VERAView

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VERAView

• Description
• Platforms and Implementation
• Application Basics
• Dataset Types
• Widgets
• Demo
VERAView : Description

- An interactive graphical user interface (GUI) for the visualization and engineering analysis of VERA output
- True multi-physics analysis tool
  - Neutronics, thermal-hydraulics, fuel performance
  - All displayed together
- Displays data at the field rod / coolant channel level
  - Calculates coarser quantities
  - Assembly, axial, core, radial, and radial assembly average and RMS datasets
- Implicitly displays data in a simplified PWR geometry
VERA View: Description

- Reads VERA output files but not connected directly to VERA codes
- Data from any reactor methods can be displayed
- Needs only a core_map, axial_mesh, number of pins indicator, and dataset(s) to display
- Designed to be used with no experience or training
- Not a replacement for VisIt, ParaView, or other general purpose (i.e., complex) data visualization tools
- Mostly 2D views with a couple of basic 3D visualizations
VERAView: Description

- Exports data as comma-separated values (CSV) for import to Excel or other spreadsheet apps

- Creates and exports images and animations

https://newton.ornl.gov/xfer/epm/final-vessel.anim.gif.html
VERAView : Description

- Analysis capabilities
  - Find maximum, minimum values
  - Create derived datasets (average, RMS)
  - Create difference datasets
VERAView: Description

- Developed as a (very) rapid prototype with frequent stakeholder feedback
  - Good for “friendly users”
  - Some fringe features only lightly tested
- Designed to be extensible
  - Framework for adding custom widget implementation
- Open source

[http://github.com/CASL/VERAView](http://github.com/CASL/VERAView)
VERAView : Platforms and Implementation

- Python-2 desktop application

- (wxWidgets) GUI widget library

- h5py HDF5 file I/O

- NumPy array processing and calculations

- SciPy interpolations

- matplotlib plotting

- Mayavi 3D rendering

- Pillow image operations
VERAView : Platforms and Implementation

• Anaconda Python distribution
  • [https://www.anaconda.com/](https://www.anaconda.com/)
  • Cross-platform with all required VERAView packages

• VERAView installers include Miniconda2, a lighter version with all required packages
VERAView : Application Basics
VERAView : Application Basics

- Current selections
- Coordinates
  - Assembly/detector (column, row)
  - Pin/channel (column, row)
- Node
- Secondary pins and nodes
- Fluence (theta, r)
- Dataset(s)
VERAView : Application Basics

- Current selections (cont’d)
  - Axial level
  - Statepoint (time)
VERAView : Application Basics

- Selections in one widget are shared with all other widgets
  - Can be toggled for each individual widget

- Sliders added for convenient selection
  - Axial level
  - Statepoint (time)
VERAView : Dataset Types

• VERAOut file is in HDF5 format

• Hierarchical with groups (directories) and leaf datasets

```plaintext
vera_p9.h5
- CORE
- INPUT
- STATE_0001
- STATE_0002
- STATE_0003
- STATE_0004
- STATE_0005
- STATE_0006
- STATE_0007
- STATE_0008
- STATE_0009
```
VERAView: Dataset Types

- Primary types

<table>
<thead>
<tr>
<th>Type</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>channel</td>
<td>(npiny+1, npinx+1, nax, nass)</td>
</tr>
<tr>
<td>detector</td>
<td>(ndetax, ndet)</td>
</tr>
<tr>
<td>fixed_detector</td>
<td>(nfdetax, ndet)</td>
</tr>
<tr>
<td>fluence</td>
<td>(nz, theta, nr)</td>
</tr>
<tr>
<td>pin</td>
<td>(npiny, npinx, nax, nass)</td>
</tr>
<tr>
<td>radial_detector</td>
<td>(ndet, )</td>
</tr>
<tr>
<td>scalar</td>
<td>()</td>
</tr>
<tr>
<td>subpin_cc</td>
<td>(nsubtheta, npiny, npinx, nsubax, nass)</td>
</tr>
</tbody>
</table>
### VERAView: Dataset Types

- Derived types

<table>
<thead>
<tr>
<th>Type</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>:assembly</td>
<td>(nax, nass)</td>
</tr>
<tr>
<td>:axial</td>
<td>(nax)</td>
</tr>
<tr>
<td>:chan_radial</td>
<td>(npiny+1, npinx+1, nass)</td>
</tr>
<tr>
<td>:core</td>
<td>()</td>
</tr>
<tr>
<td>:node</td>
<td>(4, nax, nass)</td>
</tr>
<tr>
<td>:radial</td>
<td>(npiny, npinx, nass)</td>
</tr>
<tr>
<td>:radial_assembly</td>
<td>(nass)</td>
</tr>
<tr>
<td>:radial_node</td>
<td>(4, nass)</td>
</tr>
</tbody>
</table>
VERAView: Dataset Types

- **DataModel class**
  - Encapsulates all I/O for VERAOut file
  - Finds maximum/minimum values
  - Reads datasets
  - Creates derived datasets

- **DataModelMgr class**
  - Manages multiple open files
  - Reads datasets
VERAView: Widgets

- Panels in a VERAView frame/window
VERAView: Widgets

- Available on the toolbar and menubar (*File-*->*New*)
- Based on dataset types in the open file(s)
- Tool tip specifies the name

![Diagram of VERAView Widgets]

- Core 2D View
- Core Axial 2D View
- Assembly 2D View
- Detector 2D Multi View
- Volume Slicer 3D View
- Volume 3D View
- Axial Plots
- Time Plots
- Table View
- Data Analysis View
VERAView: Core 2D View

- Displays assemblies in current symmetry
- Individual fuel rod values displayed
- Assembly quantities shown as numbers

Types
- channel
- pin
- assembly
- chan_radial
- node
- radial
- radial_assembly
- radial_node

Selects
- assembly
- channel/pin
- node

Nodal Channel
VERAView : Core Axial 2D View

• Displays vertical cut along assembly column or row
• Individual fuel rod values displayed
VERAView : Assembly 2D View

- Lattice view of selected assembly
- Individual fuel rod values displayed, numbers when they fit

Selects
channel/pin
2ndary channel/pin

Types
channel
pin
:chan_radial
:radial
VERAView: Detector Multi View

- Plots of detector, fixed_detector, and radial_detector values at detector locations
- Plots or numbers
VERAView: Axial Plots

- Plots with axial level as the Y-axis
- Multiple datasets, two scales
- Shows plots for current and secondary selections

<table>
<thead>
<tr>
<th>Selects</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>axial level</td>
<td>anything with an axial dimension</td>
</tr>
</tbody>
</table>
VERAView : Time Plots

- Plots with time as the X-axis
- Multiple datasets, two scales
- Shows plots for current and secondary selections

Selects | Types
---|---
time | channel
detector | fixed_detector
fluence | pin
radial_detector | scalar
subpin_cc | :assembly
:axial | :chan_radial
:core | :radial
:node | :radial_assembly
:radial_node | :radial_node

![Plots with time as the X-axis](image)

![Multiple datasets, two scales](image)

![Shows plots for current and secondary selections](image)
VERAView: Table View

- Shows dataset values at current coordinates and time
- Additional columns for secondary selections

**Types**
- channel
- detector
- fixed_detector
- fluence
- pin
- radial_detector
- scalar
- :assembly
- :axial
- :chan_radial
- :core
- :node
- :radial
- :radial_assembly
VERAView: Vessel Core 2D View

- Shows vessel fluence datasets
- Currently only quarter symmetry

Types
fluence

Selects
fluence r
fluence theta
VERAView: Vessel Core Axial 2D View

- Shows vessel fluence vertical slice
VERAView: Widgets

- Widget framework
- Event handlers and propagation
- Rendering

Diagram:

- Widget
  - PlotWidget
    - AxialPlot
    - TimePlots
  - TableView
  - DataAnalysisView
  - RasterWidget
    - Assembly2DView
    - Core2DView
    - CoreAxial2DView
    - Detector2DMultiView
VERAView: Demo

Live Demo!

What could possibly go wrong?

The technology demo

The software isn’t 100% complete.

If it had a user interface you would see something here... here...and sometimes here.

And then you’d be saying, “I gotta get me some of that.”

Any questions?
Additional Slides
VERAView: Dataset Types

- Dataset types determined by shape
- Can be overridden by an attribute
- Dimensions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>nass</td>
<td>Number of assemblies</td>
</tr>
<tr>
<td>nax</td>
<td>Number of axial mesh points points</td>
</tr>
<tr>
<td>npin</td>
<td>Number of pin rows and columns</td>
</tr>
<tr>
<td>ndet</td>
<td>Number of detectors</td>
</tr>
<tr>
<td>ndetax, nfdetax</td>
<td>Number of detector/fixed detector axial mesh points</td>
</tr>
</tbody>
</table>
VERAView: Dataset Types

- Dimensions determined
  - Explicitly from CORE datasets
    - CORE/npin, CORE/nass
  - Implicitly from CORE datasets
    - CORE/axial_mesh
    - CORE/core_map
    - CORE/detector_map
    - CORE/detector_mesh
    - CORE/pin_volumes
- Implicitly from STATE_0001/pin_powers