Scientific Visualization with ParaView

Weiguang Guan
guanw@sharcnet.ca

ParaView: http://www.paraview.org/download
Code & data: http://guanw.sharcnet.ca/ss2016viz.zip
What is Visualization

Data $\rightarrow$ Graphical representations
Why Visualization

- To comprehend data
- To explore and discover
  - Patterns
  - Structures
  - Trends
- To monitor simulations
- To communicate with others

A picture is worth of thousands of words - numbers!
## Numbers (S&P 500)

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...
Graph (S&P 500)
More examples
More and more examples
Overview of ParaView

- Introduction
  - Open source
  - General-purpose visualization package
  - Large user base
  - Kitware, Los Alomas, Sandia National Labs, etc
  - [www.paraview.org](http://www.paraview.org)
  - Latest version 5.2
Overview of ParaView

- Introduction
  - Parallel visualization of large data
  - Either standalone or client/server mode
  - Multiple platforms (Windows, Linux/Unix, MacOS)
  - Multi-dimensional and/or Multi-variables
  - Rich functionalities implemented as filters
  - Many file formats
  - Various data types
  - Scripting
Overview of ParaView

- Documentations and resources
  - Wiki: [http://www.paraview.org/Wiki/ParaView](http://www.paraview.org/Wiki/ParaView)
  - Tutorials: [http://www.paraview.org/tutorials](http://www.paraview.org/tutorials)
  - Webinars: [http://www.paraview.org/webinars](http://www.paraview.org/webinars)
Overview of ParaView

- Documentations and resources
  - Mailing lists:
  - Help online F1 or context-sensitive
Overview of ParaView

- Visualization pipelines
Overview of ParaView

- **Pipeline components**
  - **Source**: no input, one or more outputs
    - Primitive objects (cube, cylinder, cone, sphere, etc)
    - Data file readers
  - **Filter**: one or more inputs, one or more outputs
Overview of ParaView

- Connections in pipeline
  - Outputs of one component become the inputs of another
  - Compatibility of data type between inputs and outputs
Overview of ParaView

- Data types (sampling structures)

- Uniform Rectilinear (vtkImageData)
- Non-Uniform Rectilinear (vtkRectilinearData)
- Curvilinear (vtkStructuredData)
- Polygonal (vtkPolyData)
- Unstructured Grid (vtkUnstructuredGrid)

Multi-block
- Hierarchical Adaptive Mesh Refinement (AMR)
- Hierarchical Uniform AMR
- Octree
Overview of ParaView

- Data types at sampling points
  - Scalars (density, temperature, pressure, etc)
  - Vectors (velocity)
  - Normals
  - Texture Coordinates
  - Tensors
ParaView on SHARCNet

- SHARCNet visualization stations
  - 10 viz stations (≤64GB memory, ≤12 cores, modern GPUs)
  - [https://www.sharcnet.ca/my/software/show/67](https://www.sharcnet.ca/my/software/show/67)
- ParaView on SHARCNet viz stations
  - VNC (TigerVNC)
  - Client-server mode
Standalone ParaView

- Start ParaView
  - Linux/Unix: type `paraview` in a command window
  - MacOS: click ParaView in `Applications` folder
  - Windows: click ParaView from Start Menu

Then
- ParaView GUI appears
- `Pvserver` running in the background
ParaView GUI

- Menu Bar
- Toolbars
- Pipeline Browser
- Properties Panel
- Advanced Toggle
- 3D View