utah, Intelligent Light, …
- Over 75 person years of effort, 1.5+ million lines of code.


Project Started
ASC
2000
LLNL ASC users transitioned to VisIt
2003
2005 R&D 100
R&D 100
2005
VACET Funded
VACET
SciDAC Scientific Discovery through Advanced Computing
2006
Transition to Public SW repo
Berkeley Lab
2008
VisIt 2.0 Release
2010
SDAV
SciDAC Scientific Discovery through Advanced Computing
Intelligent Light
2012 - 2017

VisIt's capabilities are constantly being expanded.

Recent Development Efforts:

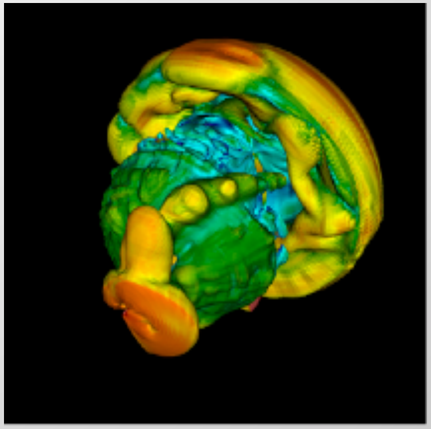


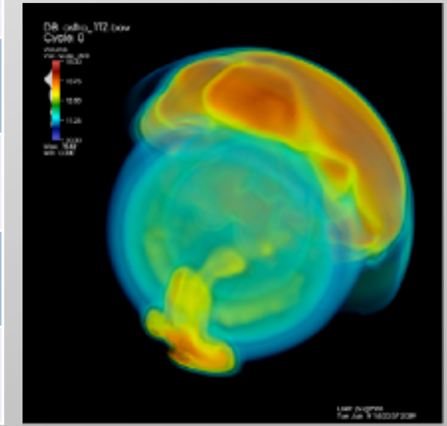
- **Support for High Order Finite Element Meshes via MFEM**
  - https://code.google.com/p/mfem/

- **Port to IBM's BG/Q Platform**
  - 98k-core runs on LLNL's Vulcan Cluster
- **Support for exports to FieldView XDBs**
  - Export reduced datasets for consumption in Intelligent Light's FieldView

VisIt scales well on current HPC platforms.

Machine	Architecture	Problem Size	# of Cores
Graph	*X86_64*	***20,001^3 (8 T cells)***	*12K*
Dawn	BG/P	15,871^3 (4 T cells)	64K
Franklin	Cray XT4	12,596^3 (2 T cells)	32K
JaguarPF	Cray XT5	12,596^3 (2 T cells)	32K
Juno	X86_64	10,000^3 (1 T cells)	16K
Franklin	Cray XT4	10,000^3 (1 T cells)	16K
Ranger	Sun	10,000^3 (1 T cells)	16K
Purple	IBM P5	8,000^3 (0.5 T cells)	8K



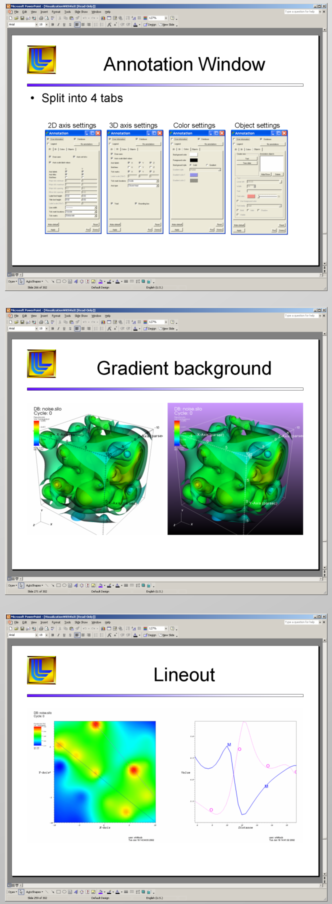


Scaling Studies of Isosurface Extraction and Volume Rendering (2009)

VisIt is also used daily by domain scientists.

The VisIt team focuses on making a robust, usable product for end users.

- Regular releases (~ 6 / year)
  - Executables for all major platforms
  - End-to-end build process script ``build_visit”
- Customer Support and Training
  - visitusers.org, wiki for users and developers
  - Email lists: visit-users, visit-developers
  - Beginner and advanced tutorials
  - VisIt class with detailed exercises
- Documentation
  - “Getting data into VisIt” manual
  - Python interface manual
  - Users reference manual



Annotation Window

- Split into 4 tabs

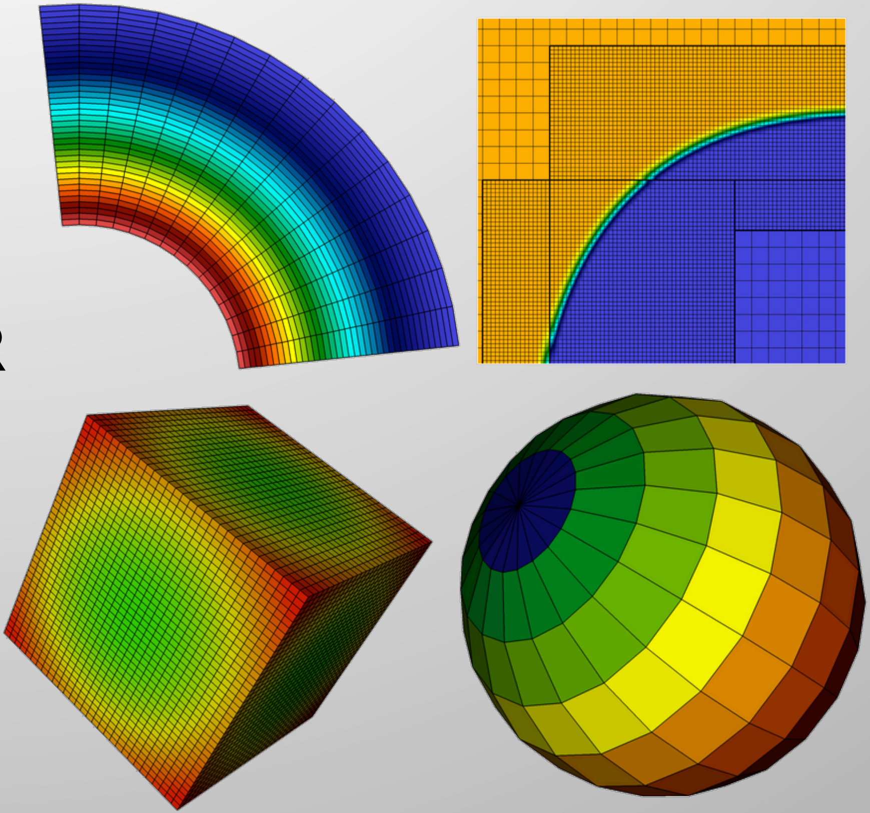
Gradient background

Lineout

Slides from the VisIt class

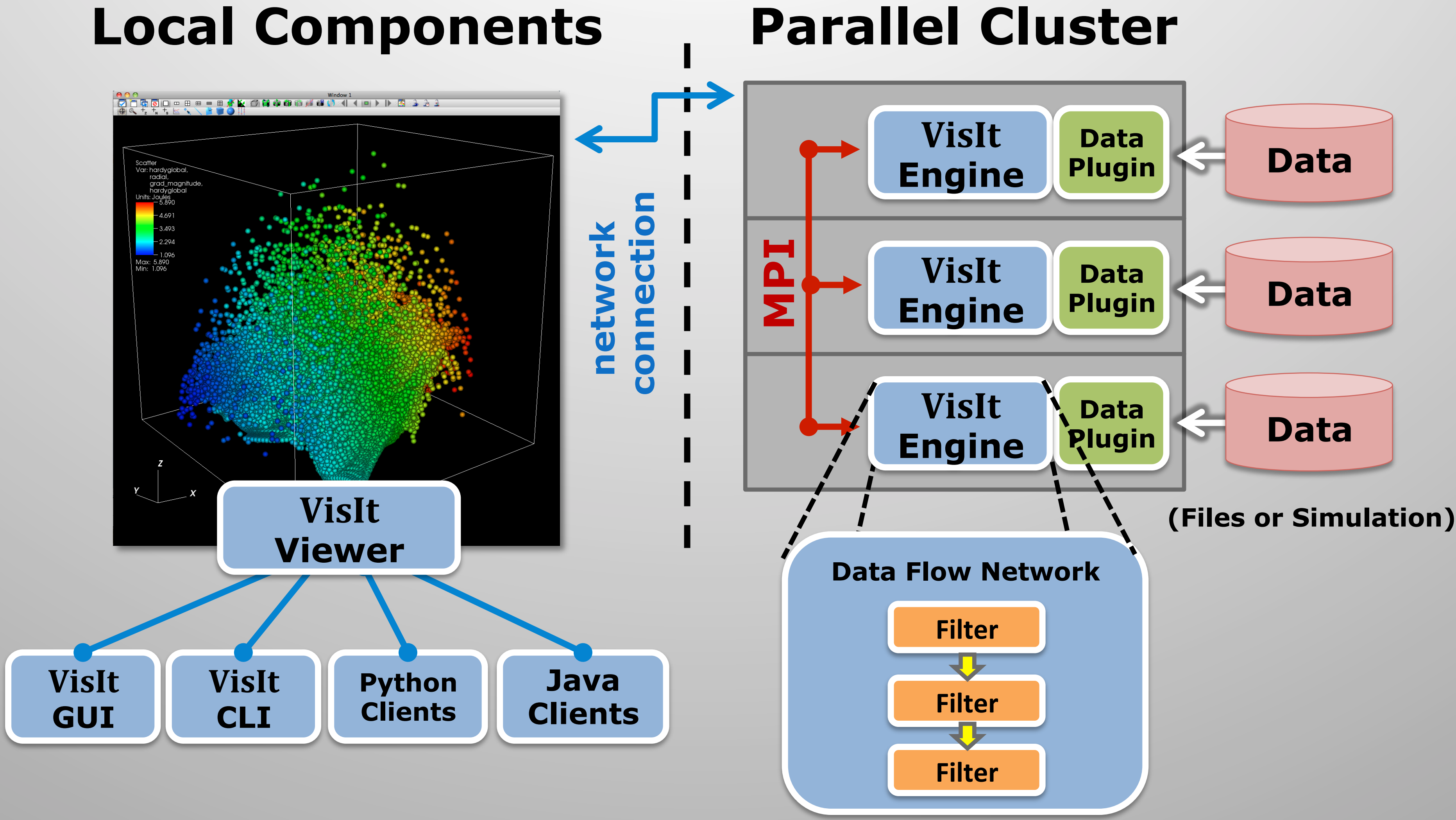
VisIt provides a flexible data model, suitable for many application domains.

- **Mesh Types:**
  - Point, Curve, 2D/3D Rectilinear, Curvilinear, Unstructured
  - Domain Decomposed, AMR
  - Time Varying
- **Fields:**
  - Scalar, Vector, Tensor, Material volume fractions, Species



VisIt currently supports over 110 file formats.

VisIt employs a parallelized client-server architecture.



Local Components

Parallel Cluster

VisIt Viewer

network connection

VisIt GUI

VisIt CLI

Python Clients

Java Clients

MPI

VisIt Engine

Data Plugin

Data

VisIt Engine

Data Plugin

Data

VisIt Engine

Data Plugin

Data

(Files or Simulation)

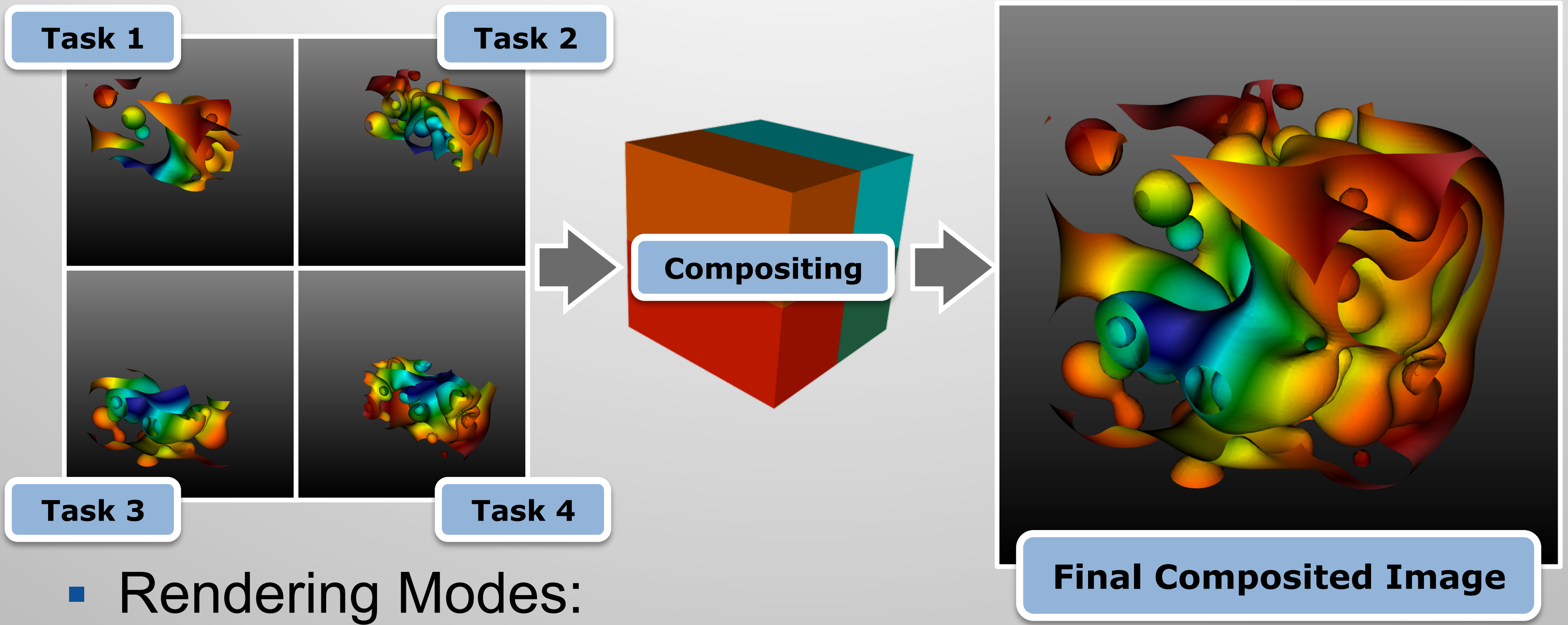
Data Flow Network

Filter

Filter

Filter

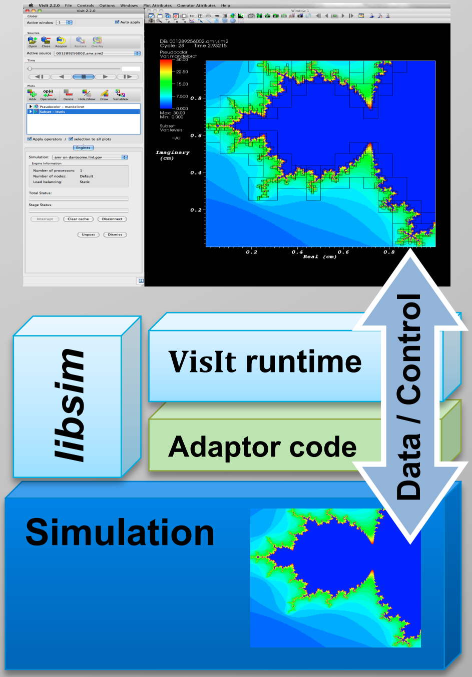
VisIt automatically switches to a scalable rendering mode for large data sets.



- Rendering Modes:
  - Local (hardware)
  - Remote (software or hardware)
- Beyond surfaces:
  - VisIt also provides scalable volume rendering.

VisIt's infrastructure provides a flexible platform for custom workflows.

- C++ Plugin Architecture
  - Custom File formats, Plots, Operators
  - Interface for custom GUIs in Python, C++ and Java
- Python Interfaces
  - Python scripting and batch processing
  - Data analysis via Python Expressions and Queries.
- *Libsim* library
  - Enables coupling of simulation codes to VisIt for in situ visualization.



VisIt is used as a platform to deploy visualization research.

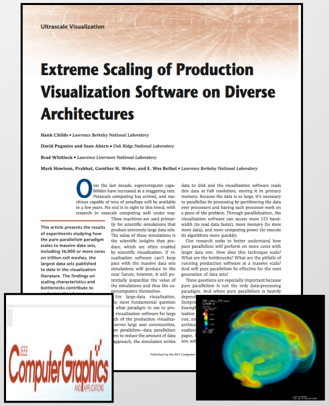
- Research Collaborations:

VACET 2006 – 2011

SDAV 2012 – 2017

Scalable Data Management, Analysis, and Visualization

- Research Focus:
  - Next Generation Architectures
  - Parallel Algorithms
  - In-Situ Processing



Ultrascale Visualization

Extreme Scaling of Production Visualization Software on Diverse Architectures

Hank Childs ▪ *Lawrence Berkeley National Laboratory*

David Pugmire and Sean Ahern ▪ *Oak Ridge National Laboratory*

Brad Whitlock ▪ *Lawrence Livermore National Laboratory*

Mark Howison, Prabhat, Gunther H. Weber, and E. Wes Bethel ▪ *Lawrence Berkeley National Laboratory*

Scaling research:
Scaling to 10Ks of cores and trillions of cells.

Scalable Computation of Streamlines on Very Large Datasets

Dave Pugmire, Oak Ridge National Laboratory, PO Box 2008 MS6016, Oak Ridge, TN 37831-6016, pugmire@ornl.gov

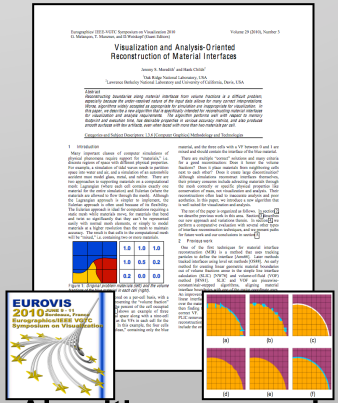
Hank Childs, Lawrence Berkeley National Laboratory, One Cyclotron Road, Berkeley, CA, 94701, hchilds@lbl.gov

Christoph Garth, University of California, Davis, One Shields Ave., Davis, CA, 95616, cgarth@ucdavis.edu

Sean Ahern, Oak Ridge National Laboratory, PO Box 2008 MS6016, Oak Ridge, TN 37831-6016, ahern@ornl.gov

Gunther H. Weber, Lawrence Berkeley National Laboratory, One Cyclotron Road, Berkeley, CA, 94701, ghweber@lbl.gov

Algorithms research:
How to efficiently calculate particle paths in parallel.



Eurographics/ IEEE-VGTC Symposium on Visualization 2010, G. Melançon, T. Munzner, and D. Weiskopf (Guest Editors) — Volume 29 (2010), Number 3

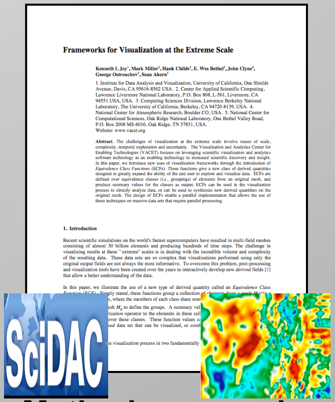
Visualization and Analysis-Oriented Reconstruction of Material Interfaces

Jeremy S. Meredith[1] and Hank Childs[2]

[1]Oak Ridge National Laboratory, USA
[2]Lawrence Berkeley National Laboratory and University of California, Davis, USA

EUROVIS 2010 JUNE 9 - 11 Bordeaux, France
Eurographics/IEEE VGTC Symposium on Visualization
(a)
(b)
(c)
(d)
(e)
(f)

Algorithms research:
Reconstructing material interfaces for visualization



Frameworks for Visualization at the Extreme Scale

Kenneth I. Joy[1], Mark Miller[2], Hank Childs[3], E. Wes Bethel[3], John Clyne[4], George Ostrouchov[5], Sean Ahern[5]

Methods research:
How to incorporate statistics into visualization.

VisIt: What's the Big Deal?

- Everything works at scale
- Robust, usable tool
- Features that span the "power of visualization":
  - Data Exploration
  - Confirmation
  - Communication
- Features for different kinds of users:
  - Visualization Experts
  - Code Developers
  - Code Consumers

Healthy future: Vibrant Developer and User Communities

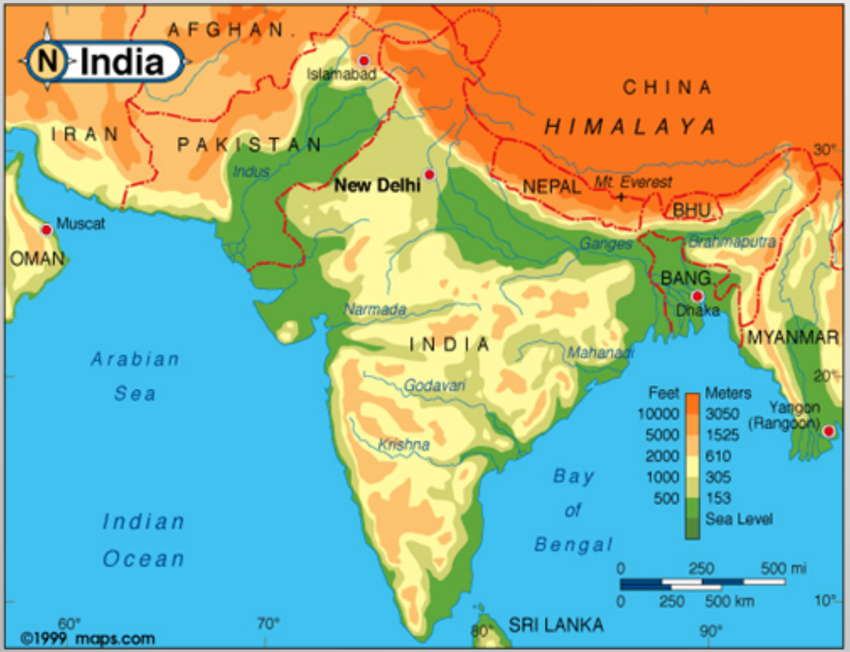
Visualization Techniques for Mesh-based Simulations

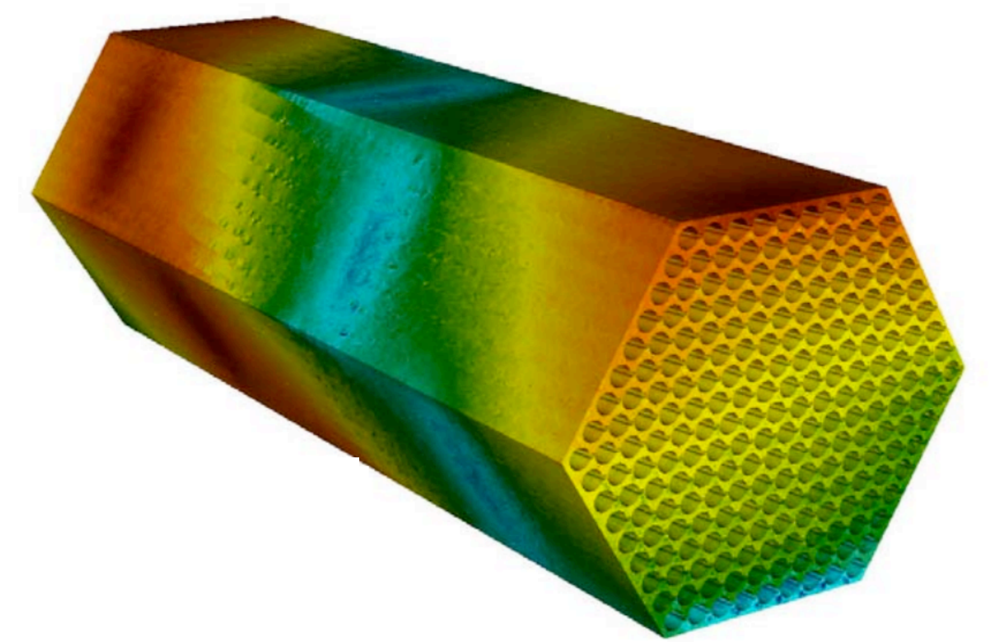
Terminology

- Meshes: discretization of physical space
  - Contains “zones” / “cells” / “elements”
  - Contains “nodes” / “points” / “vertices”
    - VisIt speak: zone & node
- Fields: variables stored on a mesh
  - Scalar: 1 value per zone/node
    - Example: pressure, density, temperature
  - Vector: 3 values per zone/node (direction)
    - Example: velocity
      - Note: 2 values for 2D, 3 values for 3D
  - More fields discussed later…

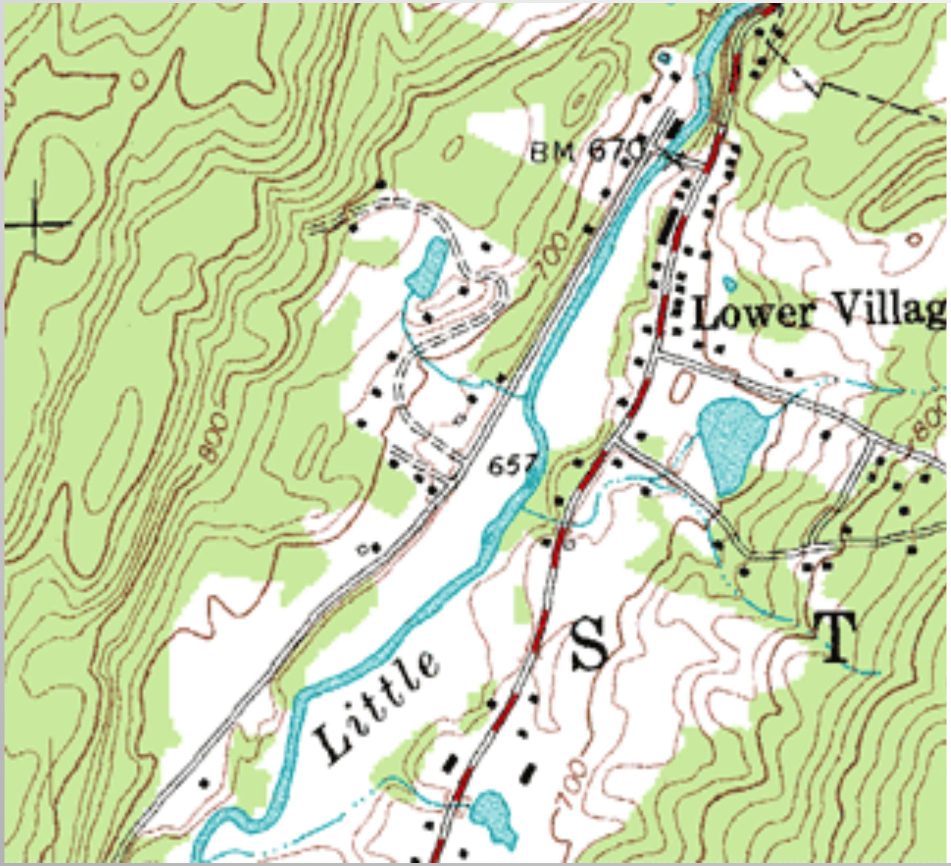
Pseudocolor

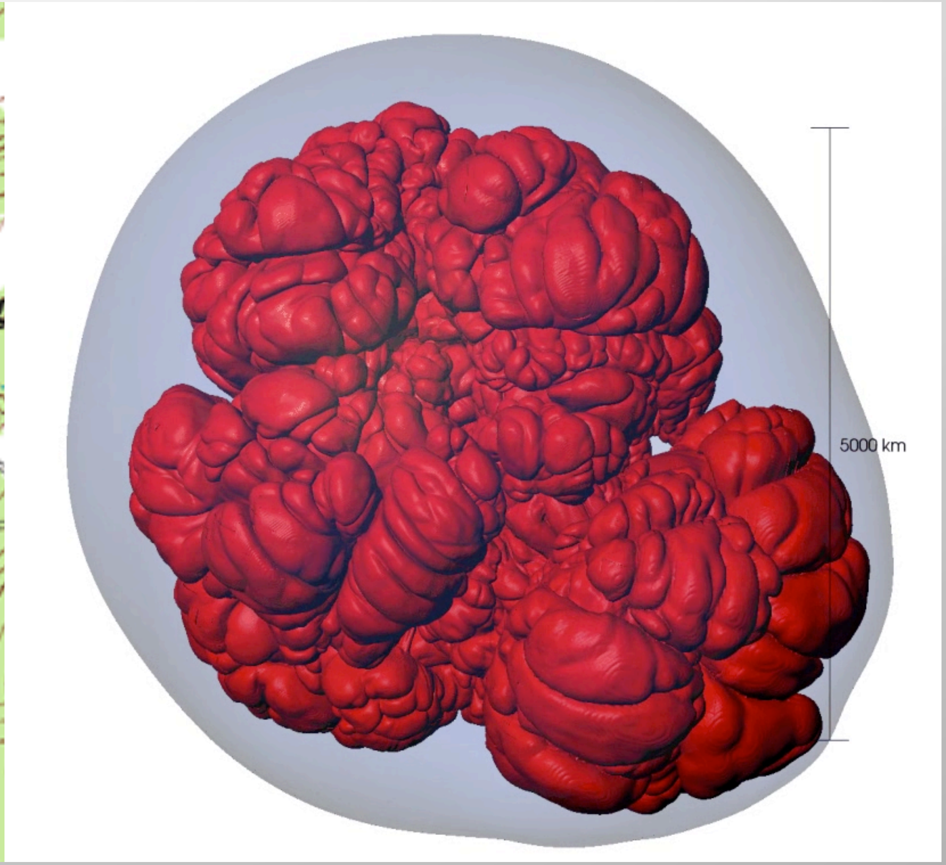
- Maps scalar fields (e.g., density, pressure, temperature) to colors.



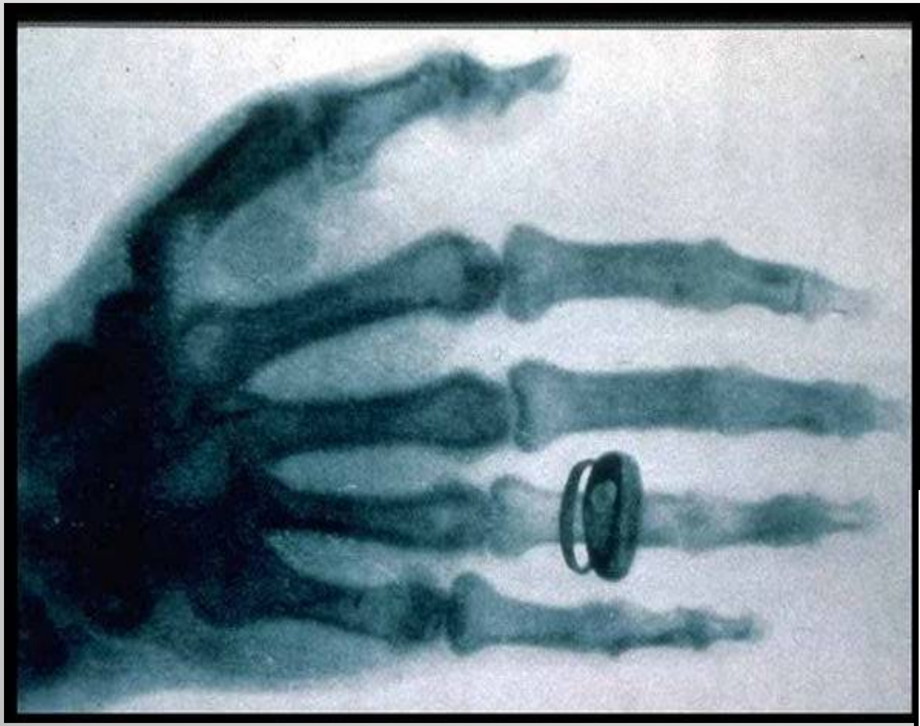


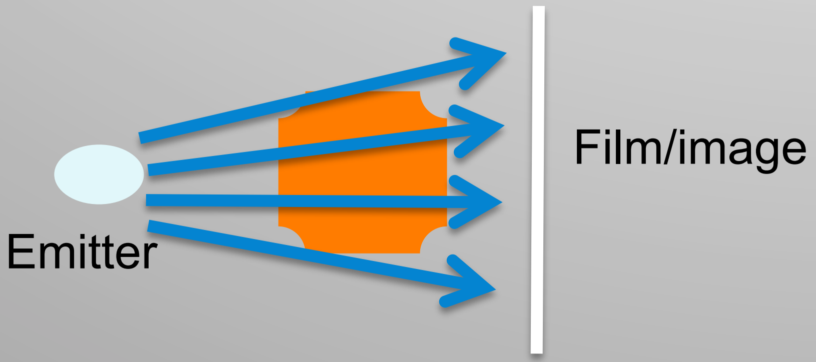
Contour / Isosurface

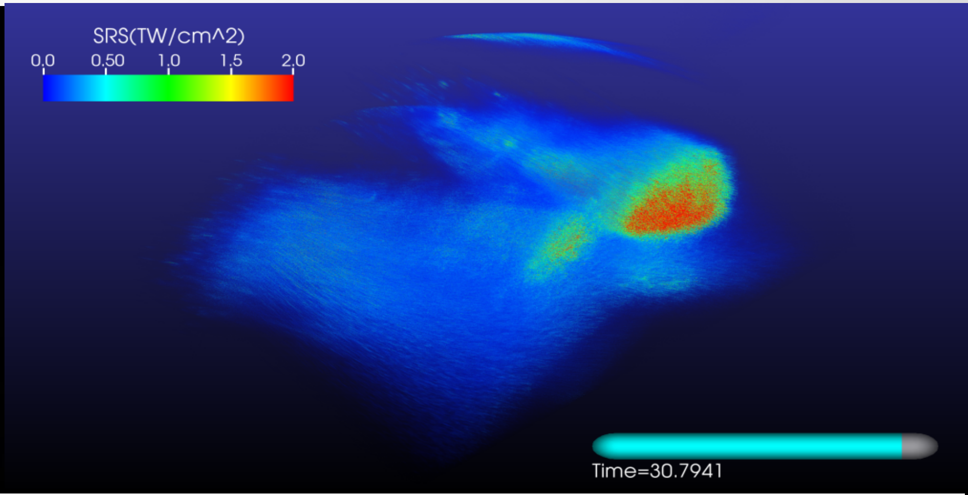


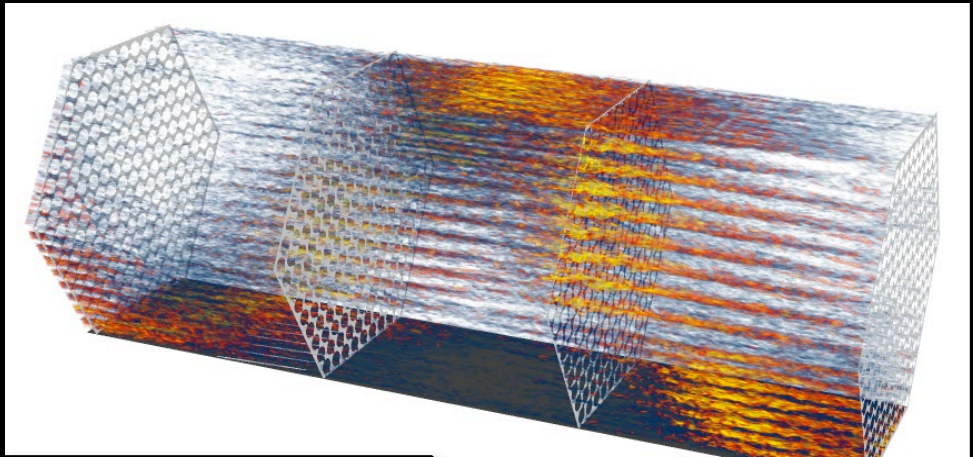


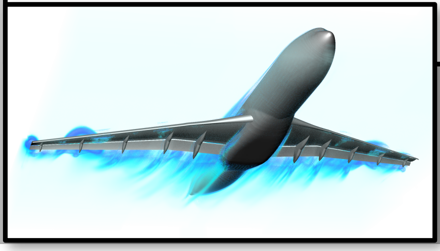
Volume rendering







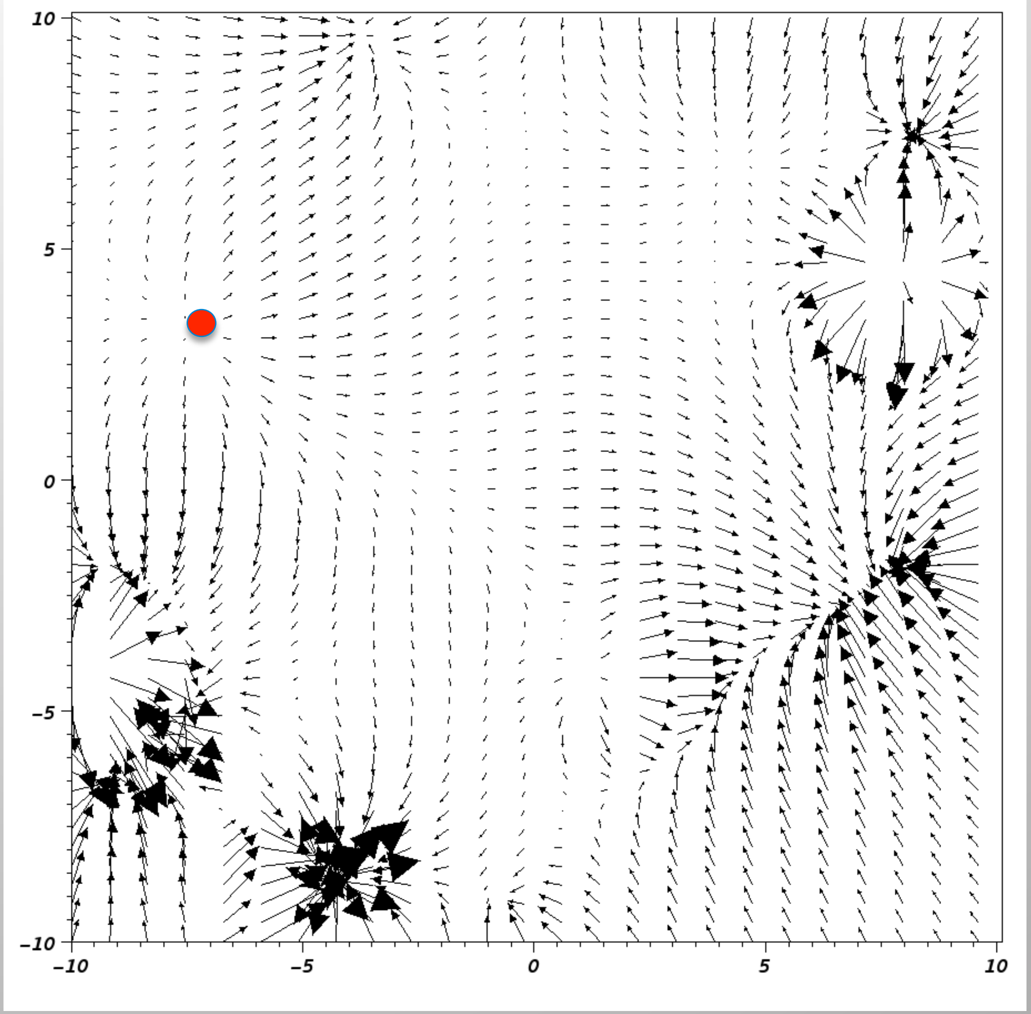




VisIt can combine volume rendering and opaque geometry

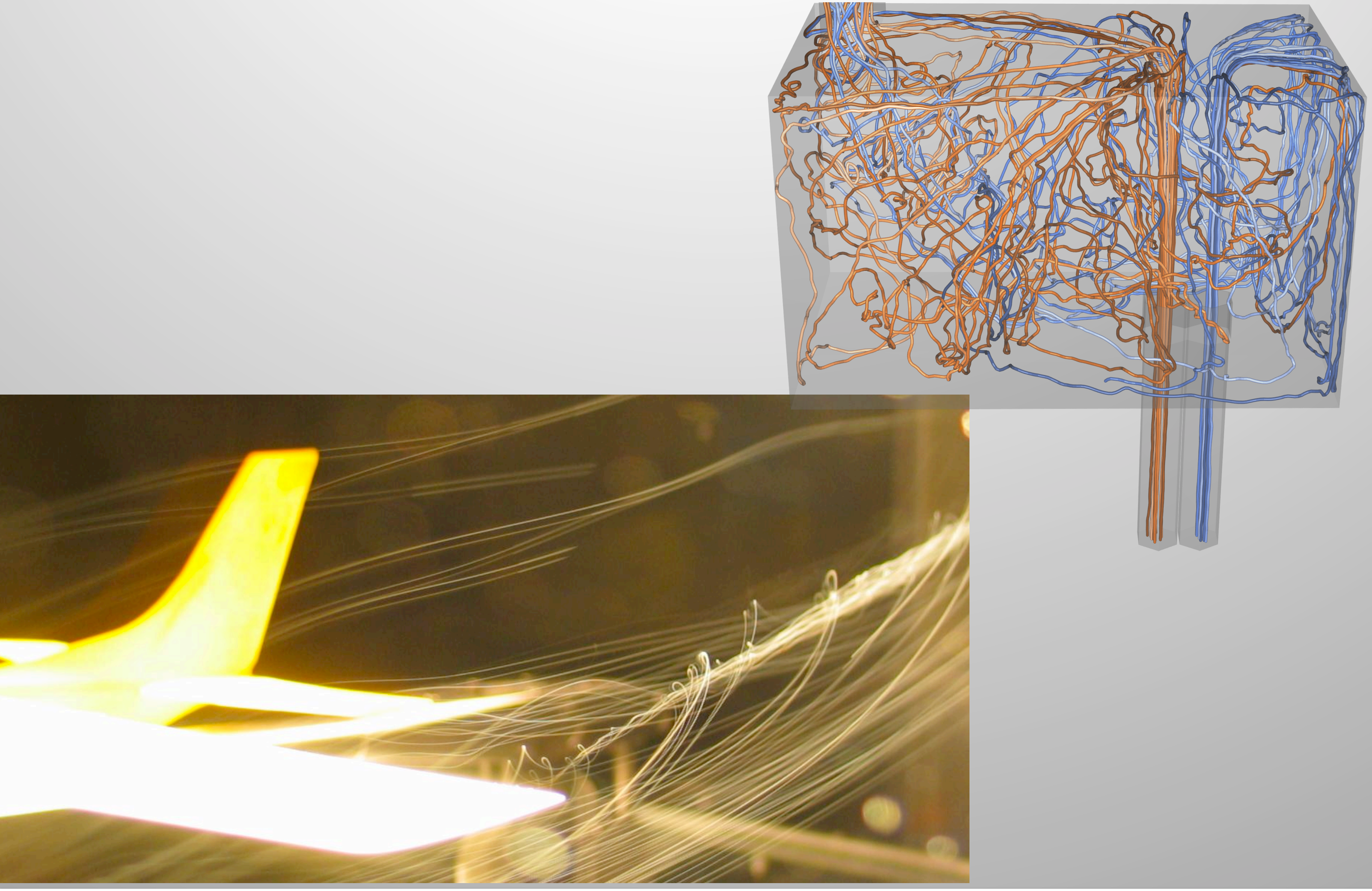
Particle advection: the foundation of flow visualization

- Displace massless particle based on velocity field
- S(t) = position of curve at time t
  - $S(t_0) = p_0$
    - t_0: initial time
    - p_0: initial position
  - $S'(t) = v(t, S(t))$
    - $v(t, p)$: velocity at time t and position p
    - $S'(t)$: derivative of the integral curve at time t



This is an ordinary differential equation

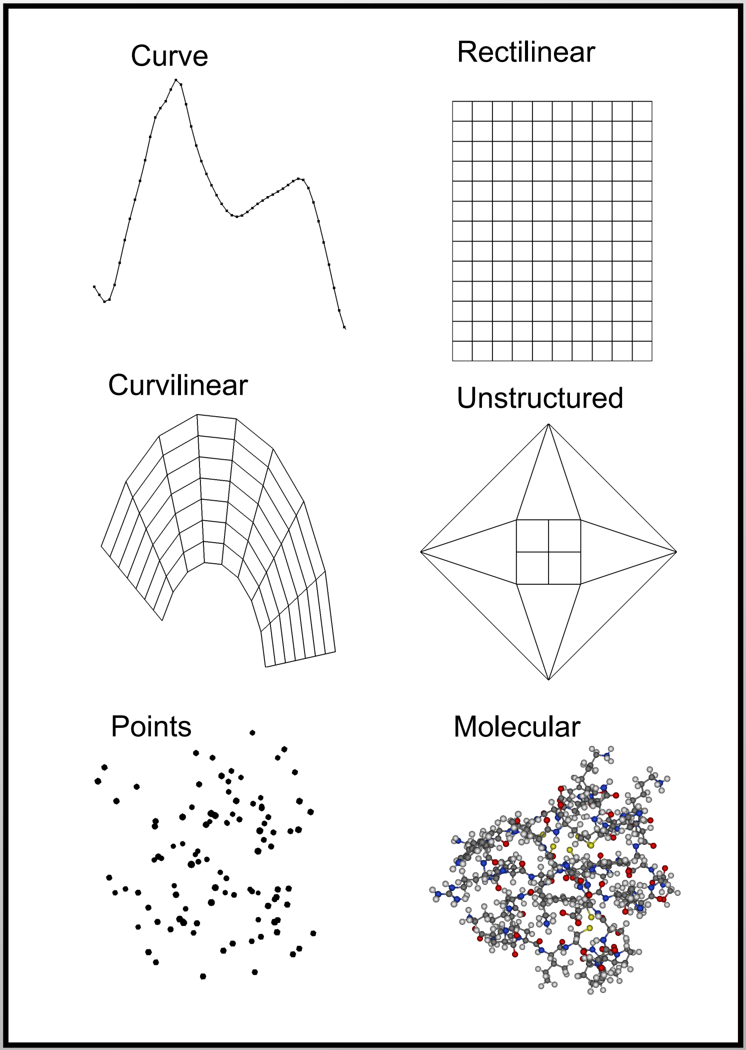
Streamlines



Meshes

- All data in VisIt lives on a mesh
- Discretizes space into points and cells
  - (1D, 2D, 3D) + time
  - Mesh dimension need not match spatial dimension *(e.g. 2D surface in 3D space)*
- Provides a place for data to be located
- Defines how data is interpolated

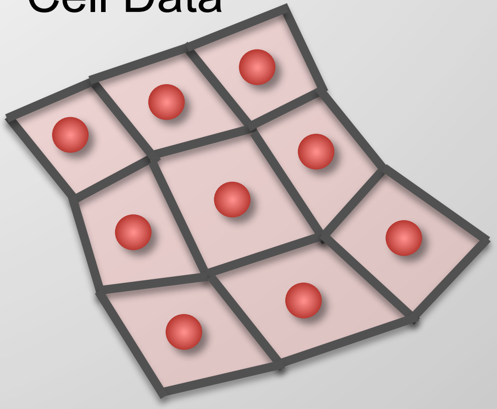
Mesh Types



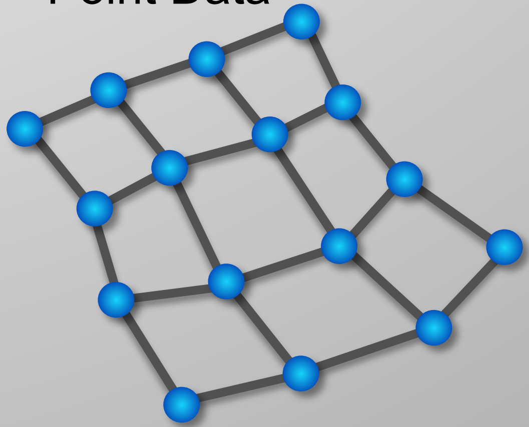
Variables

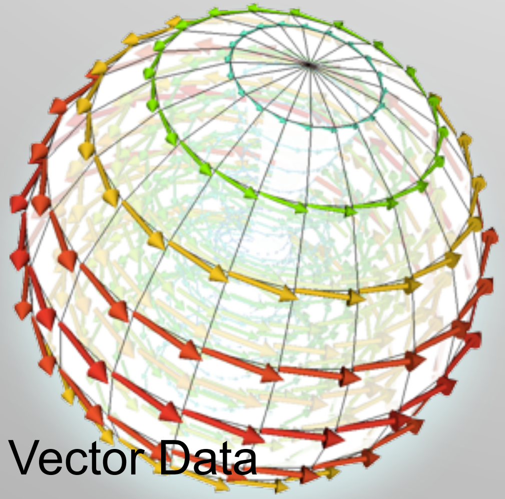
- Scalars, Vectors, Tensors
- Associated with points or cells of a mesh
  - Points: linear interpolation
  - Cells: piecewise constant
- Can have different dimensionality than the mesh (e.g. 3D vector data on a 2D mesh)

Cell Data

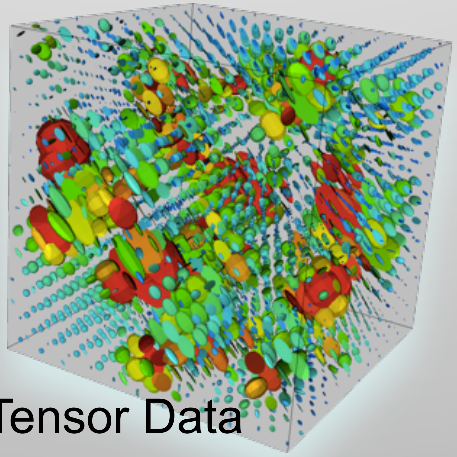


Point Data





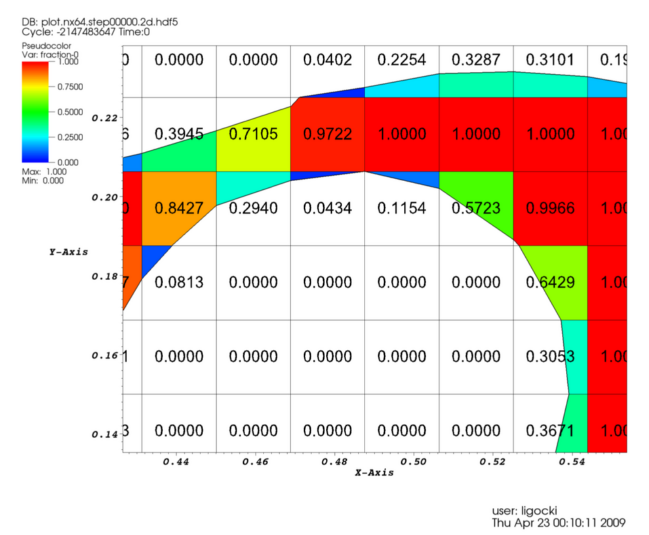
Vector Data



Tensor Data

Materials

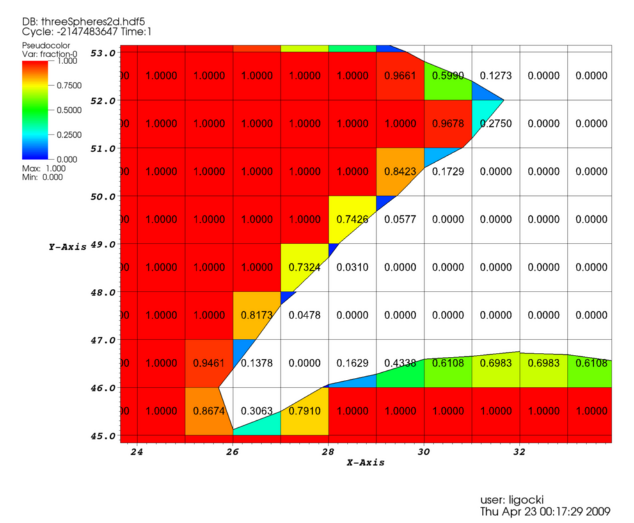
- Describes disjoint spatial regions at a sub-grid level
- Volume/area fractions
- VisIt will do high-quality sub-grid material interface reconstruction



DB: plot.nx64.step00000.2d.hdf5
Cycle: -2147483647 Time:0

0.0000	0.0000	0.0402	0.2254	0.3287	0.3101
0.3945	0.7105	0.9722	1.0000	1.0000	1.0000
0.8427	0.2940	0.0434	0.1154	0.5723	0.9966
0.0813	0.0000	0.0000	0.0000	0.0000	0.6429
0.0000	0.0000	0.0000	0.0000	0.0000	0.3053
0.0000	0.0000	0.0000	0.0000	0.0000	0.3671

user: ligocki
Thu Apr 23 00:10:11 2009



DB: threeSpheres2d.hdf5
Cycle: -2147483647 Time:1

1.0000	1.0000	1.0000	1.0000	1.0000	0.9661	0.5990	0.1273	0.0000	0.0000
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9678	0.2750	0.0000	0.0000
1.0000	1.0000	1.0000	1.0000	1.0000	0.8423	0.1729	0.0000	0.0000	0.0000
1.0000	1.0000	1.0000	1.0000	0.7426	0.0577	0.0000	0.0000	0.0000	0.0000
1.0000	1.0000	1.0000	0.7324	0.0310	0.0000	0.0000	0.0000	0.0000	0.0000
1.0000	1.0000	0.8173	0.0478	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0000	0.9461	0.1378	0.0000	0.1629	0.4338	0.6108	0.6983	0.6983	0.6108
1.0000	0.8674	0.3063	0.7910	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

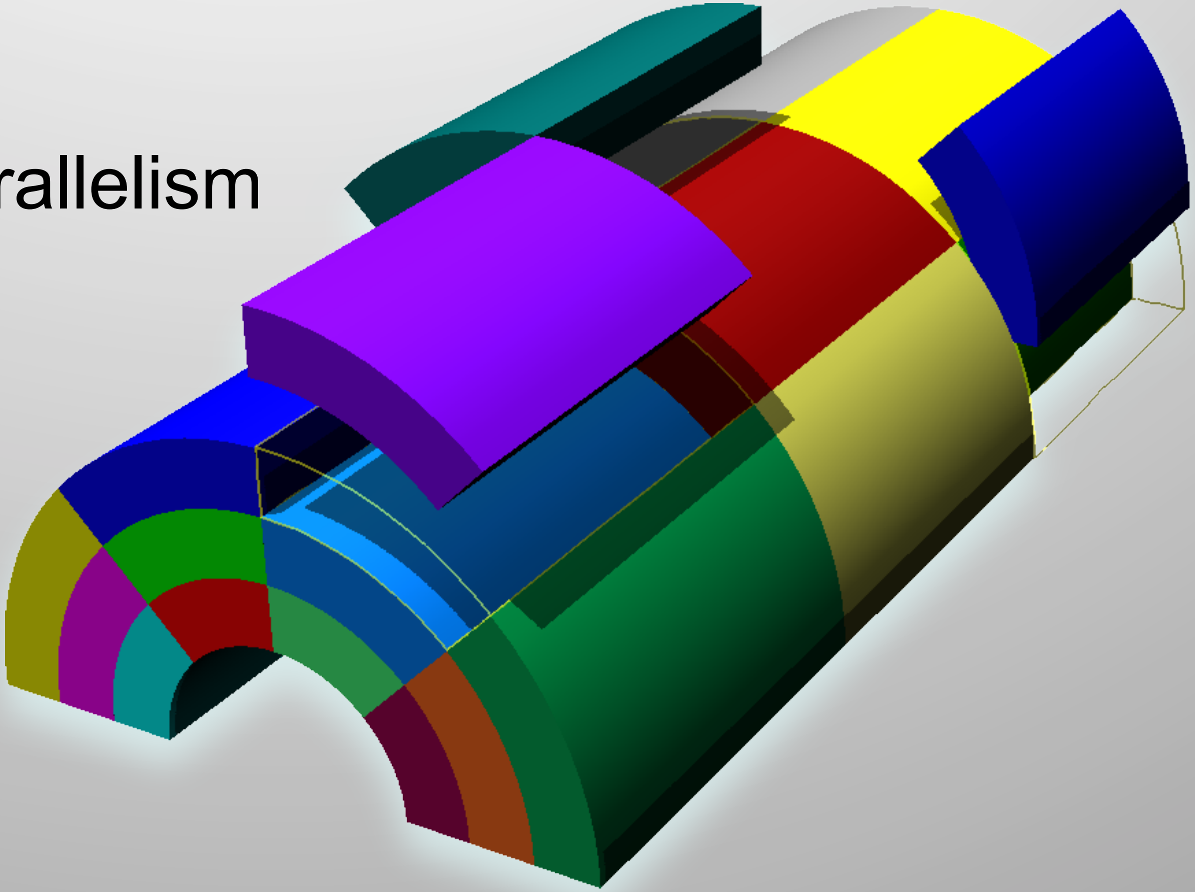
user: ligocki
Thu Apr 23 00:17:29 2009

Species

- Similar to materials, describes sub-grid variable composition
  - Example: *Material "Air" is made of species "N_2" , "O_2", "Ar", "CO_2", etc.*
- Used for mass fractions
- Generally used to weight other scalars (e.g. partial pressure)

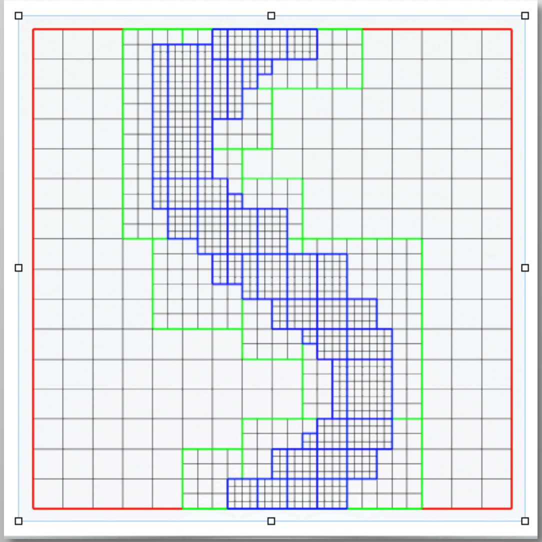
Parallel Meshes

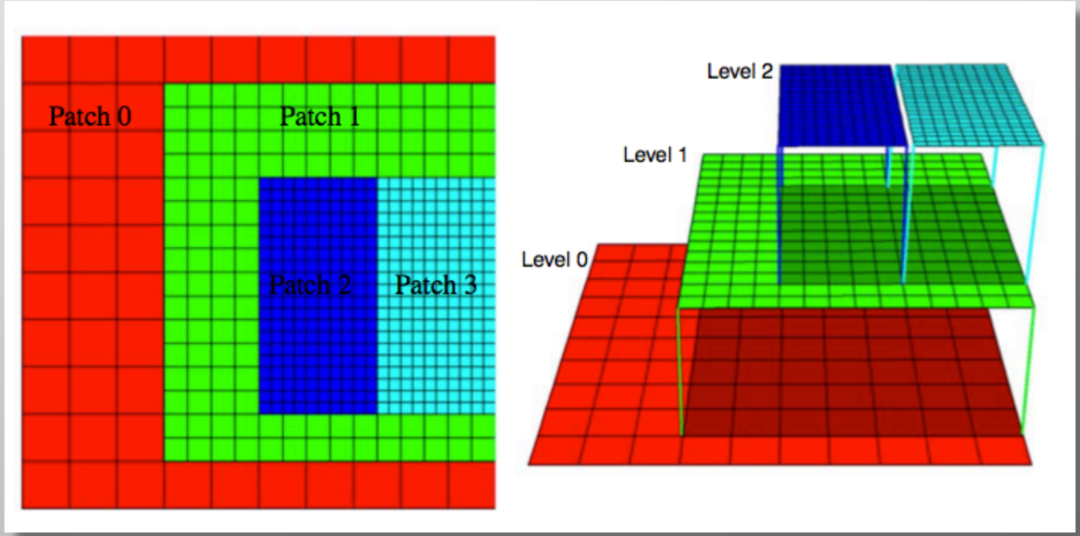
- Provides aggregation for meshes
- A mesh may be composed of large numbers of mesh “blocks”
- Allows data parallelism



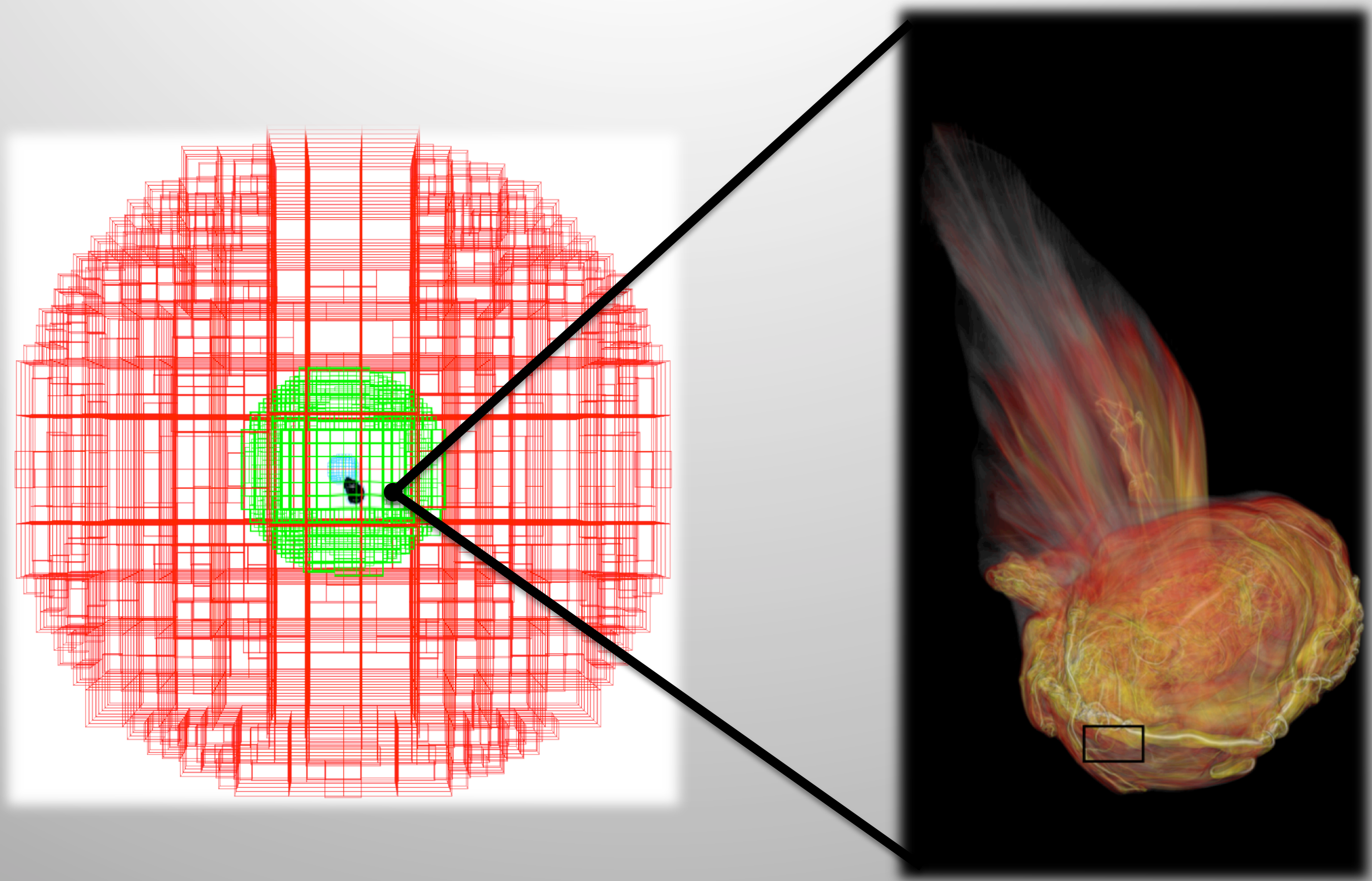
AMR meshes

- Mesh blocks can be associated with patches and levels
- Allows for aggregation of meshes into AMR hierarchy levels

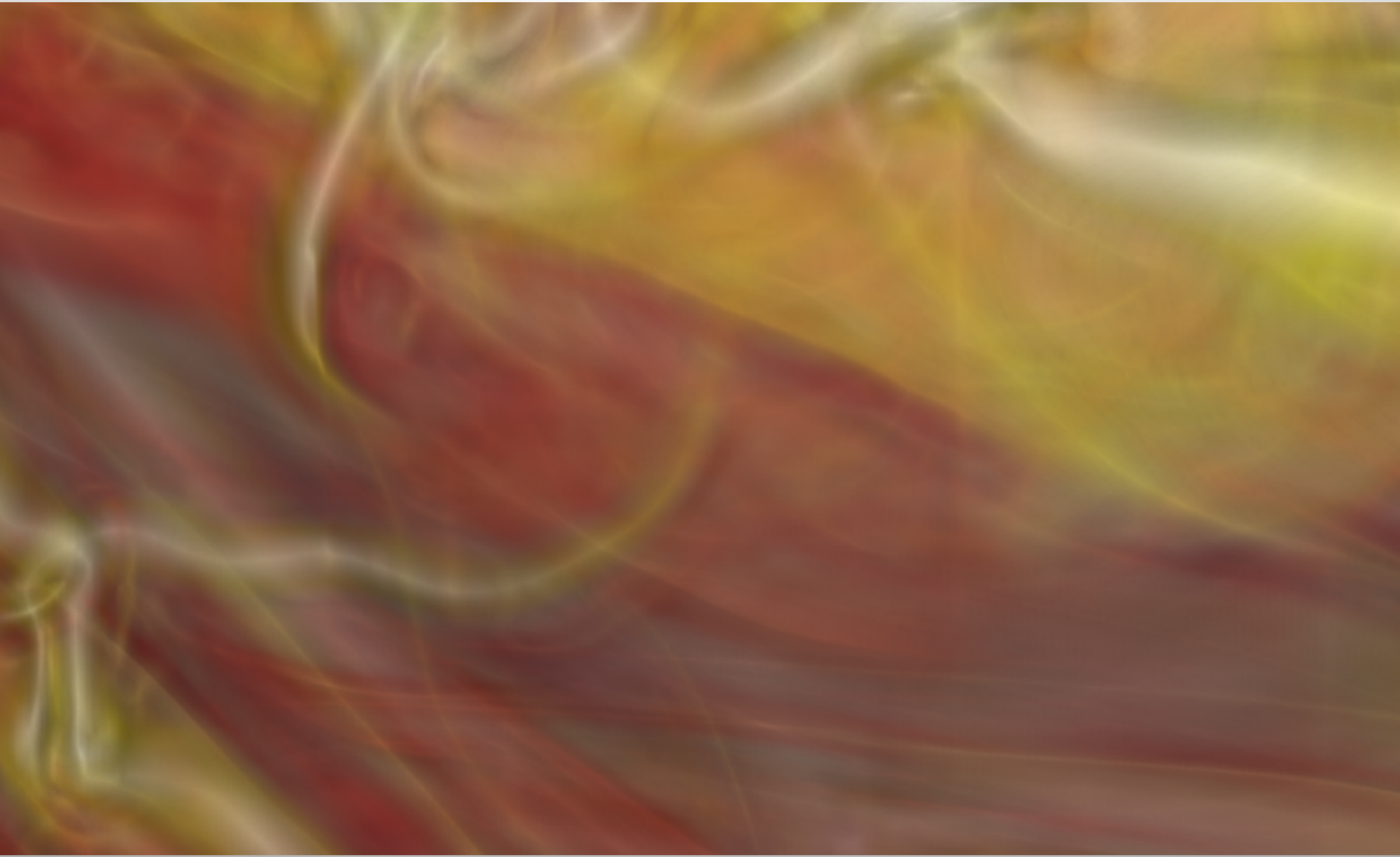




AMR Example: Image vs. Data Resolution



Data representation for mesh-based HPC simulations



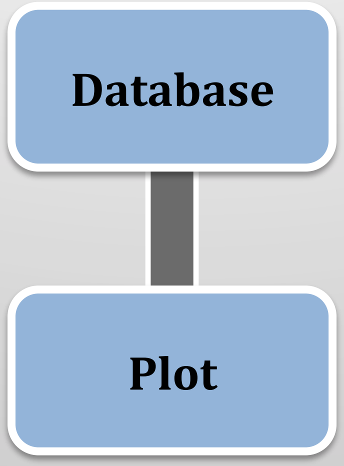
VisIt's Core Abstractions

VisIt's core abstractions

- **Databases**: How datasets are read
- **Plots:** How you render data
- **Operators:** How you manipulate data
- **Expressions:** Mechanism for generating derived quantities
- **Queries:** How to access quantitative information

Examples of VisIt Pipelines

- Databases: how you read data
- Plots: how you render data
- Operators: how you transform/manipulate data
- Expressions: how you create new fields
- Queries: how you pull out quantitative information

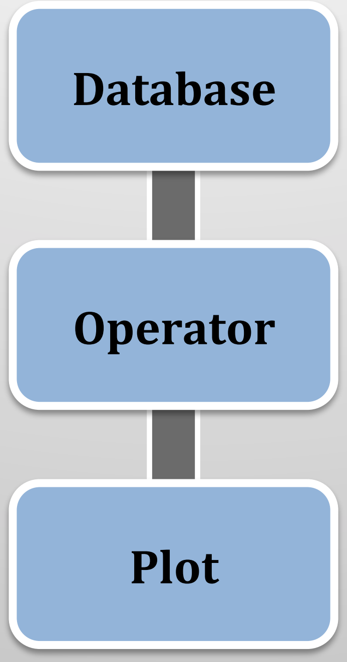


Open a database, which reads from a file (example: open file1.hdf5)

Make a plot of a variable in the database (example: Volume plot)

Examples of VisIt Pipelines

- Databases: how you read data
- Plots: how you render data
- Operators: how you transform/ manipulate data
- Expressions: how you create new fields
- Queries: how you pull out quantitative information



Database

Open a database,
which reads from a file
(example: open file1.hdf5)

Operator

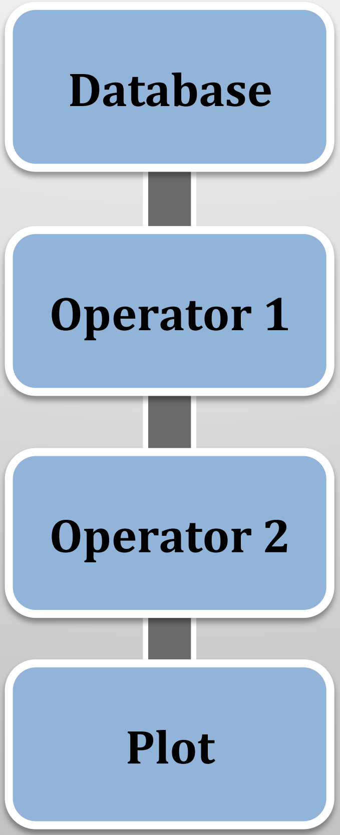
Apply an operator to transform the data
(example: Slice operator)

Plot

Plot a variable in the database
(example: Pseudocolor plot)

Examples of VisIt Pipelines

- Databases: how you read data
- Plots: how you render data
- Operators: how you transform/ manipulate data
- Expressions: how you create new fields
- Queries: how you pull out quantitative information



Database

Open a database, which reads from a file (example: open file1.hdf5)

Operator 1

Apply an operator to transform the data (example: Slice operator)

Operator 2

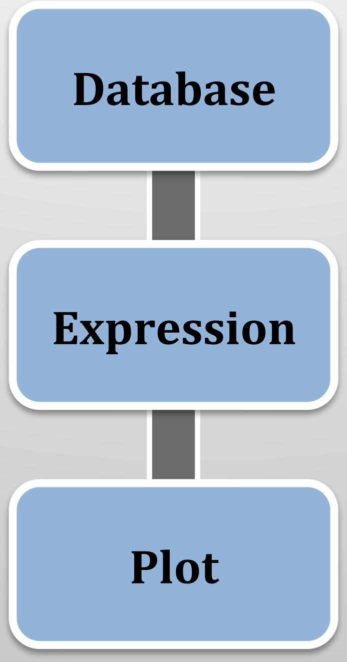
Apply a second operator to transform the data (example: Elevate operator)

Plot

Plot a variable in the database (example: Pseudocolor plot)

Examples of VisIt Pipelines

- Databases: how you read data
- Plots: how you render data
- Operators: how you transform/ manipulate data
- Expressions: how you create new fields
- Queries: how you pull out quantitative information



Database

Open a database,
which reads from a file
(example: open file1.hdf5)

Expression

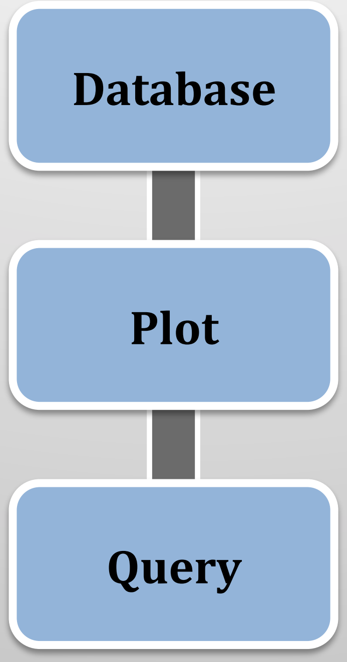
Create derived quantities from
fields in the file
(example: magnitude(velocity))

Plot

Plot the expression variable
(example: Pseudocolor plot)

Examples of VisIt Pipelines

- Databases: how you read data
- Plots: how you render data
- Operators: how you transform/ manipulate data
- Expressions: how you create new fields
- Queries: how you pull out quantitative information



Open a database, which reads from a file (example: open file1.hdf5)

Plot a field from the file (example: density + Pseudocolor plot)

Extract quantitative information (example: integrate density to find mass)

Examples of VisIt Pipelines

- Databases: how you read data
- Plots: how you render data
- Operators: how you transform/ manipulate data
- Expressions: how you create new fields
- Queries: how you pull out quantitative information

Database	Open a database, which reads from a file (example: open file1.hdf5)
Expression	Create derived quantities from fields in the file (example: magnitude(velocity))
Operator 1	Apply an operator to transform the data (example: Slice operator)
Operator 2	Apply a second operator to transform the data (example: Elevate operator)
Plot	Plot a field (example: speed + Pseudocolor plot)
Query	Extract quantitative information (example: maximum speed over cross-section)

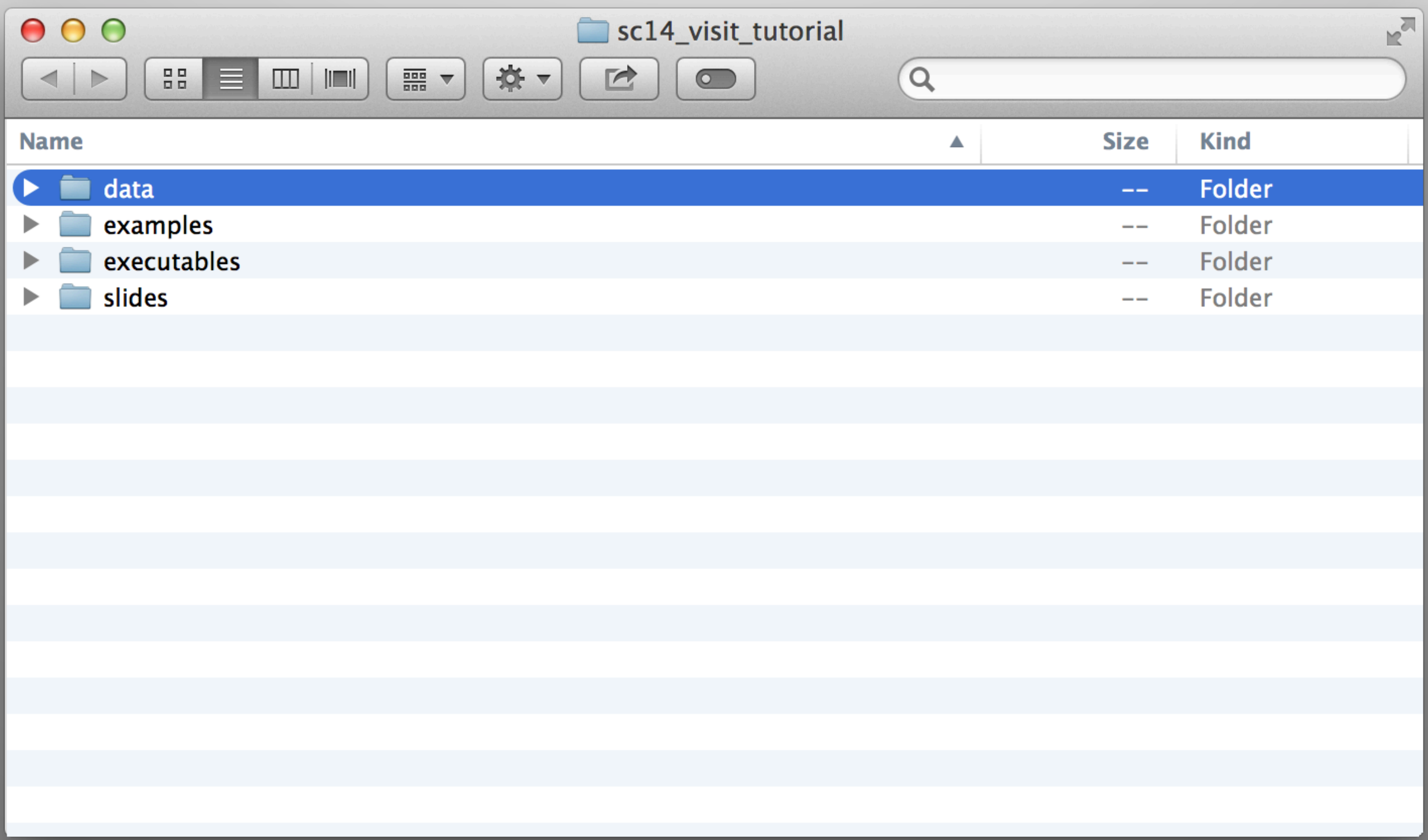
Tutorial Setup:
VisIt installation and supporting files

Also available at:

http://visitusers.org/index.php?title=Tutorial_Preparation

Shared USB Drive Contents:

- Copy the `sc14_visit_tutorial` folder

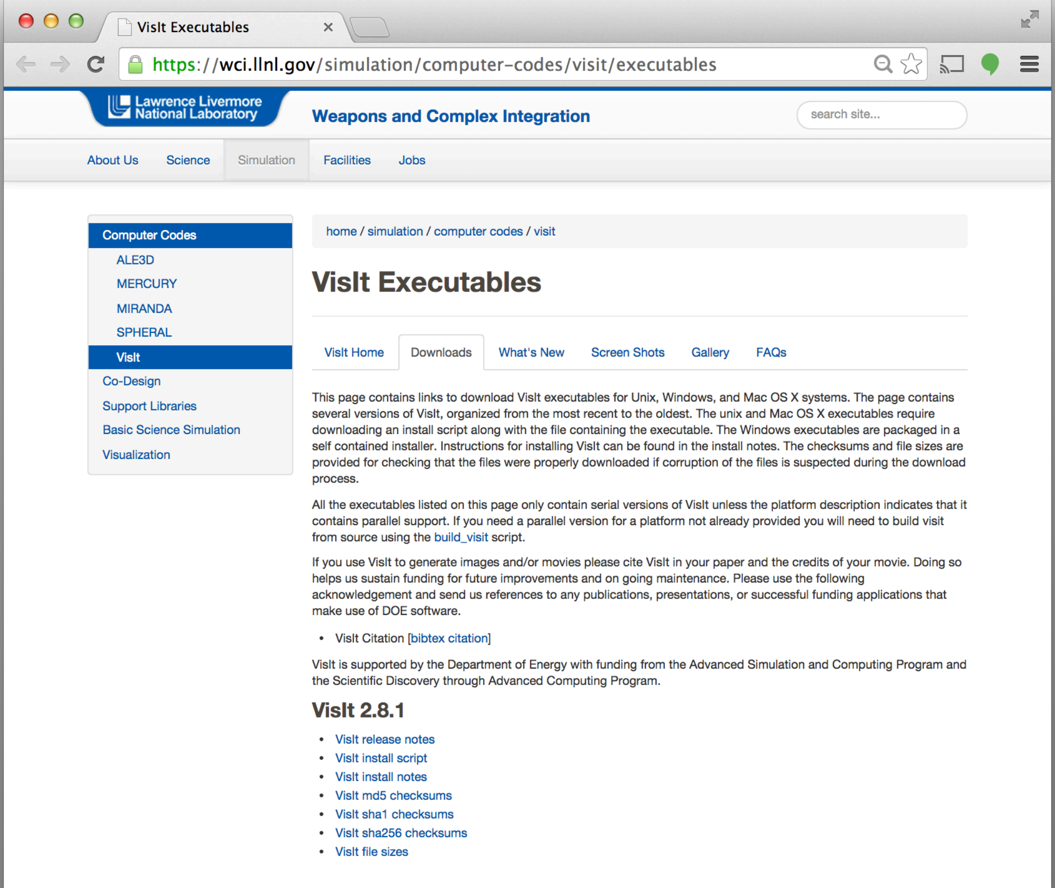


Name	Size	Kind
data	--	Folder
examples	--	Folder
executables	--	Folder
slides	--	Folder

Shared USB Drive Contents: VisIt 2.8.1

Release Binaries:

`executables/`



VisIt Executables

This page contains links to download VisIt executables for Unix, Windows, and Mac OS X systems. The page contains several versions of VisIt, organized from the most recent to the oldest. The unix and Mac OS X executables require downloading an install script along with the file containing the executable. The Windows executables are packaged in a self contained installer. Instructions for installing VisIt can be found in the install notes. The checksums and file sizes are provided for checking that the files were properly downloaded if corruption of the files is suspected during the download process.

All the executables listed on this page only contain serial versions of VisIt unless the platform description indicates that it contains parallel support. If you need a parallel version for a platform not already provided you will need to build visit from source using the build_visit script.

If you use VisIt to generate images and/or movies please cite VisIt in your paper and the credits of your movie. Doing so helps us sustain funding for future improvements and on going maintenance. Please use the following acknowledgement and send us references to any publications, presentations, or successful funding applications that make use of DOE software.

- VisIt Citation [bibtex citation]

VisIt is supported by the Department of Energy with funding from the Advanced Simulation and Computing Program and the Scientific Discovery through Advanced Computing Program.

VisIt 2.8.1

- VisIt release notes
- VisIt install script
- VisIt install notes
- VisIt md5 checksums
- VisIt sha1 checksums
- VisIt sha256 checksums
- VisIt file sizes

Also available at:

https://wci.llnl.gov/codes/visit/executables.html

Installing VisIt

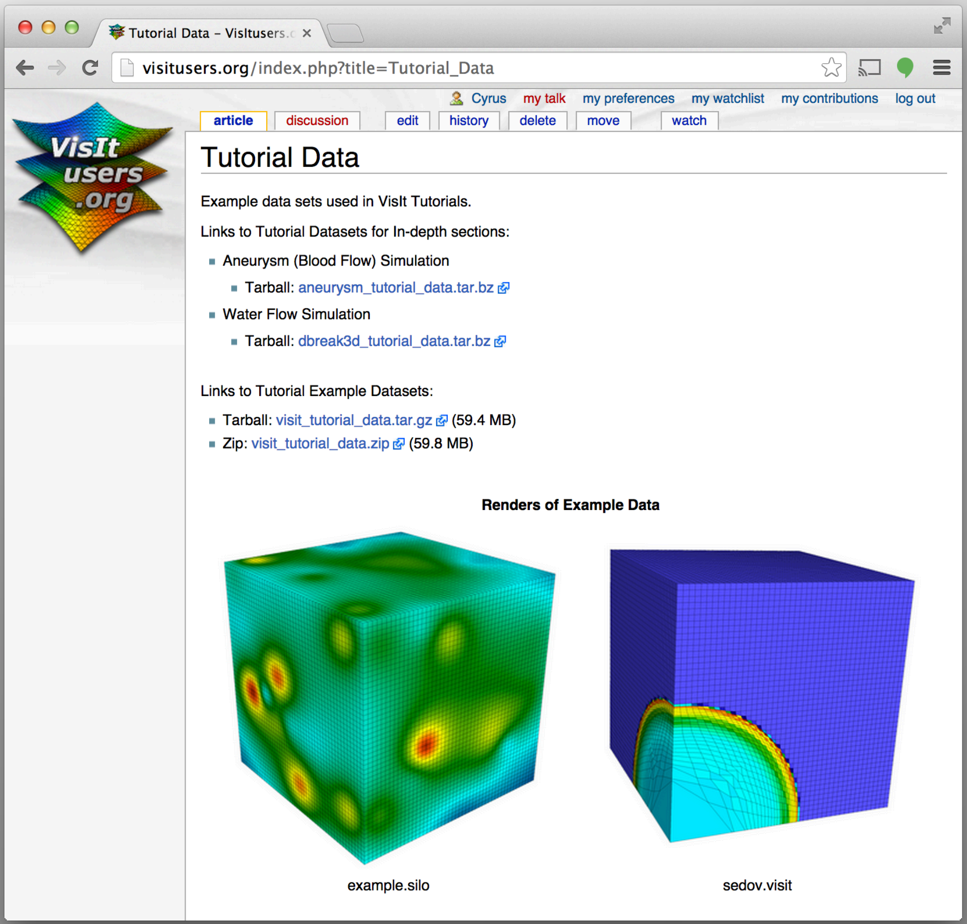
Select a binary for your platform from `executables/` and install:

- Linux/Unix:
  - untar
- Mac:
  - Open DMG and copy VisIt app bundle to Desktop
- Windows:
  - Run installer program

Testing your VisIt install

- Linux/Unix:
  - `>path/to/visit/bin/visit`
- Mac:
  - Double click VisIt app bundle
- Windows:
  - Launch from start menu

Shared USB Drive Contents: Example Datasets



Tutorial Data

Example data sets used in VisIt Tutorials.

Links to Tutorial Datasets for In-depth sections:

- Aneurysm (Blood Flow) Simulation
  - Tarball: aneurysm_tutorial_data.tar.bz
- Water Flow Simulation
  - Tarball: dbreak3d_tutorial_data.tar.bz

Links to Tutorial Example Datasets:

- Tarball: visit_tutorial_data.tar.gz (59.4 MB)
- Zip: visit_tutorial_data.zip (59.8 MB)

Renders of Example Data

example.silo

sedov.visit

Data Files:

`data/`

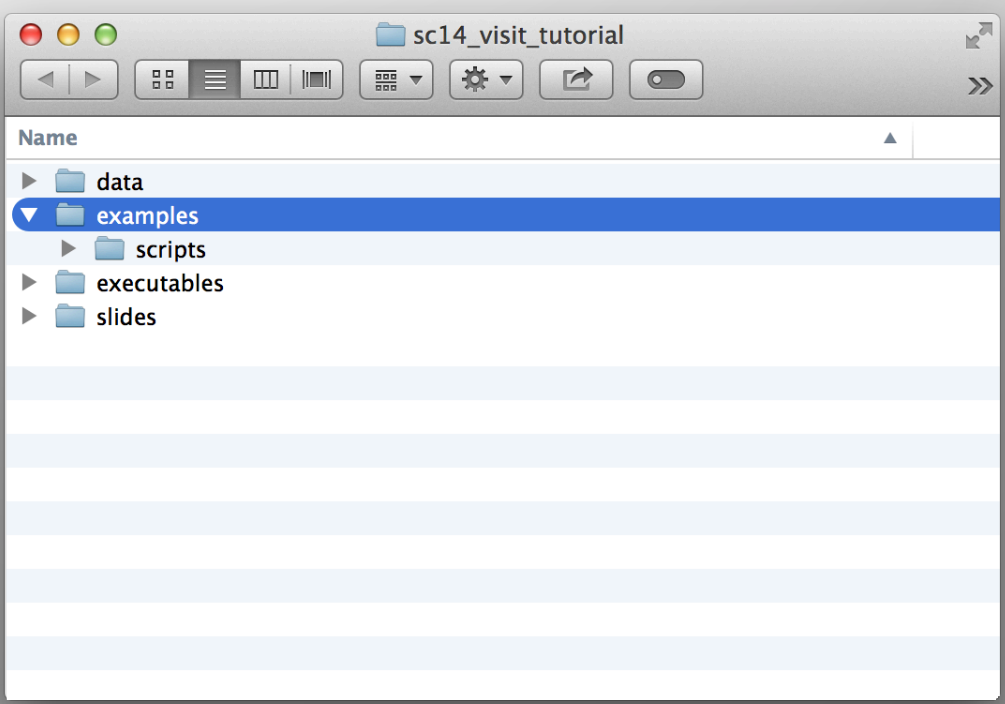
Also available at:

http://www.visitusers.org/index.php?title=Tutorial_Data

Shared USB Drive Contents: Example Scripts

Example Files:

`examples/`



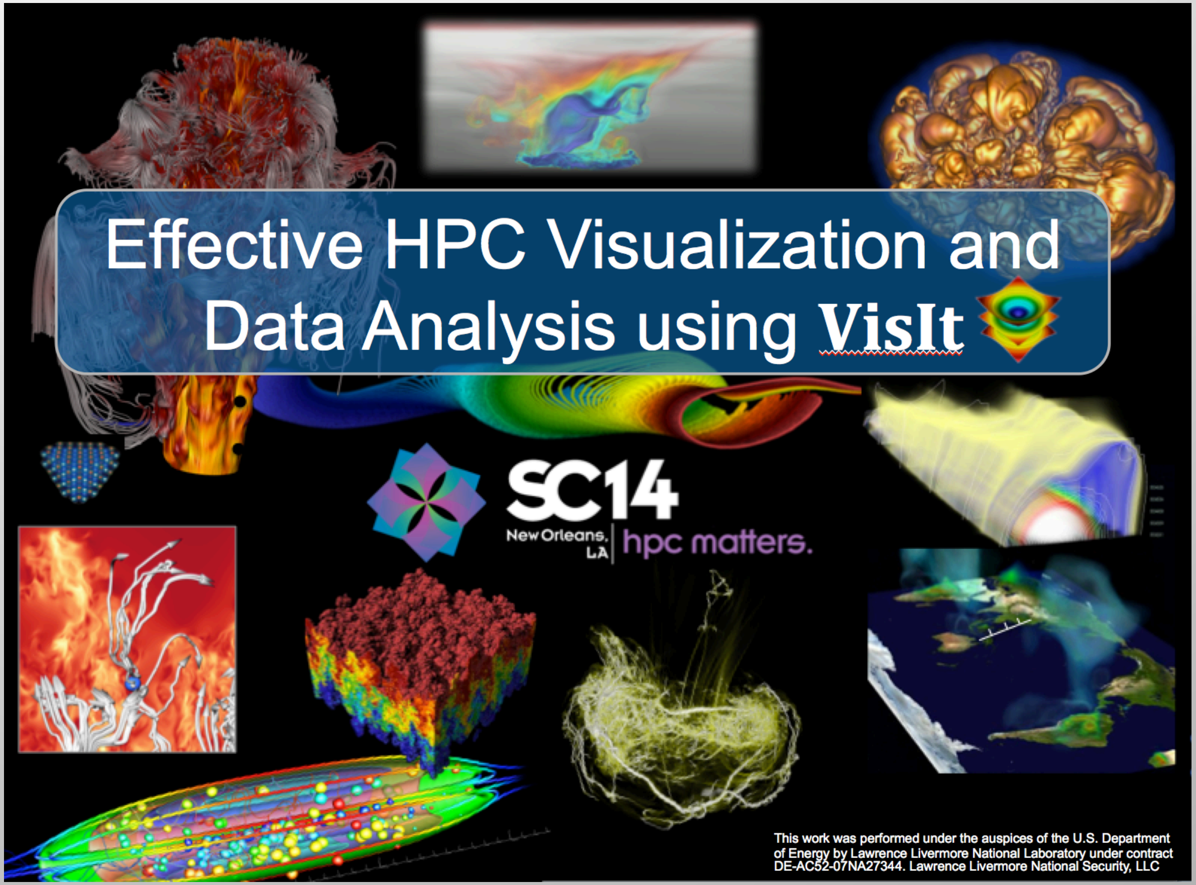
Also available at:

http://www.visitusers.org/index.php?title=Tutorial_Examples

Shared USB Drive Contents: Tutorial Sides

Tutorial PDFs:

`slides/`



Effective HPC Visualization and Data Analysis using **VisIt**

SC14

New Orleans, LA

hpc matters.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

Also available at:

http://visitusers.org/index.php?title=Tutorial

Before we begin …

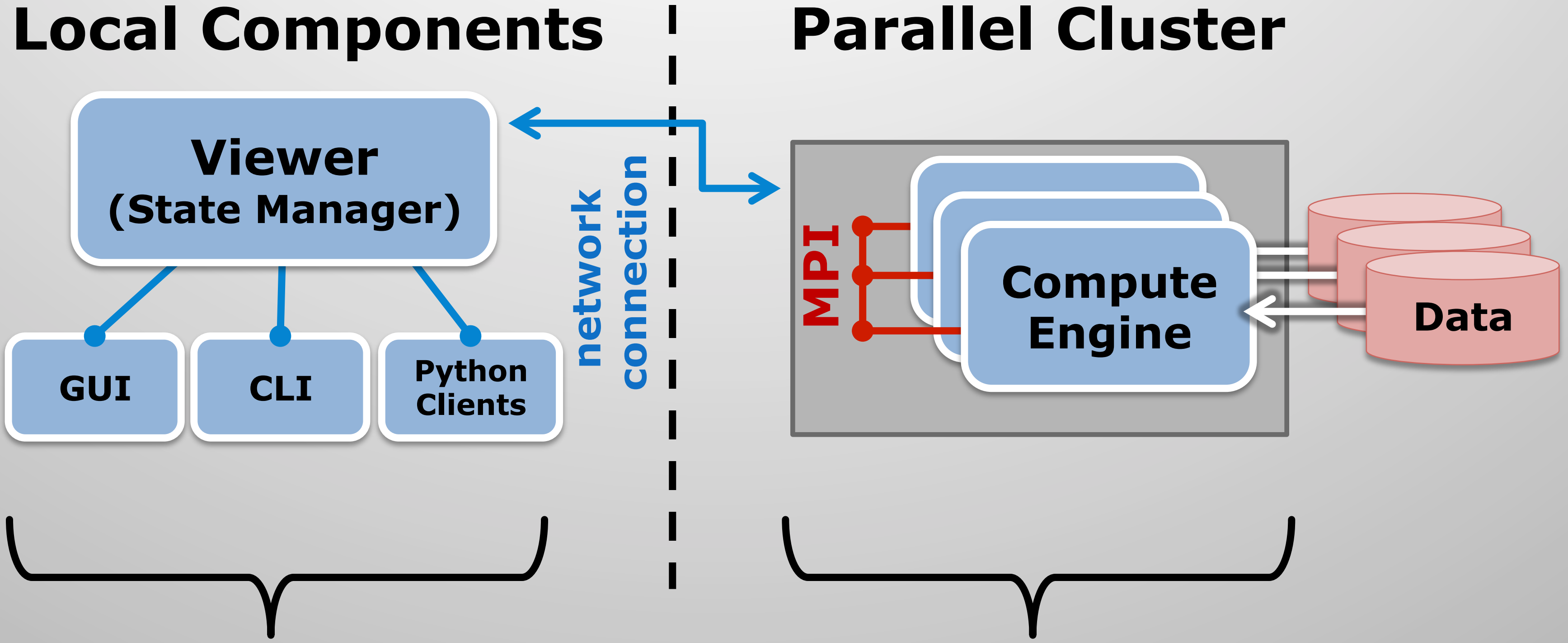
- Important: Ask questions any time!
- Tutorial contents located at visitusers.org under “Tutorial”:
  - http://visitusers.org/index.php?title=Tutorial
- Note: We will discuss file format issues and how to get help at the end of the tutorial.

Guided tour of VisIt

VisIt's core building blocks

- **Databases**: How datasets are read
- **Plots:** How you render data
- **Operators:** How you manipulate data
- **Expressions:** Mechanism for generating derived quantities
- **Queries:** How to access quantitative information

VisIt provides Python interfaces for state control and data manipulation.



Local Components

Viewer
(State Manager)

GUI

CLI

Python Clients

network connection

Parallel Cluster

MPI

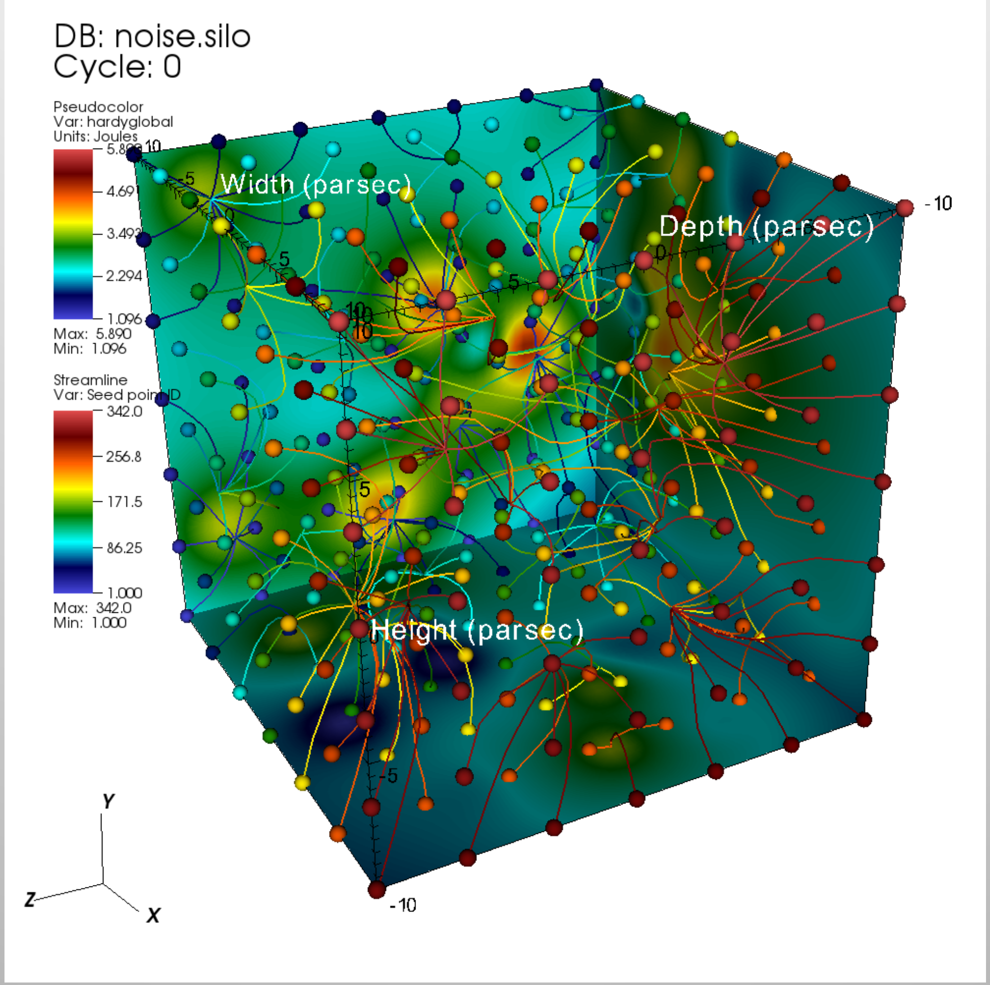
Compute Engine

Data

Python Client Interface
(State Control)

Python Filter Runtime
(Direct Mesh Manipulation)

Python Client Interface Example Script: Using VisIt's Building Blocks



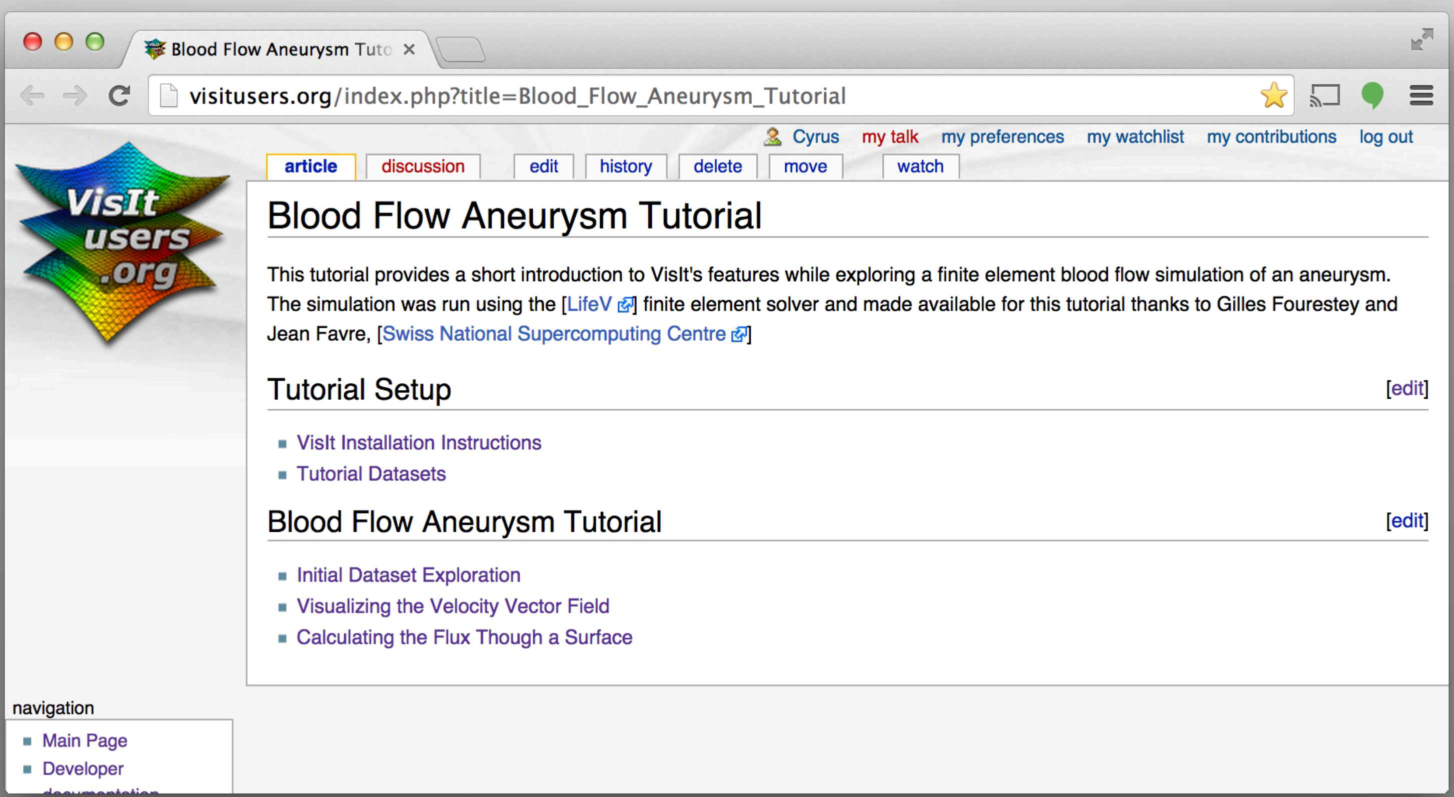
There are several ways to access VisIt's Python Client Interface.

- Launch VisIt's CLI binary:
  - `visit -cli`
- Launch for windowless batch processing:
  - `visit -nowin -cli -s <script_file.py>`
- Control VisIt from a Python interpreter:
  - `import visit'
  - http://visitusers.org/index.php?title=Python_Module_Support
- Record GUI actions in to Python snippets:
  - Macro Recording provides a quick path to learn VisIt's Python Client API.

Hands On Visualizations

Hands on visualization of a Blood Flow Simulation.

- http://visitusers.org/index.php?title=Blood_Flow_Aneurysm_Tutorial



Blood Flow Aneurysm Tutorial

This tutorial provides a short introduction to VisIt's features while exploring a finite element blood flow simulation of an aneurysm. The simulation was run using the [LifeV] finite element solver and made available for this tutorial thanks to Gilles Fourestey and Jean Favre, [Swiss National Supercomputing Centre]

Tutorial Setup [edit]

- VisIt Installation Instructions
- Tutorial Datasets

Blood Flow Aneurysm Tutorial [edit]

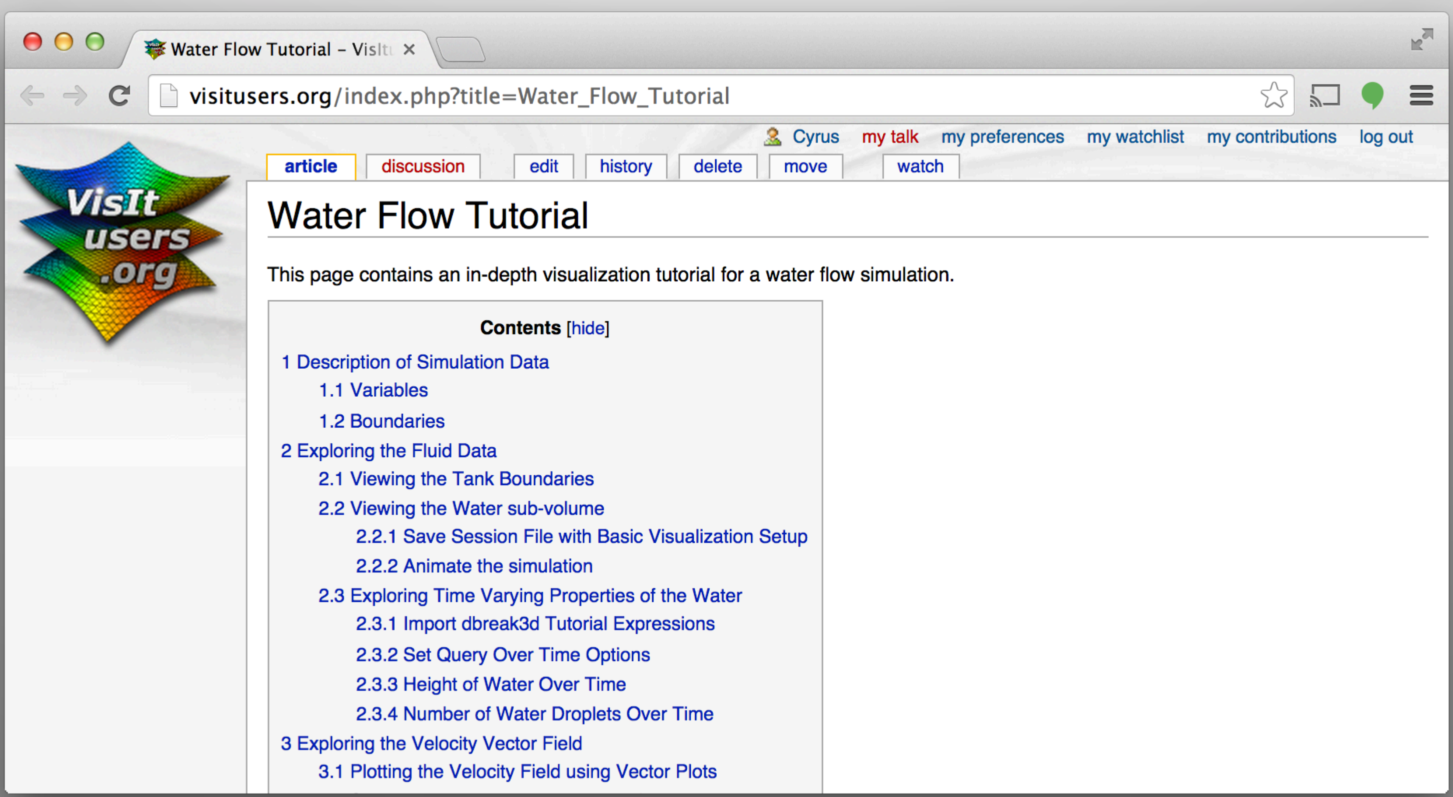
- Initial Dataset Exploration
- Visualizing the Velocity Vector Field
- Calculating the Flux Though a Surface

navigation

- Main Page
- Developer

Hands on visualization of a Water Flow Simulation.

- http://visitusers.org/index.php?title=Water_Flow_Tutorial



Water Flow Tutorial

This page contains an in-depth visualization tutorial for a water flow simulation.

Contents [hide]

Practical Tips for Using VisIt

Practical Tips for Using VisIt

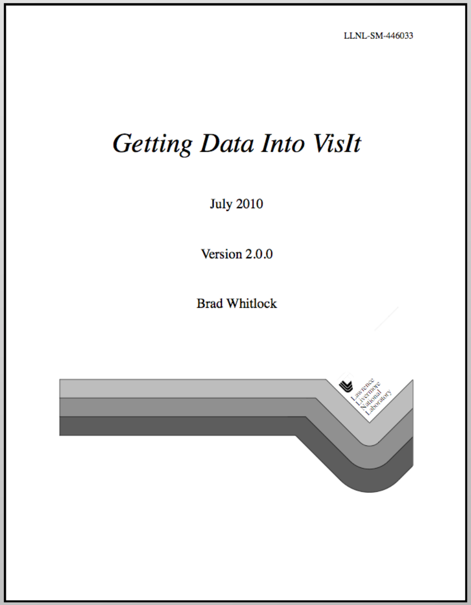
- **How to get VisIt to read your data**
- How to get help when you run into trouble

How to get VisIt to read your data.

- There is an extensive manual on this topic: “Getting Data Into VisIt”

https://wci.llnl.gov/simulation/computer-codes/visit/manuals

- Three ways:
  - Use a known format
  - Write a file format reader
  - In situ processing



LLNL-SM-446033

Getting Data Into VisIt

July 2010

Version 2.0.0

Brad Whitlock

Lawrence Livermore National Laboratory

File formats that VisIt supports

- **110+ Total Readers:** ADIOS, BOV, Boxlib, CCM, CGNS, Chombo, CLAW, EnSight, ENZO, Exodus, FLASH, Fluent, GDAL, Gadget, Images (TIFF, PNG, etc), ITAPS/MOAB, LAMMPS, NASTRAN, NETCDF, Nek5000, OpenFOAM, PLOT3D, PlainText, Pixie, Shapefile, Silo, Tecplot, VTK, Xdmf, Vs, and many more

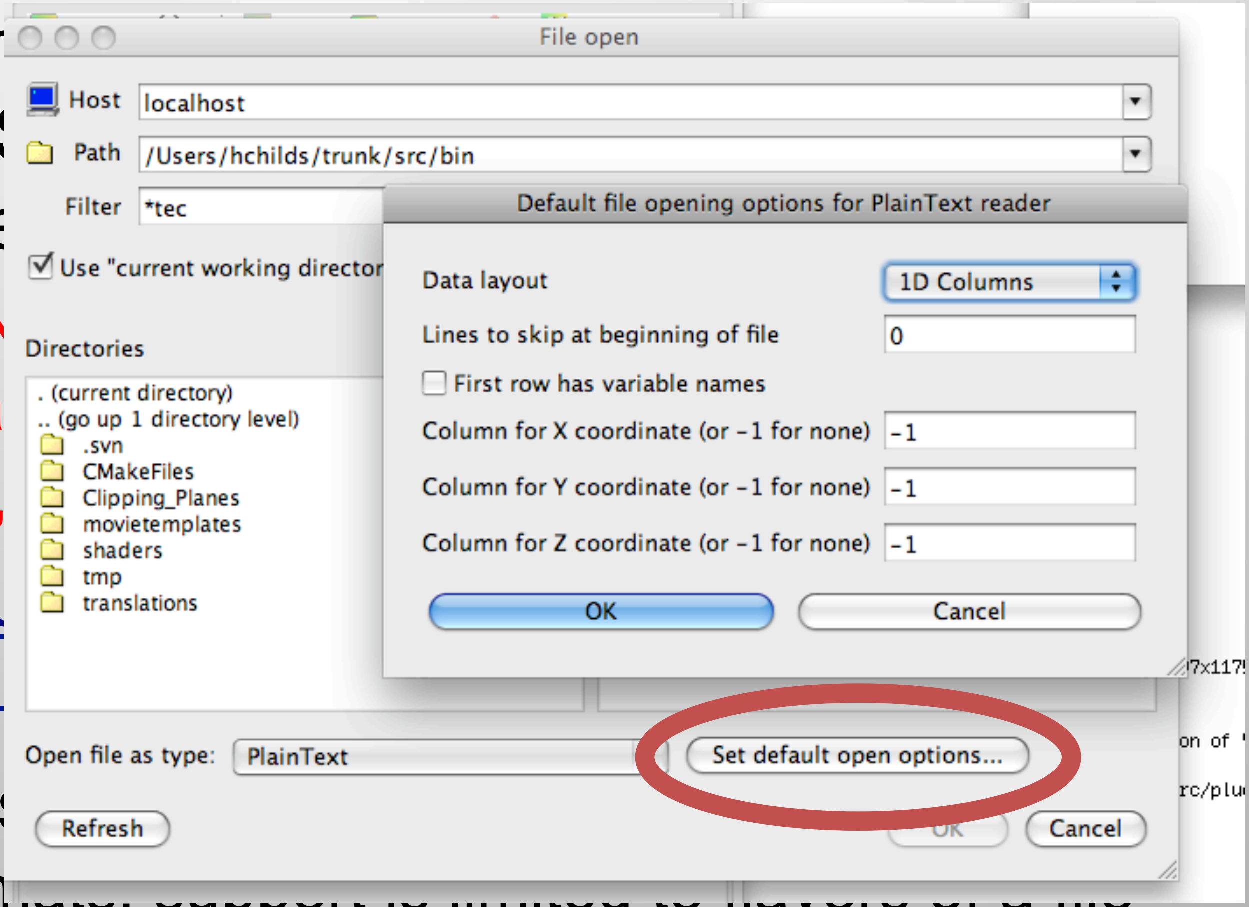
http://www.visitusers.org/index.php?title=Detailed_list_of_file_formats_VisIt_supports

- Some readers are more robust than others.
  - For some formats, support is limited to flavors of a file a VisIt developer has encountered previously (e.g. Tecplot).

File formats that VisIt supports

- **110+ Total Readers:** ADIOS, BOV, Boxlib, CCM, CGNS, Chom
Exodus, FLA
(TIFF, PNG, e
NASTRAN, N
PLOT3D, Pla
Tecplot, VTK,

[http://www.visitu
title=Detailed_li]()



File open

Host: localhost

Path: /Users/hchilds/trunk/src/bin

Filter: *tec

☑ Use "current working director

Directories

. (current directory)
.. (go up 1 directory level)
.svn
CMakeFiles
Clipping_Planes
movietemplates
shaders
tmp
translations

Open file as type: PlainText

Default file opening options for PlainText reader

Data layout: 1D Columns

Lines to skip at beginning of file: 0

☐ First row has variable names

Column for X coordinate (or -1 for none): -1

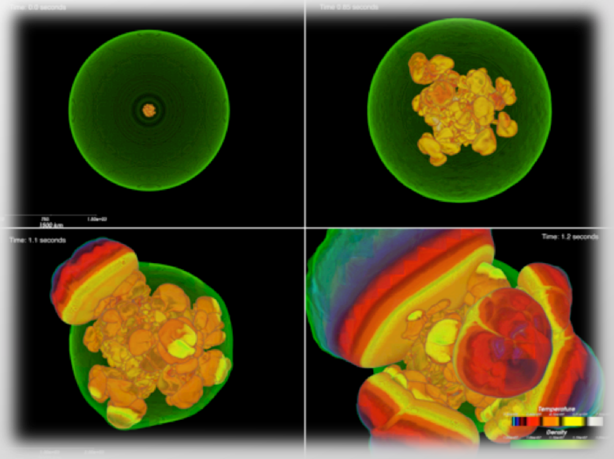
Column for Y coordinate (or -1 for none): -1

Column for Z coordinate (or -1 for none): -1

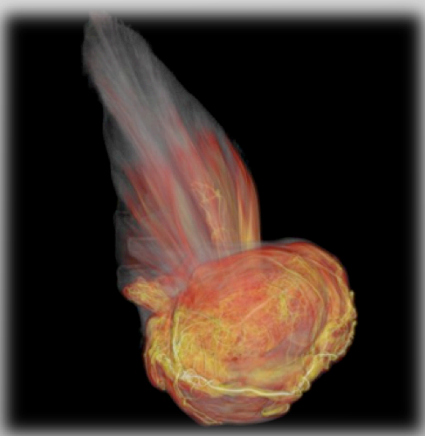
- Some reader
  - For some form
a VisIt developer has encountered previously (e.g. Tecplot).

Application Code Formats

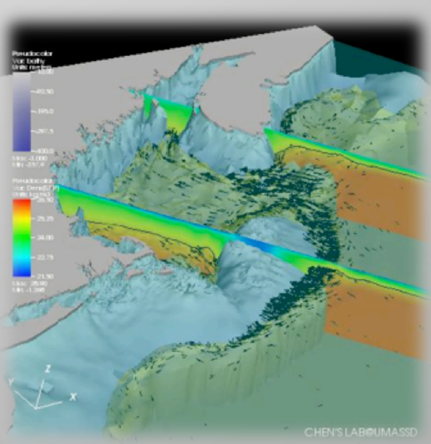
- ANSYS
- Cale
- CASTRO
- CCM
- DDCMD
- Dyna3D
- Enzo
- FLASH
- FVCOM
- Gadget
- LAMMPS
- NASTRAN
- Nek5000
- OVERFLOW
- PATRAN
- Pixie
- S3D
- ZeusMP



FLASH



CASTRO

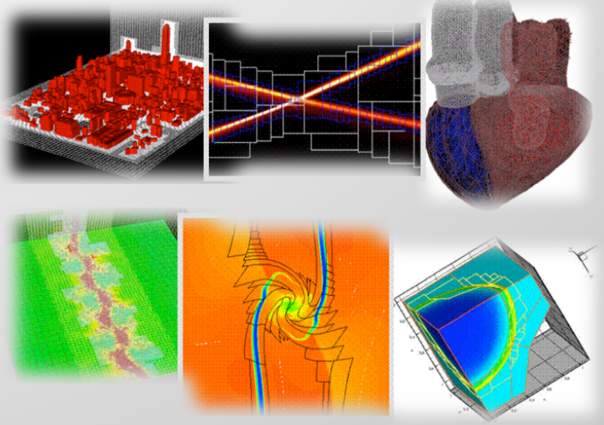


FVCOM

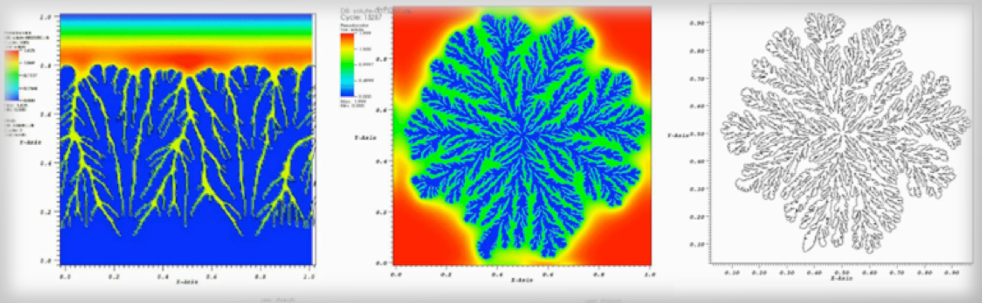
Application Toolkit Formats

- Adventure I/O
- BoxLib
- Chombo
- ITAPS
- OpenFOAM
- SAMRAI
- Spheral

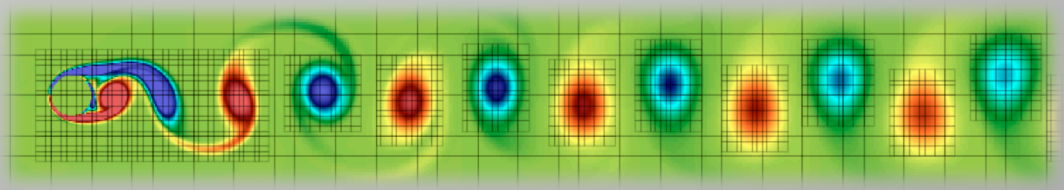
SAMRAI



ITAPS

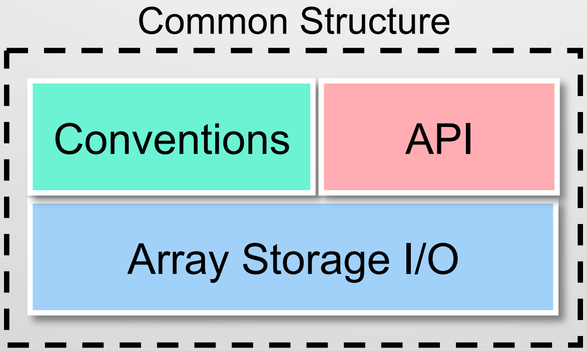


Chombo



General Scientific Data Formats

- ADIOS
- CGNS
- Exodus
- HDF5
- H5Part
- NETCDF
- PDB
- Silo
- XDMF



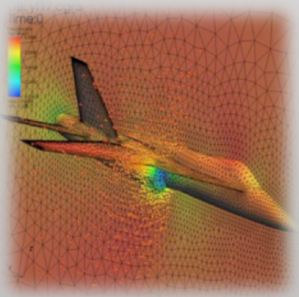
Common Structure

Conventions

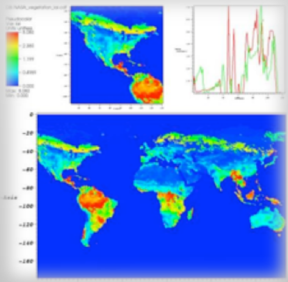
API

Array Storage I/O

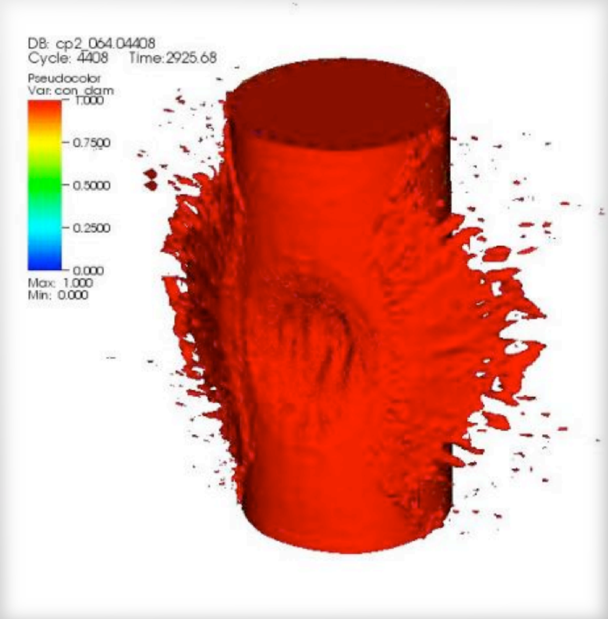
CGNS



NETCDF



Silo / Ale3d



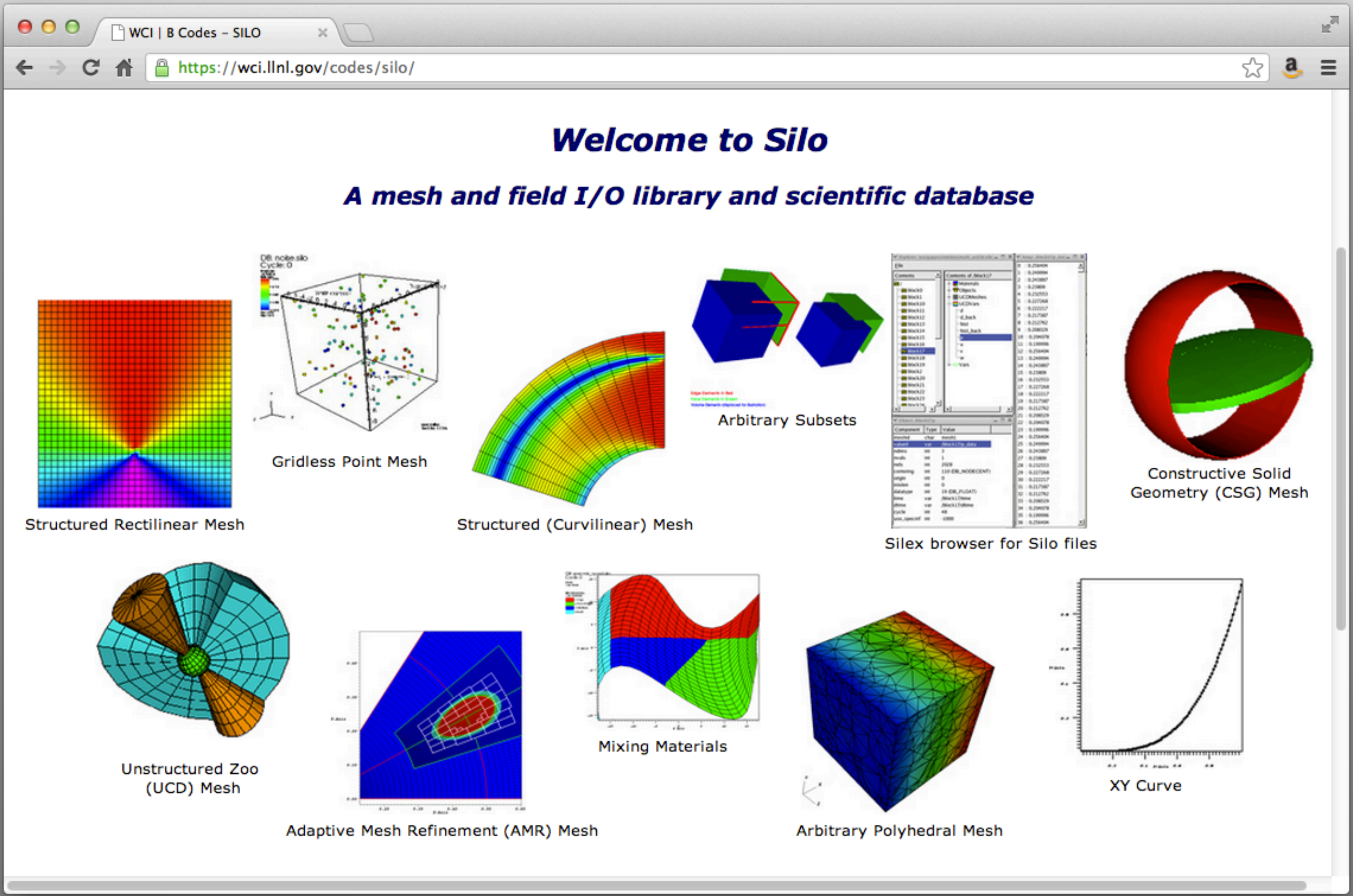
File formats that VisIt supports

- Common array writing libraries:
  - NETCDF
    - VisIt reader understands many (but not all) conventions
  - HDF5
    - Pixie is most general HDF5 reader
    - Many other HDF5 readers
- Xdmf: specify an XML file that describes semantics of arrays in HDF5 file
- VizSchema (Vs): add attributes to your HDF5 file that describes semantics of the arrays.

Silo file format

- Silo is a mature, self-describing file format that deals with multi-block data.
- It has drivers on top of HDF5 and “PDB”.
- Fairly rich data model
- More information:
  - https://wci.llnl.gov/simulation/computer-codes/silo

Silo features



Welcome to Silo

A mesh and field I/O library and scientific database

Structured Rectilinear Mesh

Gridless Point Mesh

Structured (Curvilinear) Mesh

Arbitrary Subsets

Silex browser for Silo files

Constructive Solid Geometry (CSG) Mesh

Unstructured Zoo (UCD) Mesh

Adaptive Mesh Refinement (AMR) Mesh

Mixing Materials

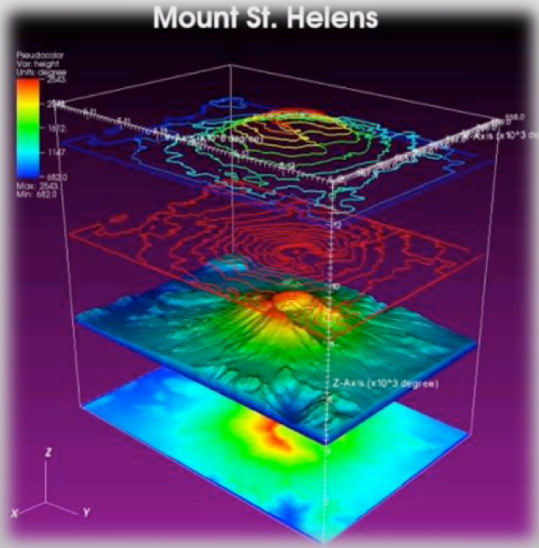
Arbitrary Polyhedral Mesh

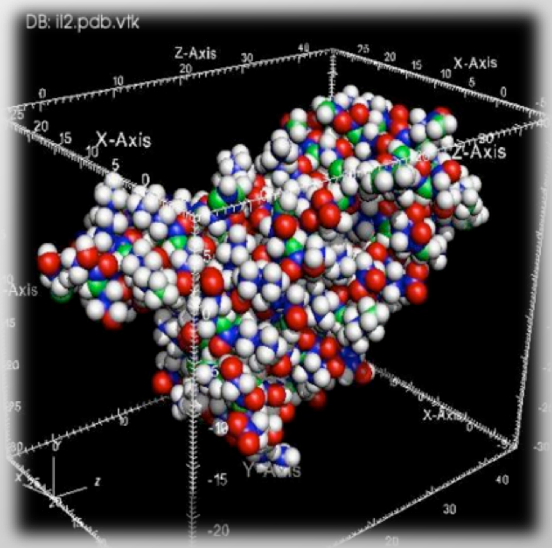
XY Curve

Specialized Scientific Data Formats

- BOW
- FITS
- GDAL
- MatrixMarket
- ProteinDataBank
- ESRI Shapefile
- XYZ

DEM from GDAL

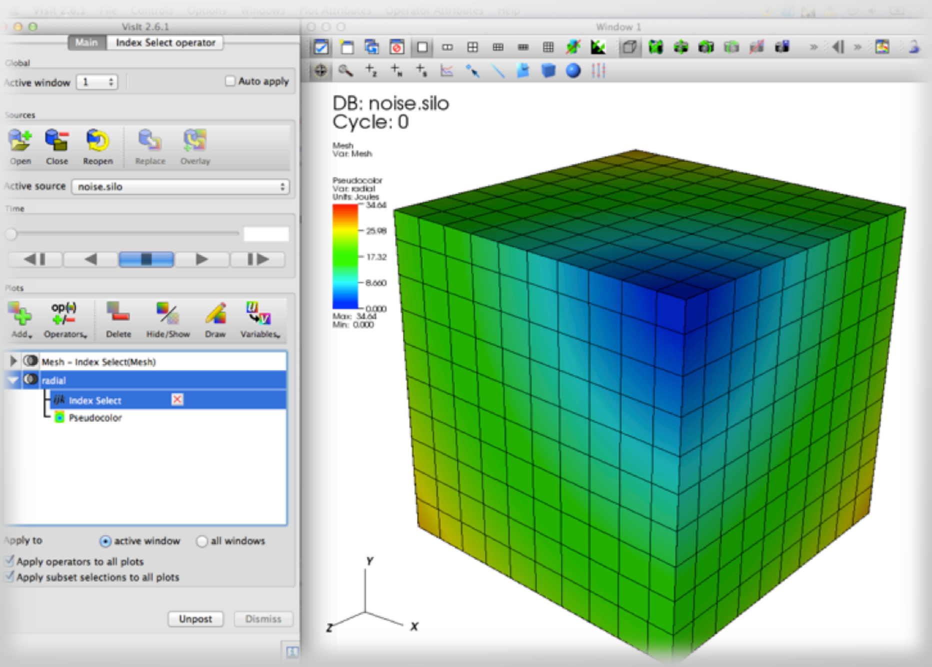




Protein Data Bank

Visualization Formats

- VTK
- EnSight
- GMV
- Plot3D
- Tecplot
- Vis5D
- Xmdv



Active window 1
☐ Auto apply
Active source noise.silo

Mesh - Index Select(Mesh)
radial
Index Select
Pseudocolor

Apply to ● active window ○ all windows
☑ Apply operators to all plots
☑ Apply subset selections to all plots

DB: noise.silo
Cycle: 0

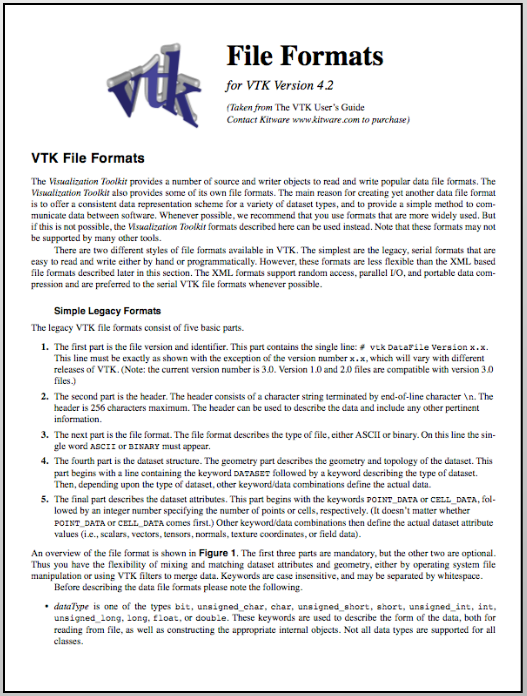
Mesh
Var: Mesh

Pseudocolor
Var: radial
Units: Joules

Max: 34.64
Min: 0.000

VTK File Format

- The VTK file format has both ASCII and binary variants.
  - Great documentation at: http://www.vtk.org/VTK/img/file-formats.pdf
- Easiest way to write VTK files: use VTK modules
  - … but this creates a dependence on the VTK library
- You can also try to write them yourself, but this is an error prone process.
- Third option: visit_writer



File Formats

for VTK Version 4.2

(Taken from The VTK User's Guide
Contact Kitware www.kitware.com to purchase)

VTK File Formats

The *Visualization Toolkit* provides a number of source and writer objects to read and write popular data file formats. The *Visualization Toolkit* also provides some of its own file formats. The main reason for creating yet another data file format is to offer a consistent data representation scheme for a variety of dataset types, and to provide a simple method to communicate data between software. Whenever possible, we recommend that you use formats that are more widely used. But if this is not possible, the *Visualization Toolkit* formats described here can be used instead. Note that these formats may not be supported by many other tools.

There are two different styles of file formats available in VTK. The simplest are the legacy, serial formats that are easy to read and write either by hand or programmatically. However, these formats are less flexible than the XML based file formats described later in this section. The XML formats support random access, parallel I/O, and portable data compression and are preferred to the serial VTK file formats whenever possible.

Simple Legacy Formats

The legacy VTK file formats consist of five basic parts.

1. The first part is the file version and identifier. This part contains the single line: `# vtk DataFile Version x.x`. This line must be exactly as shown with the exception of the version number `x.x`, which will vary with different releases of VTK. (Note: the current version number is 3.0. Version 1.0 and 2.0 files are compatible with version 3.0 files.)
2. The second part is the header. The header consists of a character string terminated by end-of-line character `\n`. The header is 256 characters maximum. The header can be used to describe the data and include any other pertinent information.
3. The next part is the file format. The file format describes the type of file, either ASCII or binary. On this line the single word `ASCII` or `BINARY` must appear.
4. The fourth part is the dataset structure. The geometry part describes the geometry and topology of the dataset. This part begins with a line containing the keyword `DATASET` followed by a keyword describing the type of dataset. Then, depending upon the type of dataset, other keyword/data combinations define the actual data.
5. The final part describes the dataset attributes. This part begins with the keywords `POINT_DATA` or `CELL_DATA`, followed by an integer number specifying the number of points or cells, respectively. (It doesn't matter whether `POINT_DATA` or `CELL_DATA` comes first.) Other keyword/data combinations then define the actual dataset attribute values (i.e., scalars, vectors, tensors, normals, texture coordinates, or field data).

An overview of the file format is shown in **Figure 1**. The first three parts are mandatory, but the other two are optional. Thus you have the flexibility of mixing and matching dataset attributes and geometry, either by operating system file manipulation or using VTK filters to merge data. Keywords are case insensitive, and may be separated by whitespace.

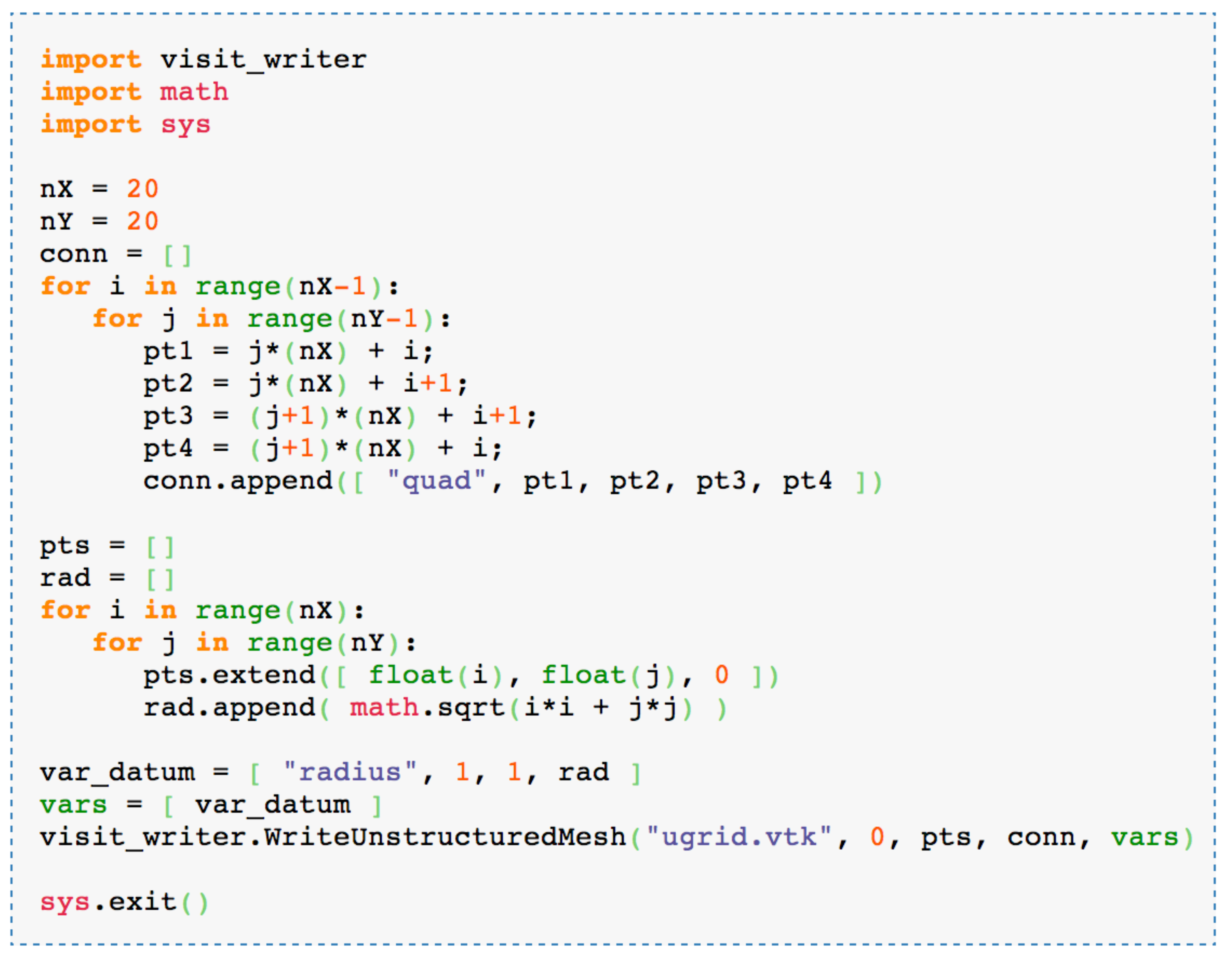
Before describing the data file formats please note the following.

- *dataType* is one of the types `bit`, `unsigned_char`, `char`, `unsigned_short`, `short`, `unsigned_int`, `int`, `unsigned_long`, `long`, `float`, or `double`. These keywords are used to describe the form of the data, both for reading from file, as well as constructing the appropriate internal objects. Not all data types are supported for all classes.

VisIt Writer writes VTK files

- It is a “library” (actually a single C file) that writes VTK-compliant files.
    - The typical path is to link visit_writer into your code and write VTK files
- There is also Python binding for visit_writer.
    - The typical path is to write a Python program that converts from your format to VTK
- Both options are short term: they allow you to play with VisIt on your data. If you like VisIt, then you typically formulate a long term file format strategy.
- More information on visit_writer:
    - http://visitusers.org/index.php?title=VisItWriter

Python VisIt Writer in action



```
import visit_writer
import math
import sys

nX = 20
nY = 20
conn = []
for i in range(nX-1):
   for j in range(nY-1):
      pt1 = j*(nX) + i;
      pt2 = j*(nX) + i+1;
      pt3 = (j+1)*(nX) + i+1;
      pt4 = (j+1)*(nX) + i;
      conn.append([ "quad", pt1, pt2, pt3, pt4 ])

pts = []
rad = []
for i in range(nX):
   for j in range(nY):
      pts.extend([ float(i), float(j), 0 ])
      rad.append( math.sqrt(i*i + j*j) )

var_datum = [ "radius", 1, 1, rad ]
vars = [ var_datum ]
visit_writer.WriteUnstructuredMesh("ugrid.vtk", 0, pts, conn, vars)

sys.exit()
```

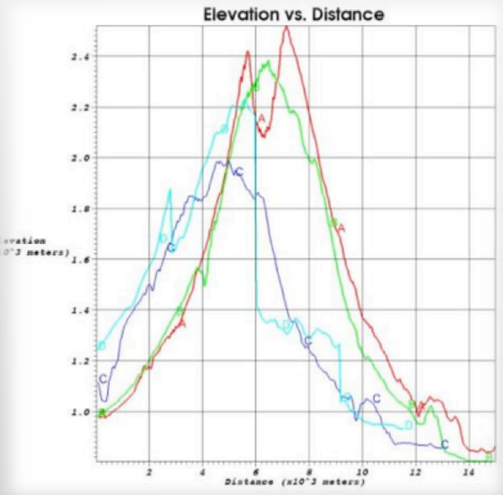
Graphics Formats

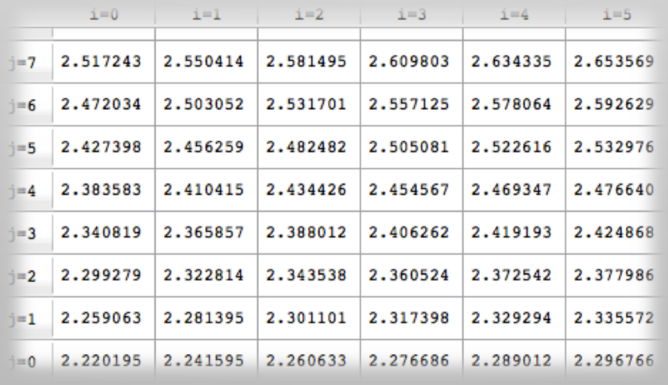
- Image
  - (PNG, JPEG, TIFF, BMP, etc.)
- RAW
- STL
- Wavefront OBJ

Carina Nebula

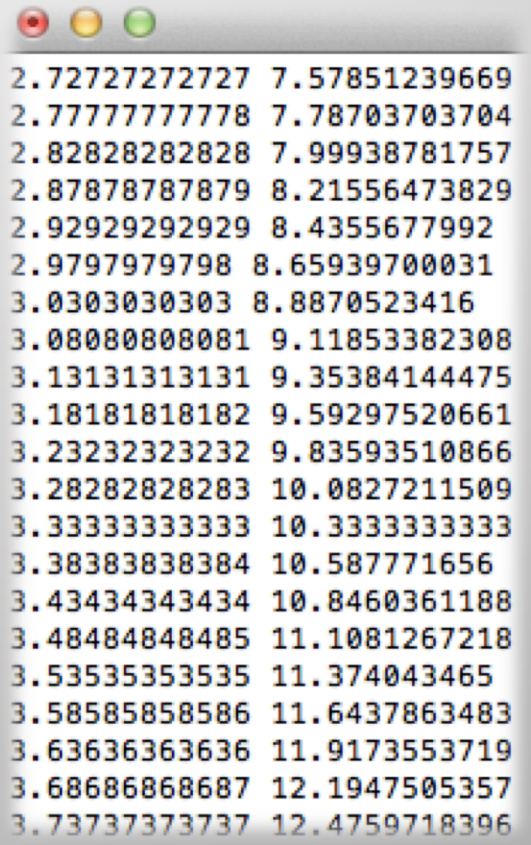
General ASCII Data Formats

- Curve2D
- Lines
- PlainText
- Point3D


Elevation vs. Distance



	i=0	i=1	i=2	i=3	i=4	i=5
j=7	2.517243	2.550414	2.581495	2.609803	2.634335	2.653569
j=6	2.472034	2.503052	2.531701	2.557125	2.578064	2.592629
j=5	2.427398	2.456259	2.482482	2.505081	2.522616	2.532976
j=4	2.383583	2.410415	2.434426	2.454567	2.469347	2.476640
j=3	2.340819	2.365857	2.388012	2.406262	2.419193	2.424868
j=2	2.299279	2.322814	2.343538	2.360524	2.372542	2.377986
j=1	2.259063	2.281395	2.301101	2.317398	2.329294	2.335572
j=0	2.220195	2.241595	2.260633	2.276686	2.289012	2.296766



```
2.72727272727 7.57851239669
2.77777777778 7.78703703704
2.82828282828 7.99938781757
2.87878787879 8.21556473829
2.92929292929 8.4355677992
2.9797979798 8.65939700031
3.0303030303 8.8870523416
3.08080808081 9.11853382308
3.13131313131 9.35384144475
3.18181818182 9.59297520661
3.23232323232 9.83593510866
3.28282828283 10.0827211509
3.33333333333 10.3333333333
3.38383838384 10.587771656
3.43434343434 10.8460361188
3.48484848485 11.1081267218
3.53535353535 11.374043465
3.58585858586 11.6437863483
3.63636363636 11.9173553719
3.68686868687 12.1947505357
3.73737373737 12.4759718396
```

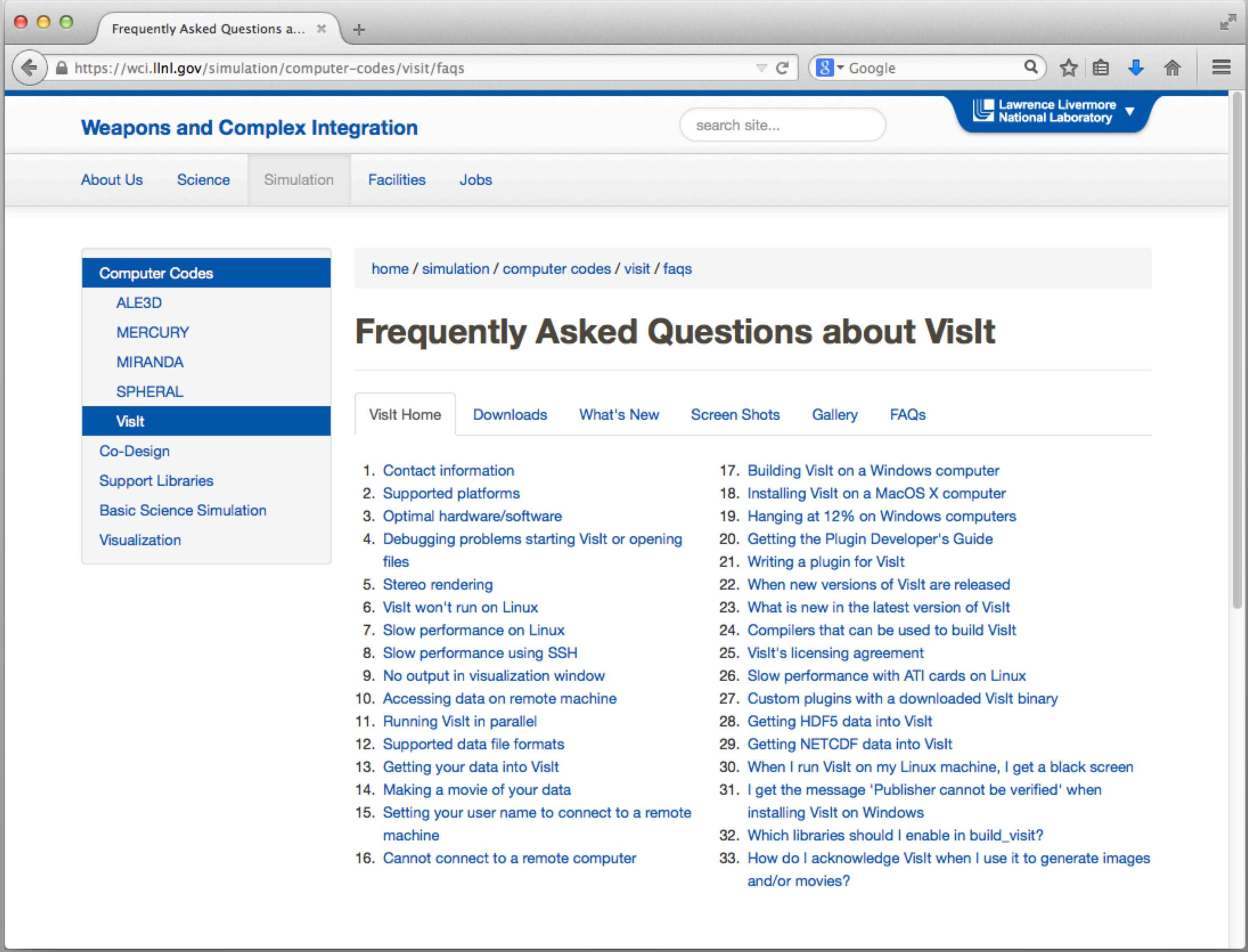
Practical Tips for Using VisIt

- How to get VisIt to read your data
- **How to get help when you run into trouble**

How to get help when you run into trouble

- FAQ
  - https://wci.llnl.gov/simulation/computer-codes/visit/faq
- VisIt Users Mailing List
  - Address: visit-users@elist.ornl.gov
  - Info: https://elist.ornl.gov/mailman/listinfo/visit-users
  - Archive: https://elist.ornl.gov/pipermail/visit-users/
- VisIt Users Wiki
  - http://www.visitusers.org
- VisIt Users Forum
  - http://visitusers.org/forum/YaBB.pl
- Priority support for specific user groups:
  - VisIt-help-{XYZ} Mailing Lists
- Reference Manuals
  - https://wci.llnl.gov/simulation/computer-codes/visit/manuals

FAQ: https://wci.llnl.gov/simulation/computer-codes/visit/faqs


Frequently Asked Questions a...
https://wci.llnl.gov/simulation/computer-codes/visit/faqs
Google
Weapons and Complex Integration
search site...
Lawrence Livermore National Laboratory
About Us
Science
Simulation
Facilities
Jobs
Computer Codes
ALE3D
MERCURY
MIRANDA
SPHERAL
VisIt
Co-Design
Support Libraries
Basic Science Simulation
Visualization
home / simulation / computer codes / visit / faqs

Frequently Asked Questions about VisIt

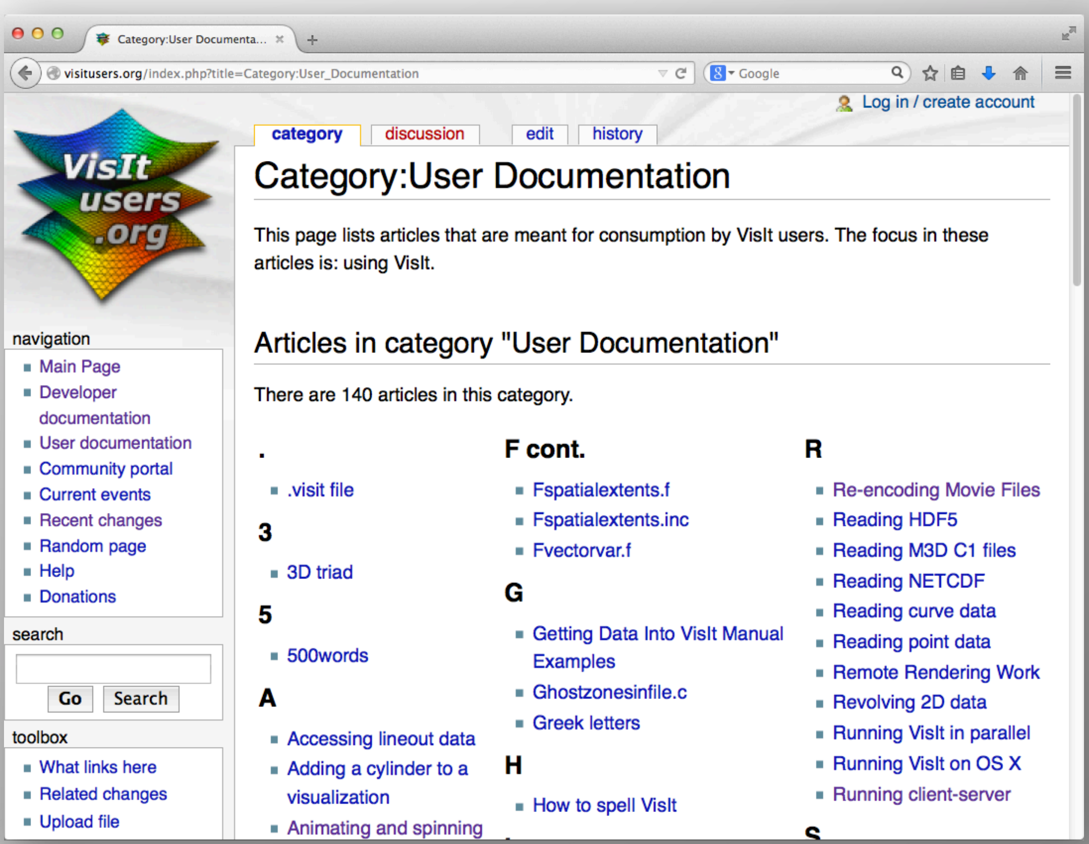
1. Contact information
2. Supported platforms
3. Optimal hardware/software
4. Debugging problems starting VisIt or opening files
5. Stereo rendering
6. VisIt won't run on Linux
7. Slow performance on Linux
8. Slow performance using SSH
9. No output in visualization window
10. Accessing data on remote machine
11. Running VisIt in parallel
12. Supported data file formats
13. Getting your data into VisIt
14. Making a movie of your data
15. Setting your user name to connect to a remote machine
16. Cannot connect to a remote computer
17. Building VisIt on a Windows computer
18. Installing VisIt on a MacOS X computer
19. Hanging at 12% on Windows computers
20. Getting the Plugin Developer's Guide
21. Writing a plugin for VisIt
22. When new versions of VisIt are released
23. What is new in the latest version of VisIt
24. Compilers that can be used to build VisIt
25. VisIt's licensing agreement
26. Slow performance with ATI cards on Linux
27. Custom plugins with a downloaded VisIt binary
28. Getting HDF5 data into VisIt
29. Getting NETCDF data into VisIt
30. When I run VisIt on my Linux machine, I get a black screen
31. I get the message 'Publisher cannot be verified' when installing VisIt on Windows
32. Which libraries should I enable in build_visit?
33. How do I acknowledge VisIt when I use it to generate images and/or movies?

VisIt-users Mailing List

- You may only post to mailing list if you are also a subscriber.
- Approximately 400 recipients, approx. 300 posts per month.
- Developers monitor mailing list, strive for 100% response rate.
- Response time is typically excellent (O(1 hour)).
    - International community participates … not unusual for a question from Australia to be answered by a European, while all US developers are asleep.
- List Address: visit-users@ornl.gov
- More information: https://email.ornl.gov/mailman/listinfo/visit-users
- Archive: https://email.ornl.gov/pipermail/visit-users/

VisItusers.org

- Great source for VisIt tips and recipes.
- Users section has lots of practical advice:
  - "I solved this problem using this technique"
  - "Here's my script to do this analysis"



Category:User Documenta… ×
visitusers.org/index.php?title=Category:User_Documentation
Google
Log in / create account
category
discussion
edit
history
VisIt users .org

Category:User Documentation

This page lists articles that are meant for consumption by VisIt users. The focus in these articles is: using VisIt.

Articles in category "User Documentation"

There are 140 articles in this category.

.
- .visit file

3
- 3D triad

5
- 500words

A
- Accessing lineout data
- Adding a cylinder to a visualization
- Animating and spinning

F cont.
- Fspatialextents.f
- Fspatialextents.inc
- Fvectorvar.f

G
- Getting Data Into VisIt Manual Examples
- Ghostzonesinfile.c
- Greek letters

H
- How to spell VisIt

R
- Re-encoding Movie Files
- Reading HDF5
- Reading M3D C1 files
- Reading NETCDF
- Reading curve data
- Reading point data
- Remote Rendering Work
- Revolving 2D data
- Running VisIt in parallel
- Running VisIt on OS X
- Running client-server

navigation
- Main Page
- Developer documentation
- User documentation
- Community portal
- Current events
- Recent changes
- Random page
- Help
- Donations

search

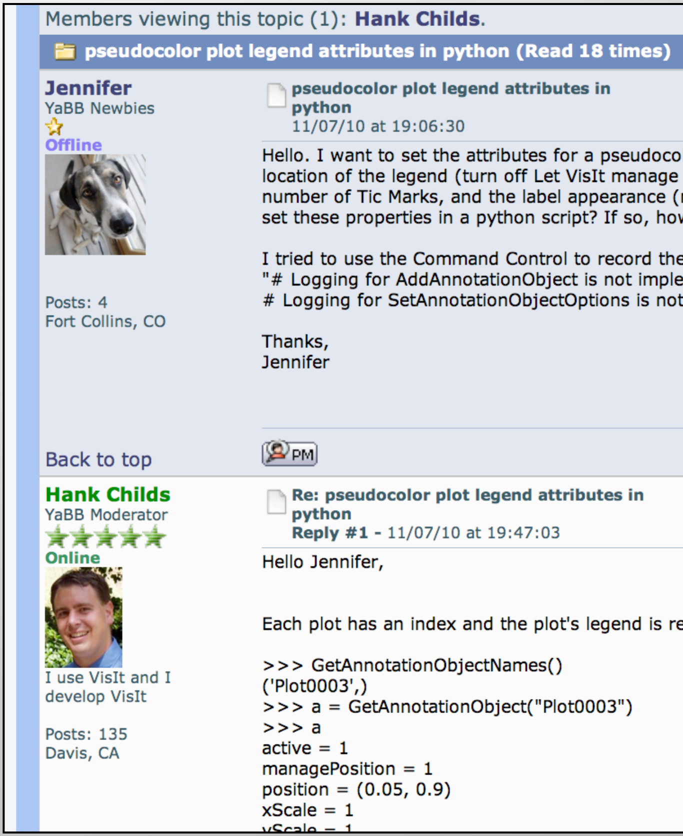
Go Search

toolbox
- What links here
- Related changes
- Upload file

VisItusers.org is the VisIt project's staging area for usage recipes and future formal documentation.

VisIt Users Forum

- http://www.visitusers.org/forum
- Increasingly popular option; you can post without receiving 300 emails a month
  - But it is viewed by less people and less well supported.
- Google indexes these pages.



Members viewing this topic (1): **Hank Childs**.

pseudocolor plot legend attributes in python (Read 18 times)

Jennifer
YaBB Newbies
Offline

Posts: 4
Fort Collins, CO

pseudocolor plot legend attributes in python
11/07/10 at 19:06:30

Hello. I want to set the attributes for a pseudoco
location of the legend (turn off Let VisIt manage
number of Tic Marks, and the label appearance (
set these properties in a python script? If so, ho

I tried to use the Command Control to record the
"# Logging for AddAnnotationObject is not imple
Logging for SetAnnotationObjectOptions is not

Thanks,
Jennifer

Back to top

Hank Childs
YaBB Moderator
Online

I use VisIt and I develop VisIt

Posts: 135
Davis, CA

Re: pseudocolor plot legend attributes in python
Reply #1 - 11/07/10 at 19:47:03

Hello Jennifer,

Each plot has an index and the plot's legend is re

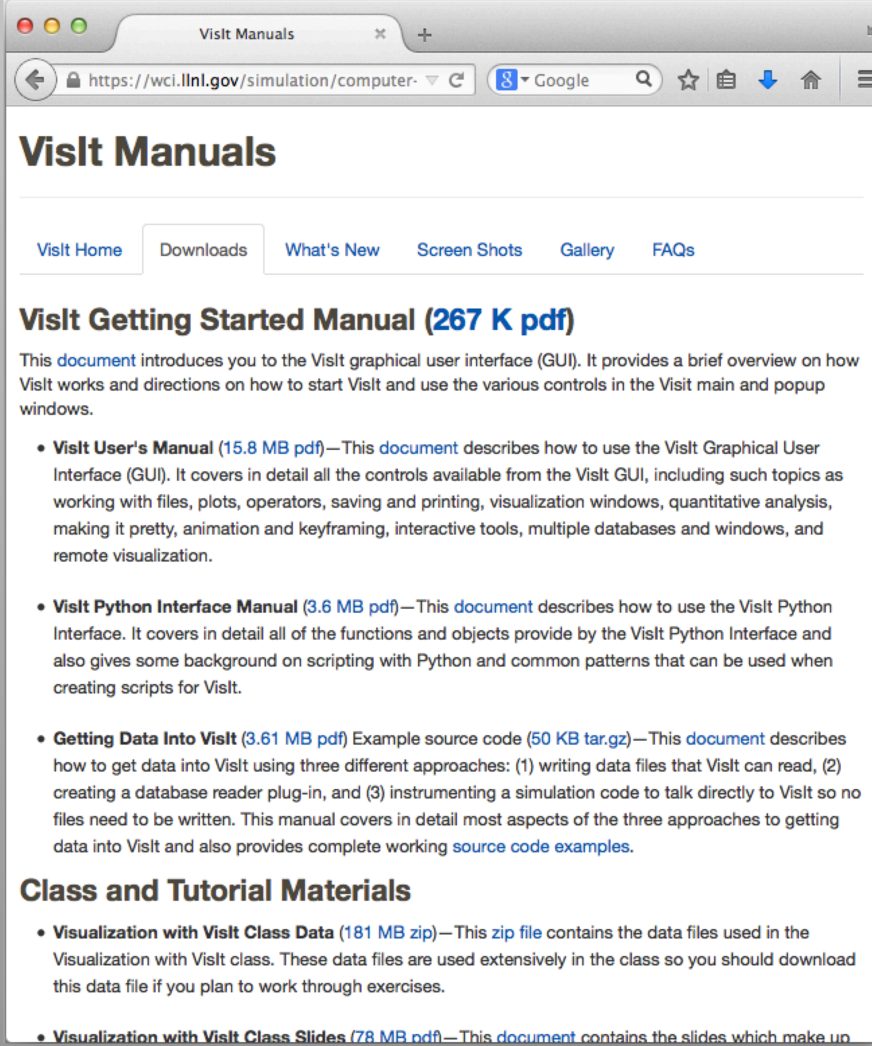
```
>>> GetAnnotationObjectNames()
('Plot0003',)
>>> a = GetAnnotationObject("Plot0003")
>>> a
active = 1
managePosition = 1
position = (0.05, 0.9)
xScale = 1
yScale = 1
```

Visit-help-{XYZ}

- Some customer groups pay for priority VisIt support:
  - These customers can post directly to specific visit-help-{XYZ} support lists without subscribing.
  - The messages are received by all VisIt developers and supported collectively.
- Example Lists:
  - visit-help-asc, visit-help-scidac

Manuals & Other Documentation

- Getting Started Manual
- Users Manual
- Python Interface
- Getting Data Into VisIt
- VisIt Class Slides
- VisIt Class Exercises
- {Tutorials}



VisIt Manuals

VisIt Getting Started Manual (267 K pdf)

This document introduces you to the VisIt graphical user interface (GUI). It provides a brief overview on how VisIt works and directions on how to start VisIt and use the various controls in the Visit main and popup windows.

- **VisIt User's Manual** (15.8 MB pdf)—This document describes how to use the VisIt Graphical User Interface (GUI). It covers in detail all the controls available from the VisIt GUI, including such topics as working with files, plots, operators, saving and printing, visualization windows, quantitative analysis, making it pretty, animation and keyframing, interactive tools, multiple databases and windows, and remote visualization.
- **VisIt Python Interface Manual** (3.6 MB pdf)—This document describes how to use the VisIt Python Interface. It covers in detail all of the functions and objects provide by the VisIt Python Interface and also gives some background on scripting with Python and common patterns that can be used when creating scripts for VisIt.
- **Getting Data Into VisIt** (3.61 MB pdf) Example source code (50 KB tar.gz)—This document describes how to get data into VisIt using three different approaches: (1) writing data files that VisIt can read, (2) creating a database reader plug-in, and (3) instrumenting a simulation code to talk directly to VisIt so no files need to be written. This manual covers in detail most aspects of the three approaches to getting data into VisIt and also provides complete working source code examples.

Class and Tutorial Materials

- **Visualization with VisIt Class Data** (181 MB zip)—This zip file contains the data files used in the Visualization with VisIt class. These data files are used extensively in the class so you should download this data file if you plan to work through exercises.
- **Visualization with VisIt Class Slides** (78 MB pdf)—This document contains the slides which make up

Resources

- **Presenters:**

Cyrus Harrison	cyrush@llnl.gov
Jean Favre	jfavre@cscs.ch
Brad Whitlock	bjw@ilight.com
David Pugmire	pugmire@ornl.gov
Robert Sisneros	sisneros@illinois.edu

- **User resources:**
  - Website: https://wci.llnl.gov/simulation/computer-codes/visit/
  - Wiki: http://www.visitusers.org
  - Email List: visit-users@ornl.gov

- **Development resources:**
  - Email List: visit-developers@ornl.gov
  - SVN: http://portal.nersc.gov/svn/visit