

 ARTENUM, PARIS Science & Groupware	CASSANDRA	
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Cassandra 2.5

USER GUIDE

	Name	Date
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Updated by	J.Forest	2013/11/10

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Overview

Abstract

Cassandra is a generic 3D scientific data viewer written in Java, based on VTK and providing a native multiplatform support. Including most of the current filters (clipping, cutting, colour mapping, elevation, etc...), Cassandra can be used for 3D visualisation and data analysis as well as in pre/post processing phases. Its modular design, based on plug-ins, allows numerous possibilities of extension and adaptation to specific purposes. Cassandra's User Interface (UI) offers several levels of interaction, including an advanced graphical pipeline manager to facilitate the compositions of processes and a Jython console for the fine control of low-level components, like VTK objects.

Cassandra is the result of the internal R&D effort of Artenum Company in scientific data visualization and analysis. Cassandra illustrates Artenum's know-how in VTK and high performance Java developments [1][2]. Cassandra is used for many applications in scientific computing, energy and space environment analysis. Cassandra is supported by the Artenum Company and an increasing scientific and industrial community.

The present document corresponds to the Cassandra's User Manual (Cassandra UM) and focuses on a quick-start in the use of the software. This UM is compliant with the version 2.4.03 of Cassandra and the default set of plug-ins. Please see the Cassandra Web page and the related documentation for additional plug-ins.

Products and services

Cassandra is a fully open-source project and is freely available free of charges under the terms of the GPL license. In complement and in order to provide a professional tool, Artenum proposes a structured set of related services, including:

- On-demand development and extension;
- Close-source development license;
- Additional close-source plug-ins for advanced processing;
- Expertise and study-case analysis for tailored data analysis and visualization processes;
- VTK and data analysis training

Please feel free to visit on our Web site (<http://www.artenum.com>) or contacts us (contact@artenum.com) for further information.

Cassandra's Web page: <http://www.artenum.com/cassandra>

Cassandra's development area: <http://dev.artenum.com/projects/cassandra>

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Changes

Version	Revision	Date	Auteur / Observation
2	0	2010/07/10	
2	5	2013/11/10	Update according version 2.5


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1. Introduction

Cassandra is a generic 3D scientific data viewer written in Java, based on VTK and providing a native multiplatform support. Including most of the current filters (clipping, cutting, color mapping, elevation, etc...), Cassandra can be used for 3D visualisation and data analysis as well as in pre/post processing phases.

In its default package Cassandra, provide a large set of filters and data processing tools, like cutting planes, colour mapping, iso-level extraction, threshold extraction, vector fields representation... But thanks to its modular design, based on plug-ins, allows numerous possibilities of extension and adaptation to specific purposes.

Cassandra's User Interface (UI) offers several levels of interaction, including an advanced graphical pipeline manager to facilitate the compositions of processes and a Jython console for the fine control of low-level components, like VTK objects.

Cassandra is also a simple and efficient tool to discover and learn powerful capabilities of VTK in the Java and Jython contexts. The Graphical Pipeline Editor and the scripting facilities simplify the access to VTK's key-concepts for beginners and provide useful tools to the expert to develop in a simple way business and advanced scientific data processing tools based on VTK and Java.

Cassandra is the result of the internal R&D effort of Artenum Company in scientific data visualization and analysis. Cassandra illustrates Artenum's know-how in VTK and high performance Java developments [1][2]. Cassandra is used for many applications in scientific computing, energy and space environment analysis. Cassandra is developed by the Artenum Company and used an large scientific and industrial community.

The present document corresponds to the Cassandra's User Manual (Cassandra UM) and focuses on a quick-start in the use of the software. This UM is compliant with the version 2.4.03 of Cassandra and the default set of plug-ins. Please see the Cassandra Web page and the related documentation for additional plug-ins.

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2. Key features

2.1. Pipeline viewer and editor

Cassandra is composed of a graphical pipeline editor that simplifies the understanding and the manipulation of the data processing and visualisation. This graphical representation of the VTK pipeline provides a rich interaction between the users and the data to process.

2.2. Dynamic plug-ins system

Cassandra works on top of a dynamic class loader, which allows dynamic class integration such as plug-ins with dedicated filter processing.

2.3. Dynamic object manipulation

Cassandra integrates an advanced Jython console for the hot manipulation of Java or Jython objects. This console can be used to load Jython script in order to extend the plug-in approach with the script approach. It has become possible to write a script in order to generate animations and export them as a set of images or movies.

2.4. Cassandra architecture

Cassandra provides a powerful framework for manipulating VTK data. It is based on a dynamic class loader for loading external plug-ins at runtime and a powerful VTK pipeline manager that allows a graphical representation and manipulation of the VTK pipeline.

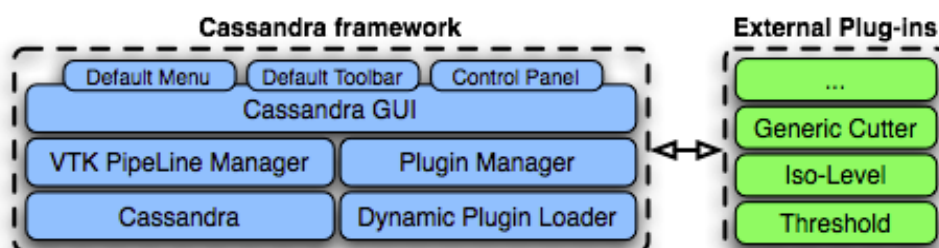


Figure 1: Schematic architecture of Cassandra.

2.5. Cassandra GUI overview

The Cassandra graphical interface is divided in three main areas that have different usage. The first one is used to manipulate and change the input data. The second one is the 3D view that is used to manipulate the 3D object by rotating and scaling it. The last one is the console that allows hot manipulation of Java and Python objects. Each graphical section can be hidden or reduced in order to enlarge or view another component.

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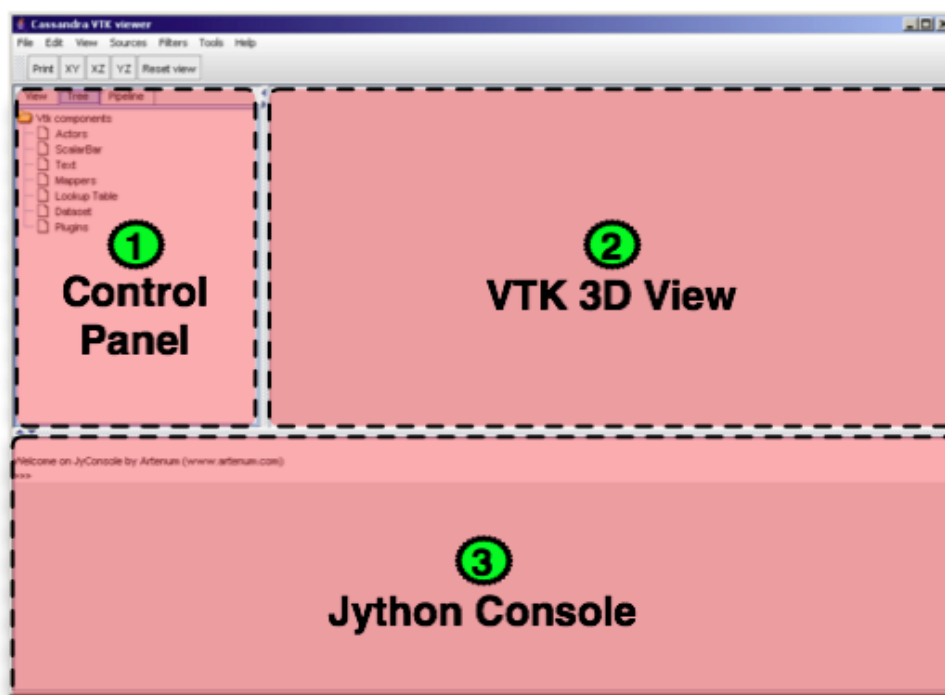


Figure 2: General review of the Graphical User Interface (GUI) of Cassandra

2.6. A context driven GUI for a simpler life

Efforts has been done to simplify as much as possible the user interface to simplify the use of the application, especially for non-experts in 3D data analysis and visualisation. In this logic, buttons and control components are displayed only when this is necessary only through contextual menus and control panels, and in function of the handled element.

The global approach is:

- 1) Select in the pipeline editor the element to be edited/controlled/modified;
- 2) Perform on this element a right mouse click, a contextual control menu should appear;
- 3) In the contextual menu, select the targeted action, a control panel should appear with all needed widgets, controls and buttons.
- 4) Perform your settings and validate by clicking on the update button. The process should be done or updated.
- 5) The control panel can be close by clicking on the escape button.

NB: When a new process (i.e. plug-in) is called the control panel is automatically opened.

Figure 3 shows an example of control panel of a cutting plane filter.

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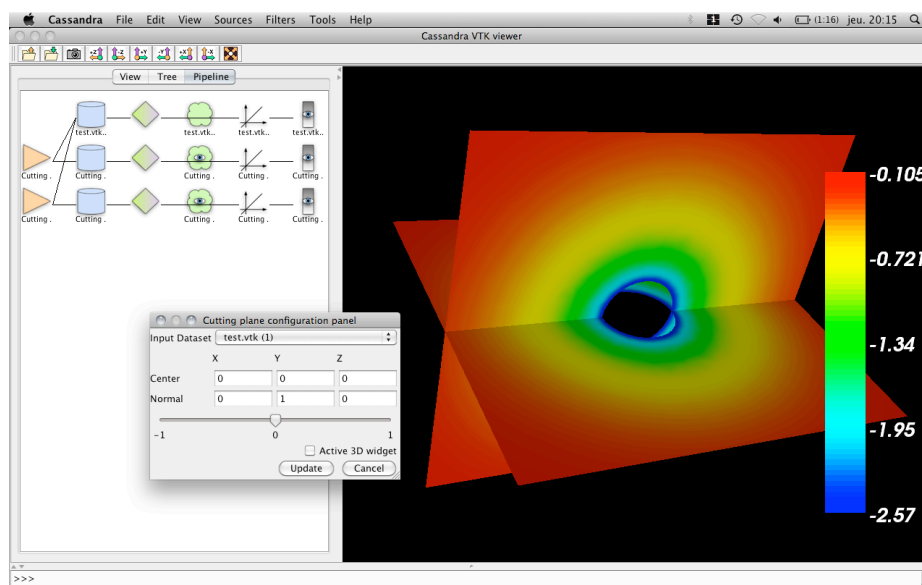


Figure 3 Example of control panel for the cutting plane filter.

3. Cassandra usage

3.1. How to run Cassandra?

Cassandra can be launched in two different ways on each system. Each system has its own launching script which will automatically set the global variable for the local VTK binaries. If you already own a VTK installation, Cassandra can be launched by executing the following commands:

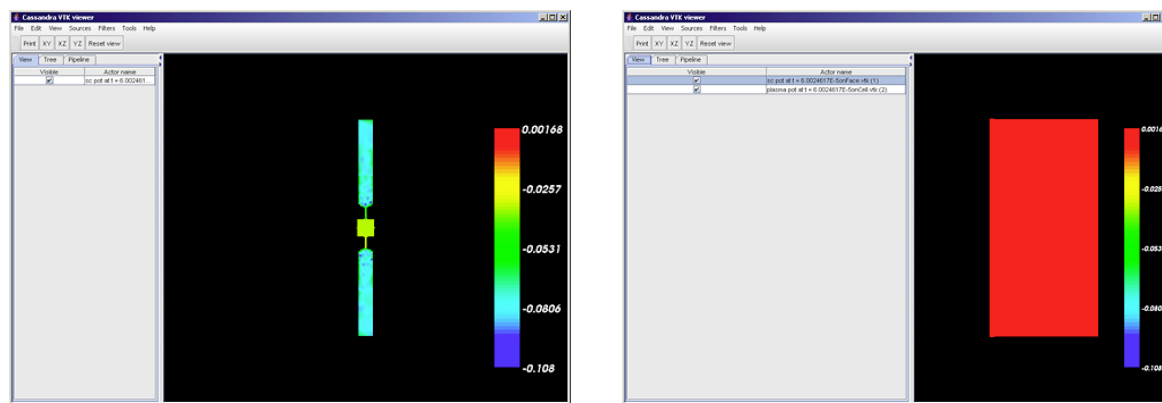
- Under Linux/Unix/Apple MacOSX command: **Cassandra.sh**
- Under Microsoft Windows based system: **Cassandra.bat**

Trouble shootings: On some Windows systems, if the starting script does start properly, you may have to correct manually the VTK system variable (LD_LIBRARY_PATH, PATH).

3.2. Load a data set file

Go to the “File” menu then “Open”, and select your input VTK file. By default, you will only see the file that ends with the VTK extension. You can repeat this operation in order to load several data in the same view.

In our example, we will load two files, the first one will be a satellite and the second one its surrounded plasma environment with the electrical potential as the data visualisation.

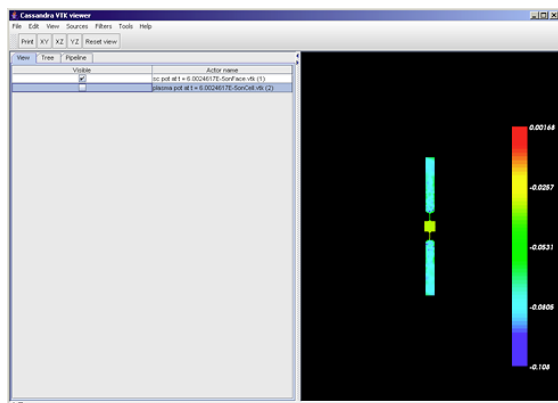


Once the files are loaded, you should be able to see your data inside the 3D VTK panel on the right side of the Cassandra GUI. You can rotate, scale and move it with the different mouse movements and buttons.

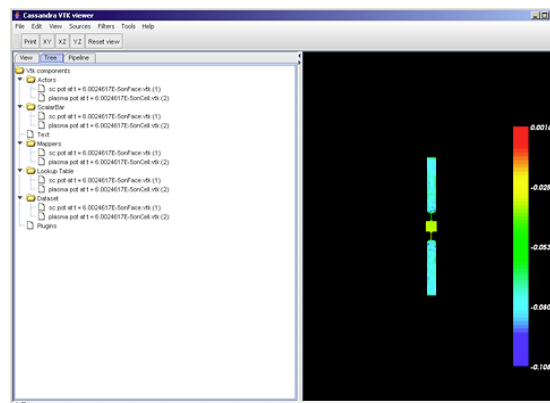
On the left side, several tools for manipulating your data are available.

- In the View tab you are allowed to show or hide quickly 3D objects.
- In the Tree tab you can reach the structured tree of objects where you can access their dedicated contextual menu.

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View tab

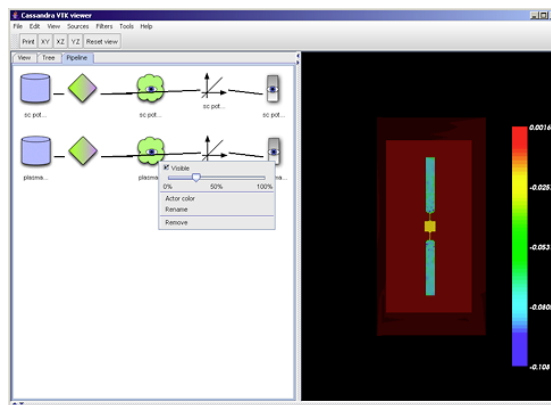
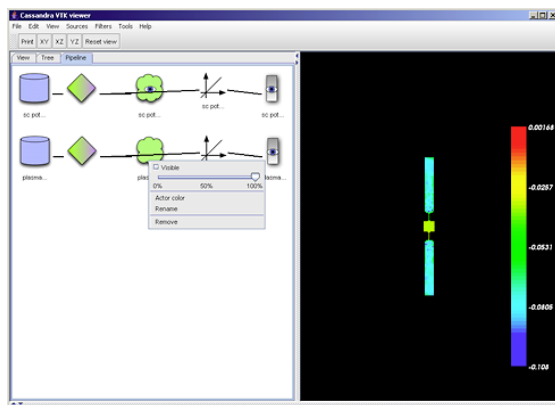


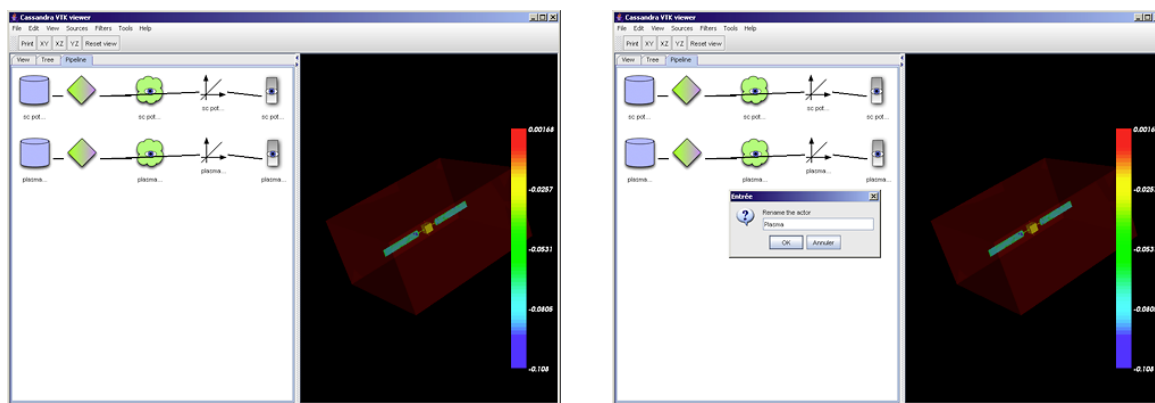
Tree tab

- In the Pipeline tab you can see the data processing with the links between filters, data and objects with direct access to their contextual menu for their specific properties in order to manipulate them...

Actor manipulation:

- Making it visible or not.
- Changing opacity.
- Assigning a colour when you unselect the view of scalar data on the mapper.
- Rename the object.
- Remove the object.





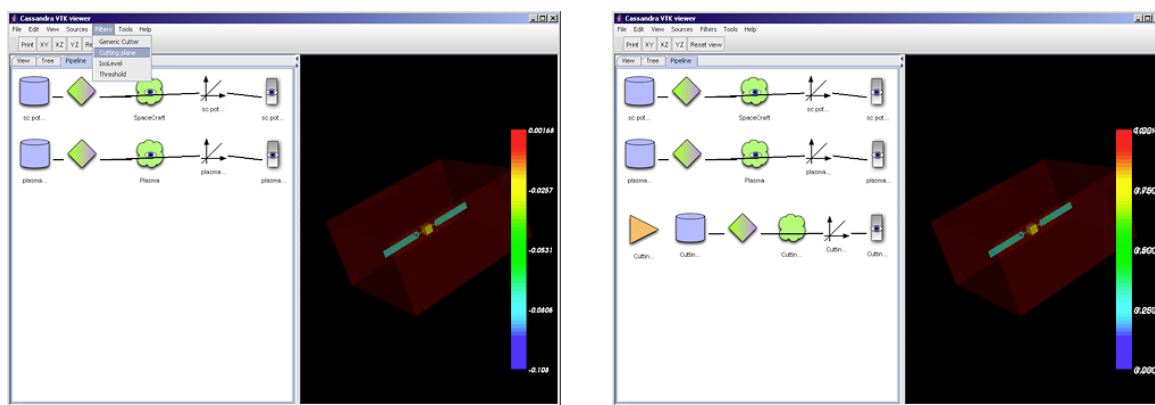
Examples of actor control.

3.3. Apply a simple filter

Go to the “Filters” menu and select the one you want to add to your VTK pipeline. In our example, we will start with a cutting plane, in order to look at the plasma potential around the satellite along a plane.

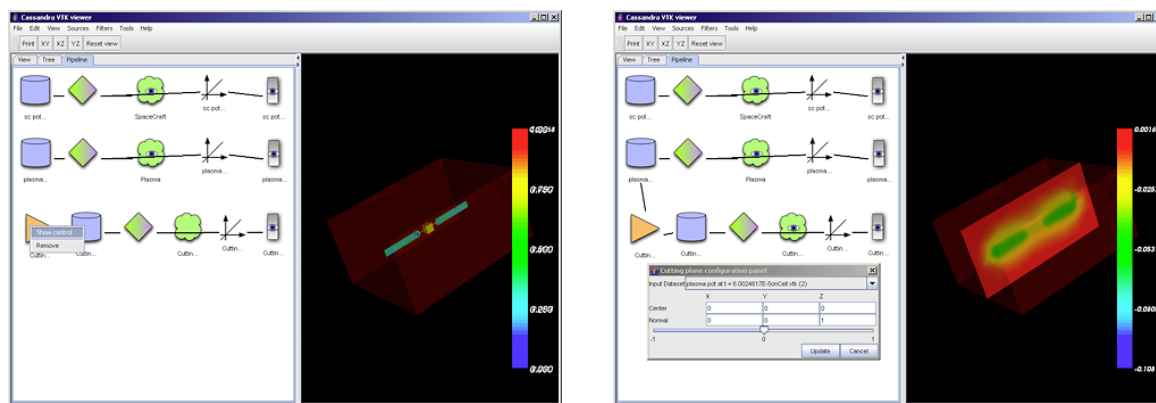
Steps to follow:

a) Add the filter to the pipeline by selecting it in the Filters menu.



b) Go to the control panel of the filter in order to set the data to process and specify the property of our filter. Since you update your control input, the pipeline will be updated automatically and you will be able to see the flow of the data processing.

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Example of settings of a simple filter, here cutting plane. Left image shows how to access to the filter contextual menu. Right image show how to select the input data set.

c) In the cutting plane filter, you set a point inside the plane and the normal of that plane. The slide bar is used to move slightly around the specified point easily. It enables you to move the plane back and forward around the normal vector as a unit.

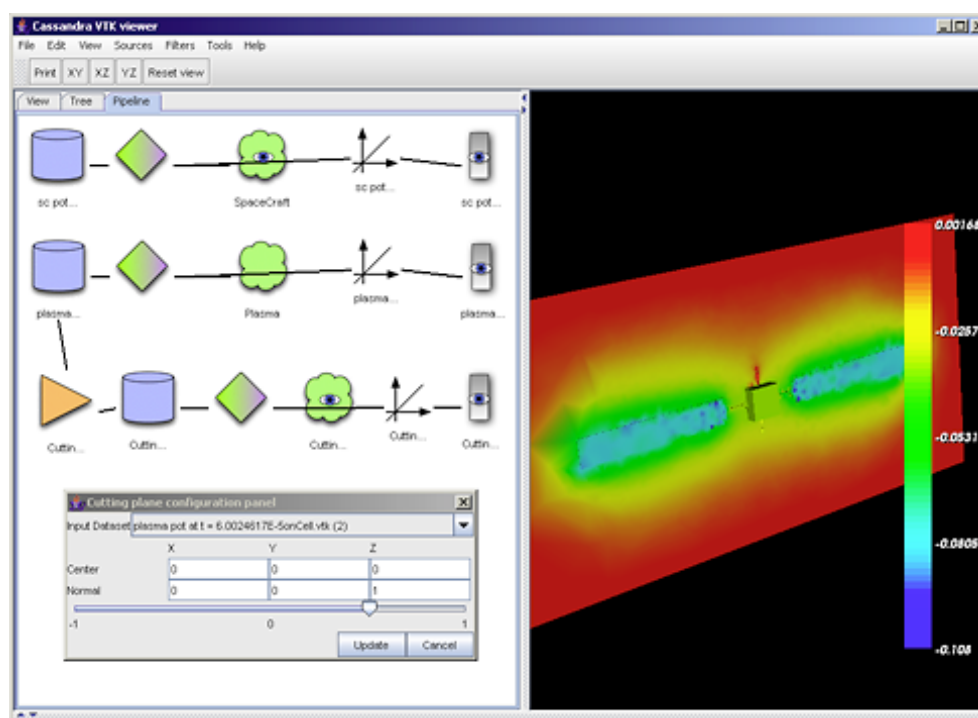


Figure 4: Contextual control menu of the cutting plane filter.

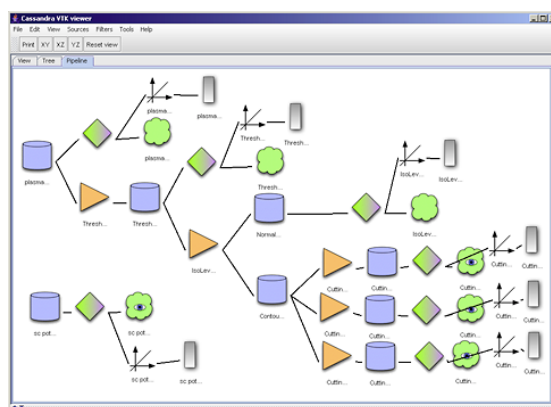
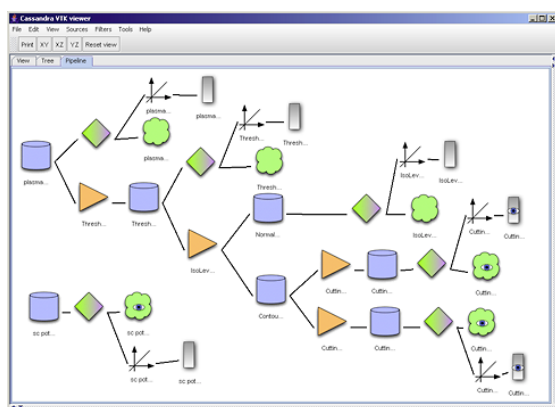
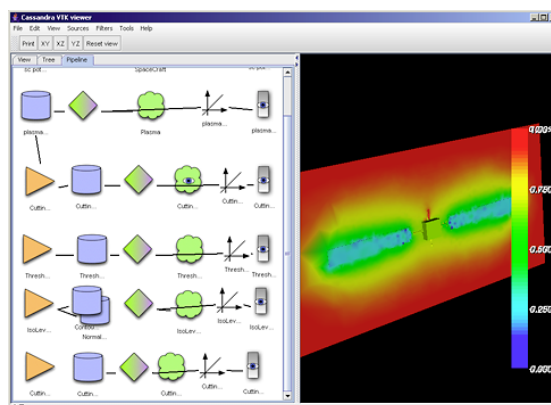
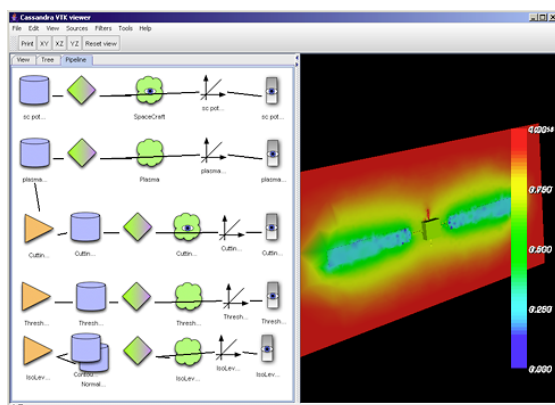
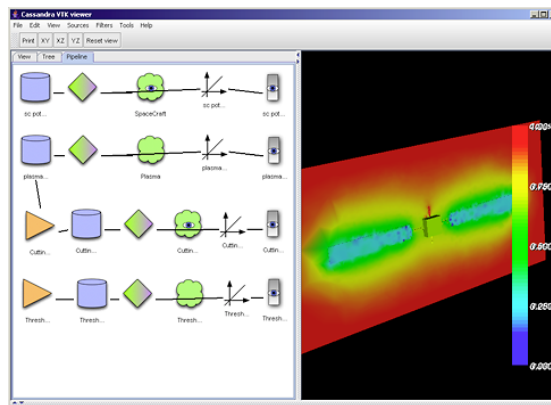
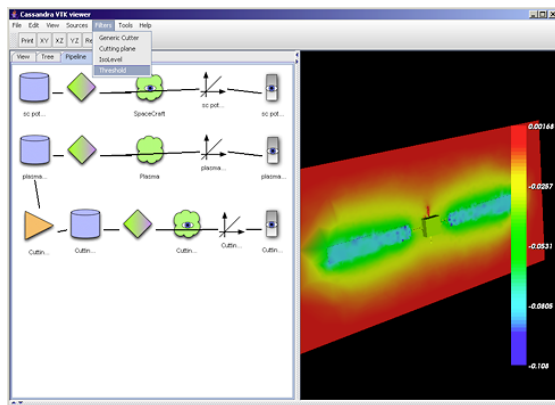
3.4. Composition of filters

Go to the “Filters” menu and select the one(s) you want to add to your VTK pipeline. In our example, we will add an iso-level on which we will apply several cutting planes in order to see the field lines. On top of that, we will cut the range of the data with a threshold filter.

Steps to follow

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a) Add the filter to the pipeline by selecting it in the Filters menu. (1x Threshold – 1x Iso-Level – 2x Cutter)



b) Go to the control panel of the filter in order to set the data to process and specify the property of our filter. Since you update your control input, the pipeline will be automatically updated and you will be able to see the flow of the data processing.

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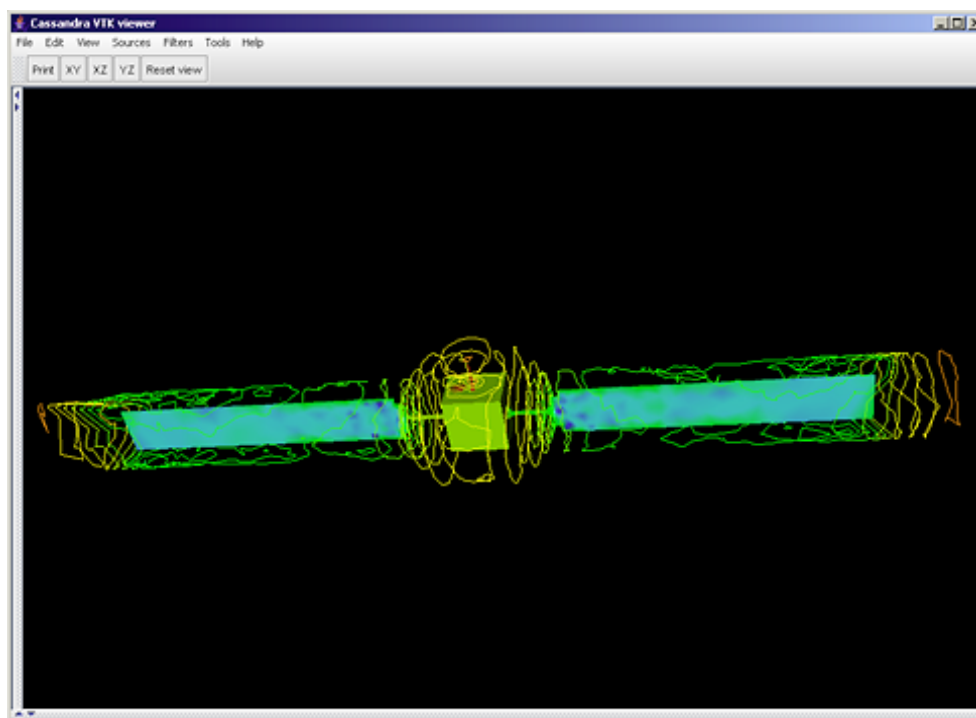
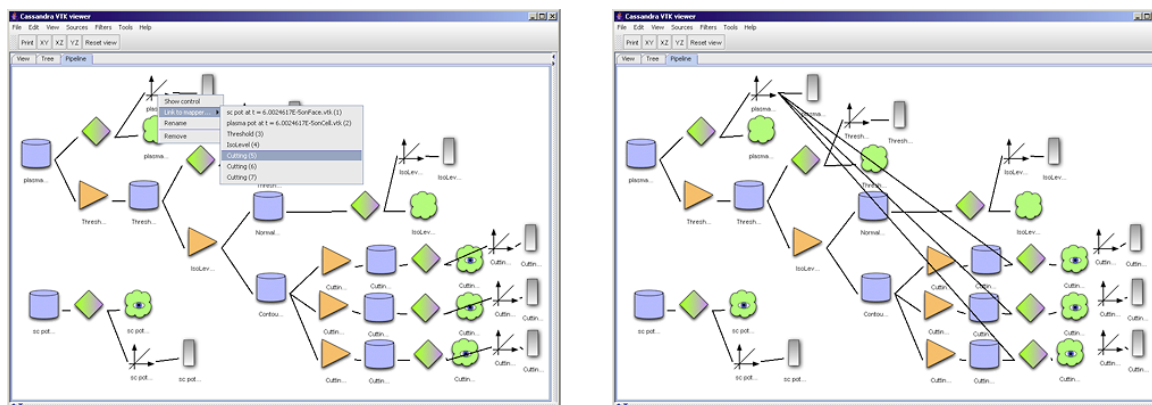


Figure 5: Example of complex processing by composition of basic filters.

3.5. Managing several scales and lookup tables

Every time a new date is loaded or a filter added, a dedicated lookup table and a *scalar bar* appear with its own reference (i.e. min-max).

If a common values to colours range conversion is needed, to compare data with a unique lookup table and scalar bar for instance, lookup tables should be linked to one dedicated mapper. This is done through the *lookup table* contextual menu as follow.



The position of the colour bar can be changed in its control panel, accessible from its contextual menu.

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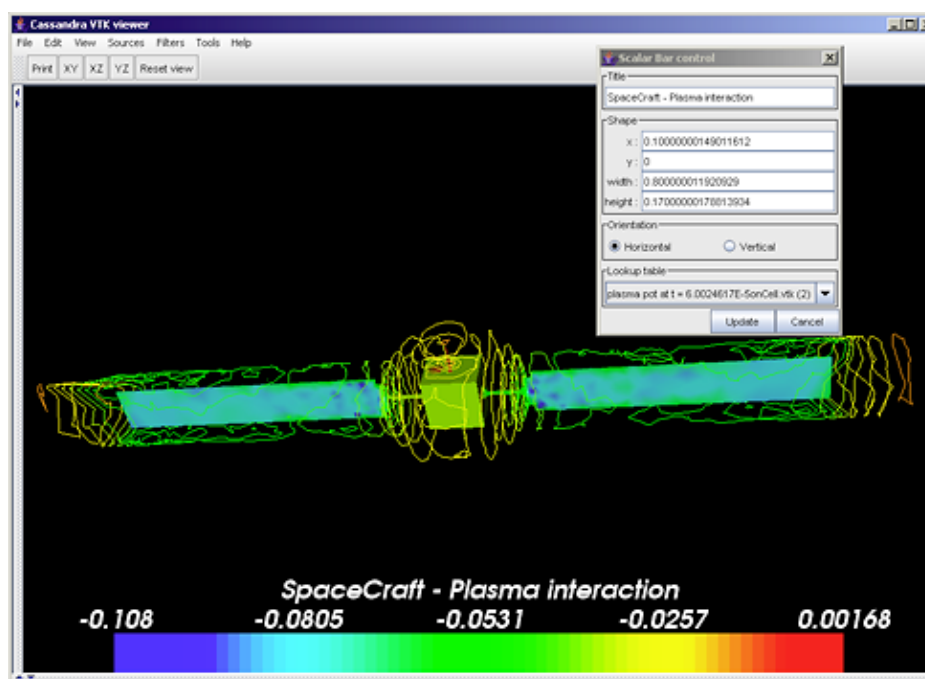


Figure 6: Setting of the position and visible information of the colour bar.

3.6. Removing components

It is possible to remove unnecessary items from the contextual menu.

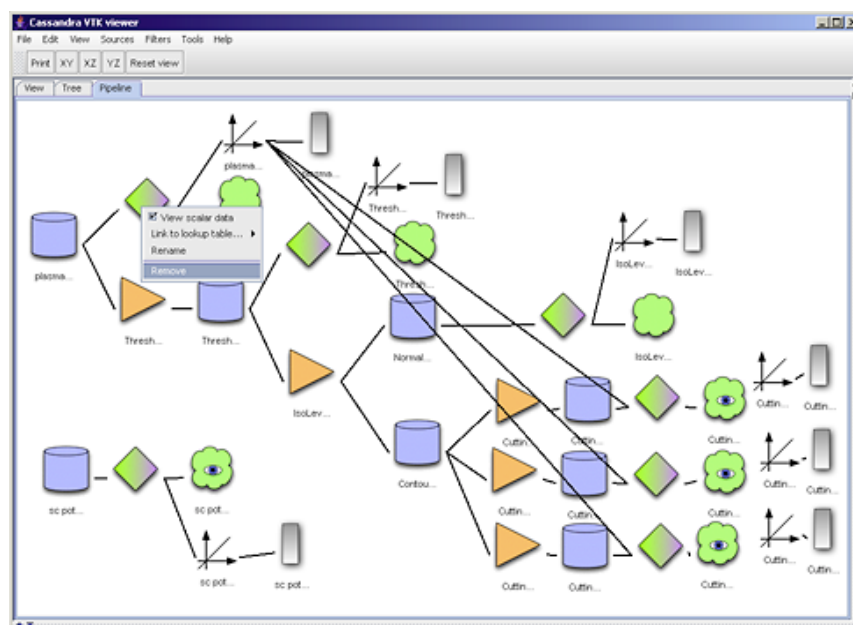


Figure 7: Simplification of the pipeline by suppression of unused items.

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3.7. Saving generated view

The 3D view can be saved by the “Save as image” button on the toolbar or directly in the file menu by the “Save image” item. This will use the TIFF image format.

3.8. Using the Python console

The Jython console integrated into the Cassandra application allows the user to call directly the method on the Java object. Moreover, the completion helps the user to see which operation can be done on that object. To access the completion just press CTRL + SPACE keys. All low level VTK functions are available.

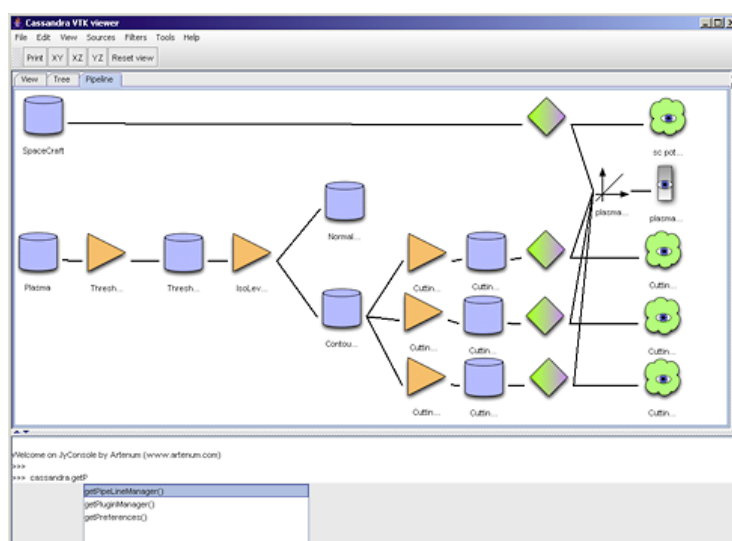


Figure 8: Object completion in the Jython console (JyConsole). To access to objects and methods, just type on CTRL + space touches.

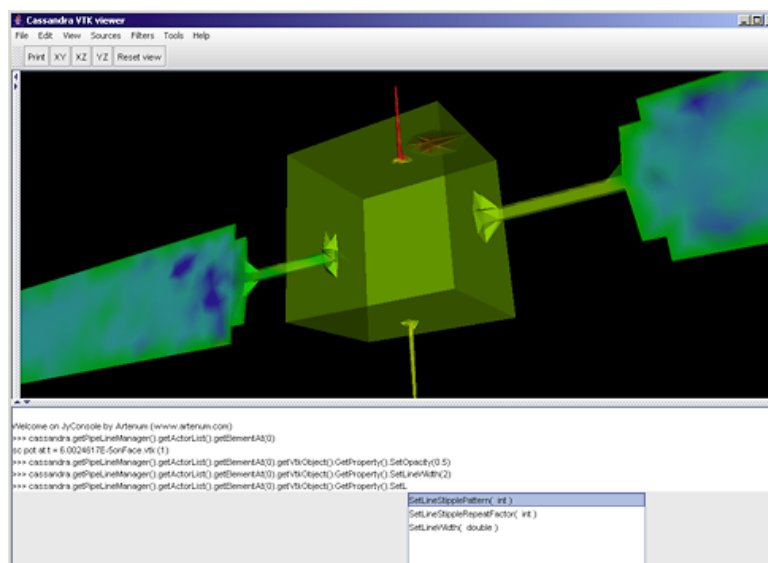


Figure 9: Example of direct access to loaded data (i.e. data set and filters) through the JyConsole.

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3.9. Loading an external Jython script

Cassandra processing can be fully scripted through Python/Jython scripts. To load a Python script, the user has to go to the contextual menu of the console by right clicking the console window and select the script to be loaded. All low level VTK functions are available.

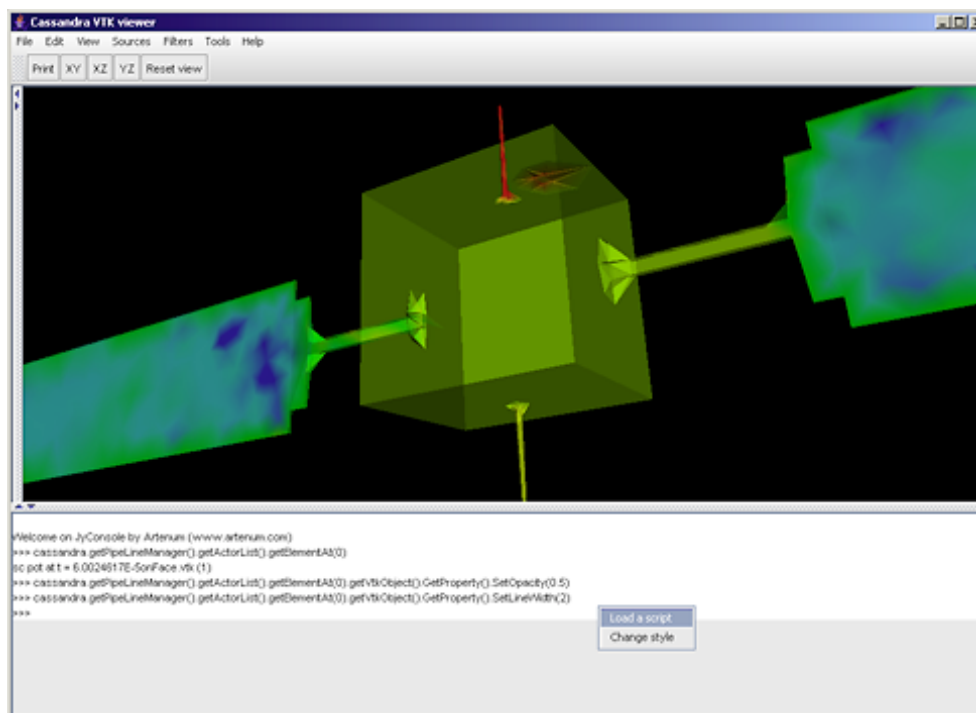


Figure 10: Example of scripting capabilities of Cassandra, with and external Jython script loaded.

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4. Core plugins

In Cassandra data processes are done in dynamically loadable plugins and, by the way, the number of processes being performed by Cassandra is extensible and variable from one package to another one. However, Artenum's team and the Cassandra's community regularly develop new open-source plugins that are directly provided with the standard package of Cassandra. The present section describes these core plugins, their functionalities and use.

4.1. Cutting plane

The Cutting Plane filter performs the cut of a data set along a given plan. Position and orientation of the plan can be defined dynamically through the control menu or using 3D control widget.

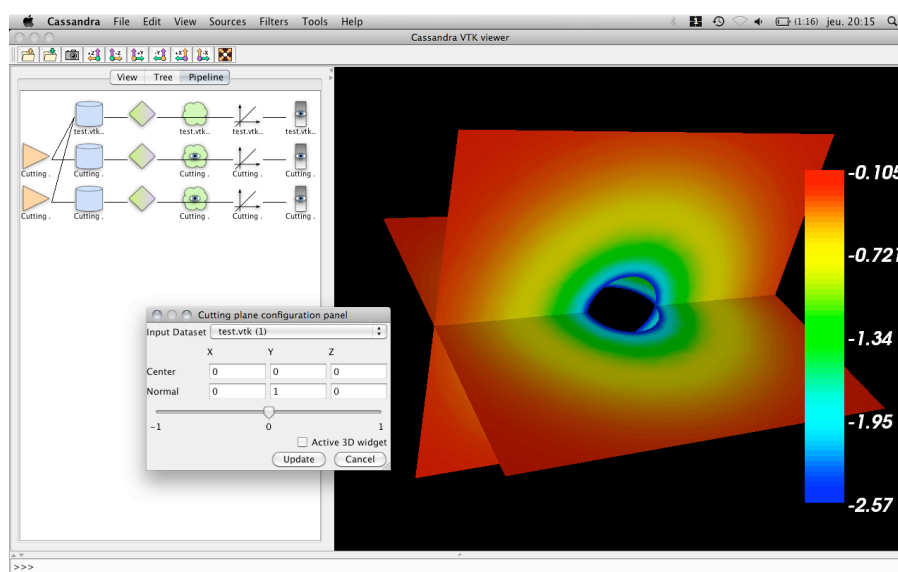


Figure 11: Example of application of the Cutting Plane filter. Two cutting planes are showed here.

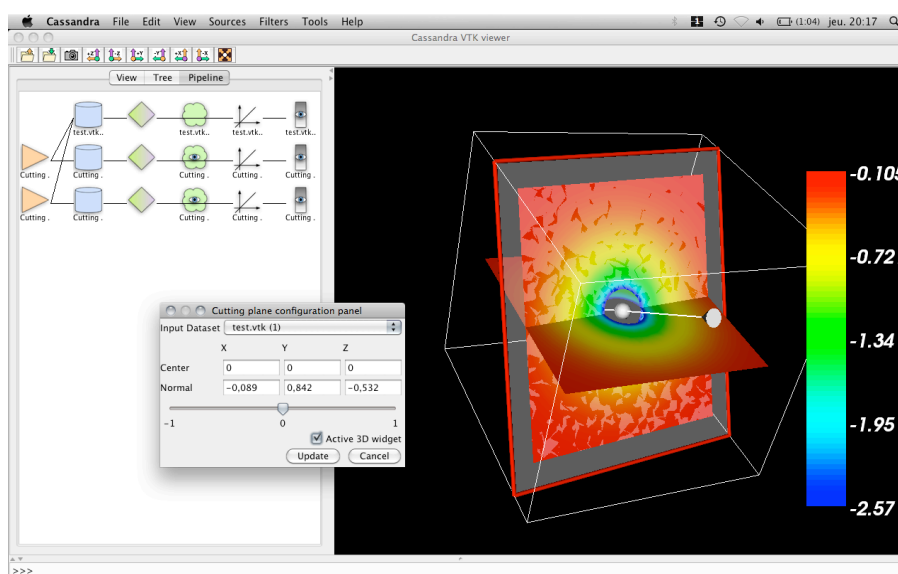


Figure 12: Example of the 3D widget to set the cutting plane.

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4.2. Clipping filter

The Clipping Filter performs the same cutting than the Cutting plane but keep one of the half space.

4.3. Generic Cutter

The Generic Cutter performs similar operations than the Cutting Plane but on various types of geometrical support (e.g. Sphere, cylinder...).

4.4. Outline box and actor axis

The Outline box and axis filter draw the outline and/or the axis surrounding the input data set.

4.5. Iso-levels filter

The Iso-level filter computes the iso-levels of the input data set.

4.6. Probing line filter

The Probing Line Plugin allows probing, by local interpolation, an input data set along a given line. Figure 13 shows an example of usage of the probing line.

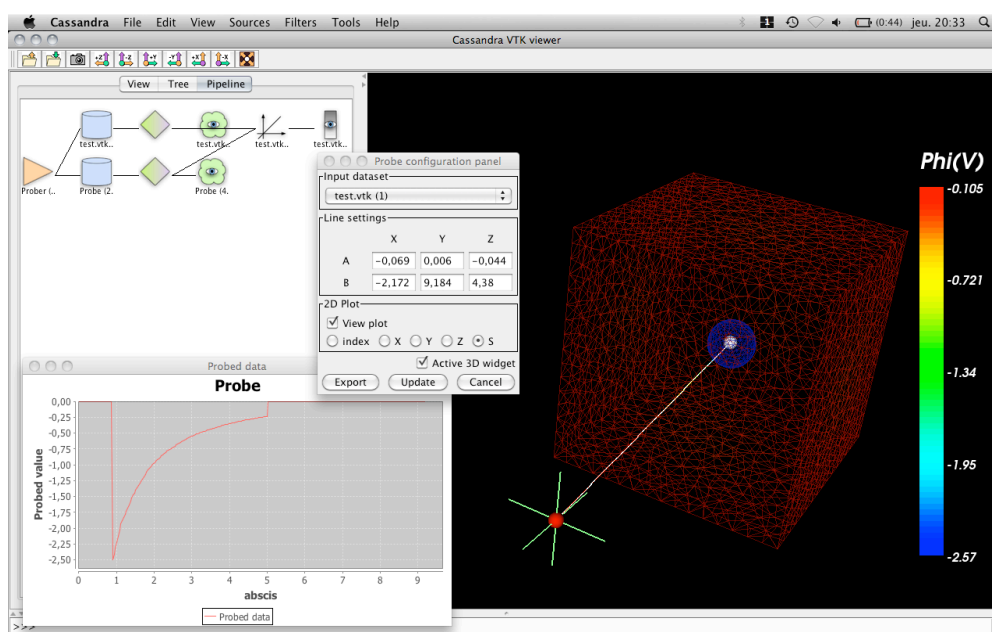


Figure 13: Example of the use of the Probing Line plugin. The line position and orientation can be set using the 3D widget.

Probed data can be exported into ASCII raw based files as illustrated here below.

Example of ASCII output of the probing line.

```
# index x y z s value
0.0 -0.069073244929 0.006387104745 -0.04443041926 0.0056911727 0.0
1.0 -0.077286377549 0.042237780988 -0.02714911662 0.0415418491 0.0
2.0 -0.085499517619 0.078088490214 -0.00986781062 0.0773925302 0.0
3.0 -0.093712657690 0.113939128877 0.007413406800 0.1132431962 0.0
(...)
```

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4.7. Threshold filter

The Threshold Filter will extract data with a value between or upper or below given values.

4.8. Cell centring filter

Cassandra can be launched in two different ways on each system. Each system has its own launching script which will automatically

4.9. Glyph representation

The Glyph Filter provides glyphs (e.g. arrows, lines, spheres...) to represent vectors based data. Figure 14 shows an example of glyphs based representation.

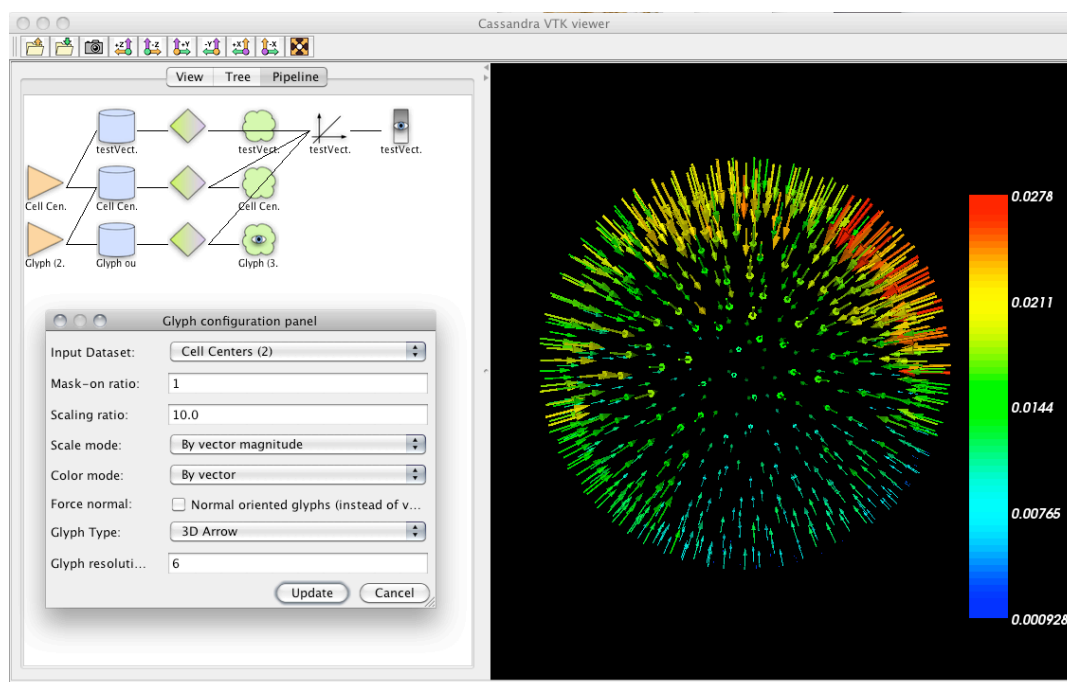


Figure 14: Glyph representation with Cassandra.

4.10. 3D Picking Information filter

Local information can be extracted with the Picking Information filter. After activation of the filter, select the data to probe in the 3D view with the mouse and type the p-key to pick the corresponding information (values, element id, etc...). Data can be localised on both nodes and cells. A detection radius or tolerance can be set. Figure 15 shows an example of picked data on the surface of an object.

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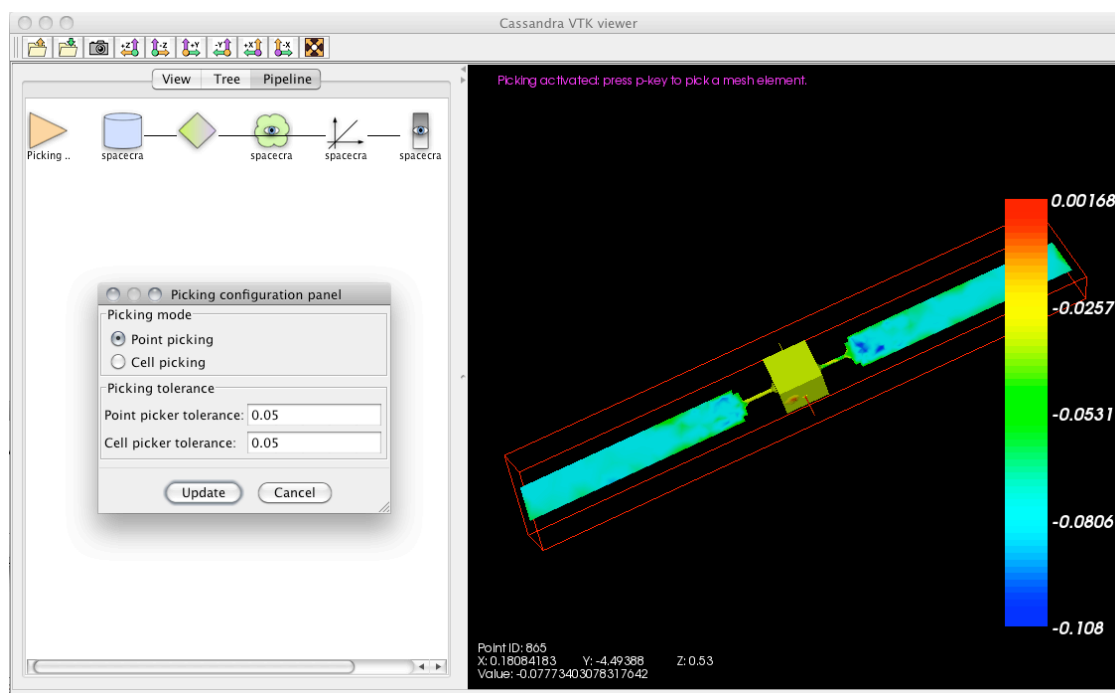


Figure 15: Example of picking of local information (e.g. local value) on a given data set.

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5. Cassandra in other contexts

Cassandra is especially design to be easily integrated into other Java based applications for both generic and tailored purposes. This may include as well the adaptation of the GUI, the development of specific plug-ins or pre-define processing pipelines, in order to simplify complex data processing. A set of integrated data converter tools helps the loading and the import of business of specific formats.

In this section, some examples of integration of Cassandra into Artenum's products and client development are presented.

All information needed to integrate Cassandra in your application is available on the Cassandra's Developers Web Site.

On demand, in the frame of the Cassandra's Service offer, Artenum's team can also fully perform this integration for you. Please feel free to contact our commercial services.

5.1. Cassandra in the Keridwen IME: Application case to the ESA/SPIS system for the Spacecraft Plasma Interaction Simulation software

Cassandra is integrated into Keridwen, the Artenum Integrated Modelling Environment (IME). Keridwen is an open-source softare (see www.keridwen.org) [4]. The Keridwen/Cassandra couple constitute the dedicated IME of the SPIS project (www.spis.org), initiated by the European Space Agency (ESA). SPIS is an open-source software dedicated to the detailed modelling of the spacecraft-plasma interactions. It is used now by a large by a large international communitiy of users. SPIS in supported in the frame of the SPINE community (www.spis.org) [1] [2].

Cassandra is here used in both pre and post-processing, from the visualisation of CAD models to the tailored analysis of results of simulations.

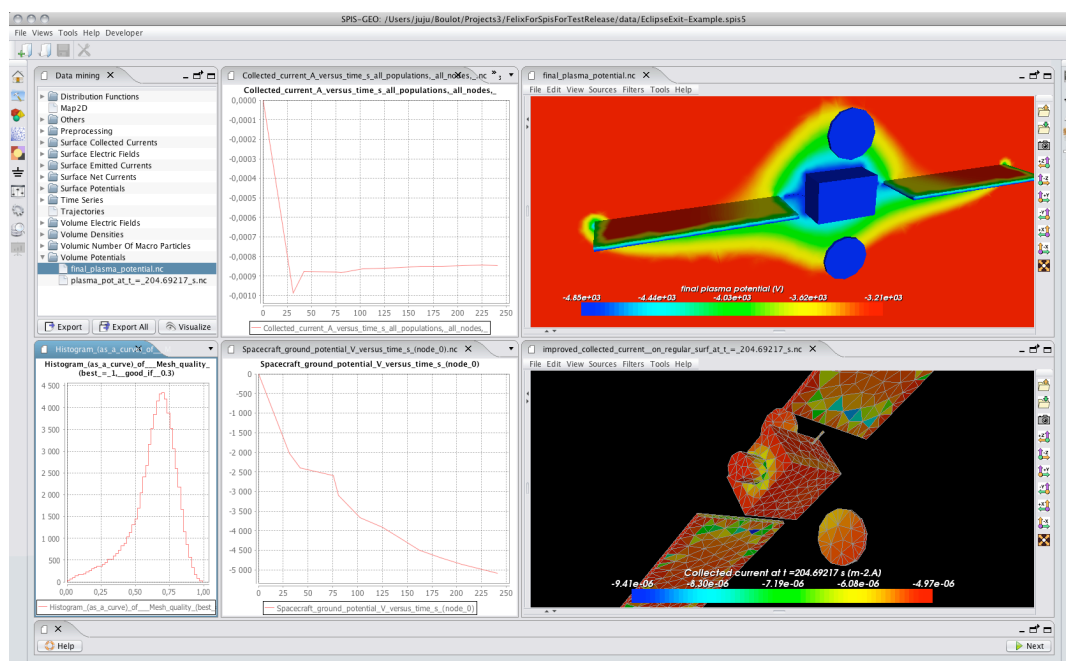


Figure 16- Example of integration of Cassandra into a tailored application. Here the SPIS project of ESA.

Reference: Cassandra-UG-2010-12-001	Version: 2	Revision: 5
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5.2. Cassandra in Penelope's Mesh Inspector

Penelope is used in the Mesh Inspector of the Artenum Penelope Mesh library. This tool allows evaluating the quality of a tetrahedral mesh and performs corrections and edition. Penelope is an Artenum open-source project available online (<http://dev.artenum.com/projects/Penelope>) [4].

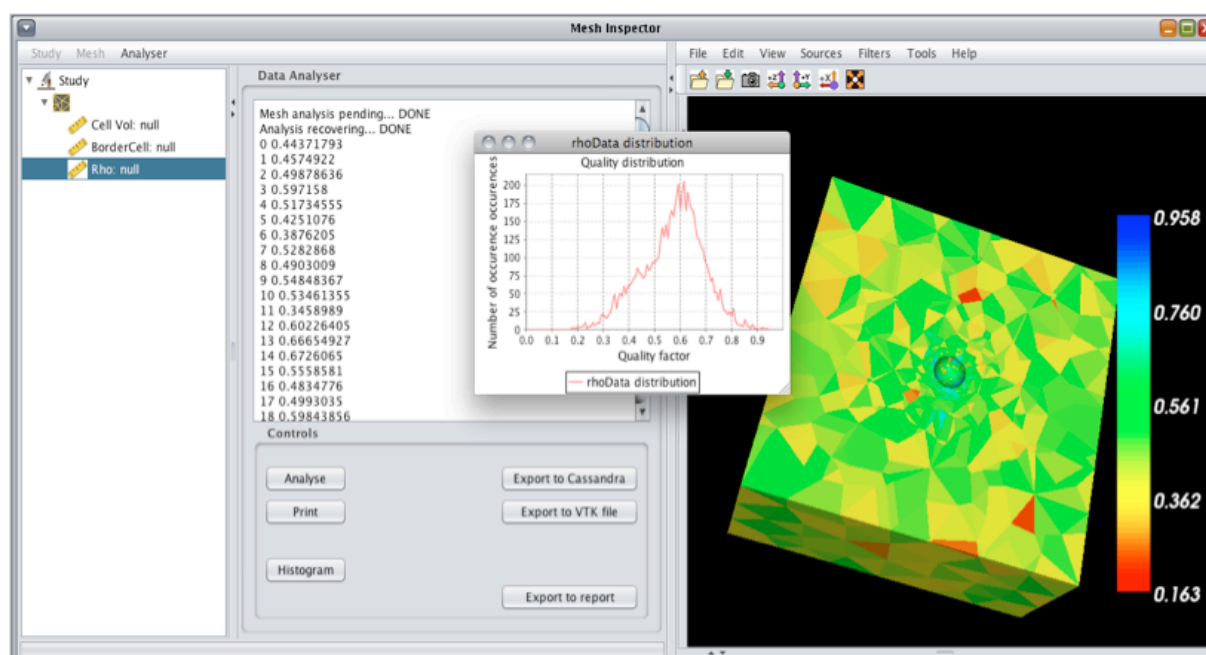


Figure 17- Use of Cassandra in the Penelope Mesh Inspector.

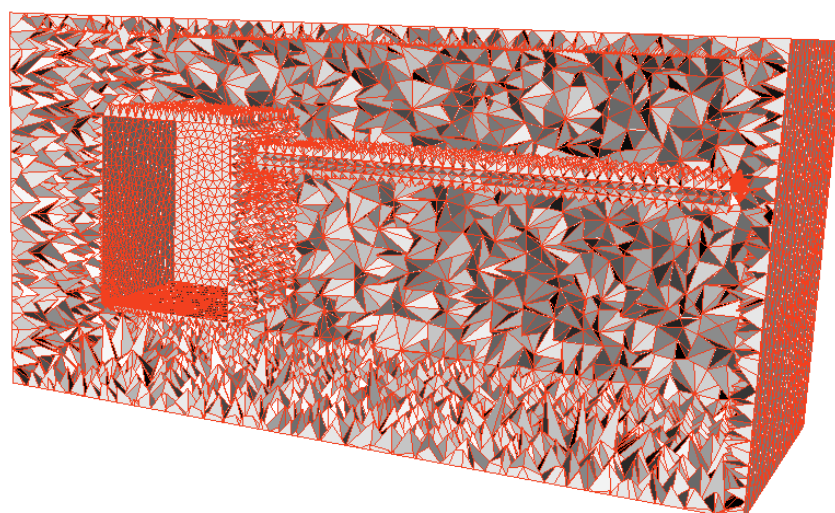



Figure 18: Extraction and visualisation of boundary elements with the Penelope Mesh inspector and Cassandra.

Reference: Cassandra-UG-2010-12-001	Version: 2	Revision: 5
Status: DRAFT	Date: 2013/11/10	

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- [3] SPINE community Web site, www.spis.org
- [4] Keridwen Web site, www.kerdiwen.org
- [4] Penelope Web site, <http://dev.artenum.com/projects/Penelope>

Reference: Cassandra-UG-2010-12-001	Version: 2	Revision: 5
Status: DRAFT	Date: 2013/11/10	

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