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Hands-on

# Analysator



Ten letters you can count on.

# What is Analysator

1. An analysis tool developed for vlasiator
2. Originally developed as an array reader for vlsv files
3. Another aim: *pointn'click tool* to get a velocity distributions
4. Functions optimized with Scipy and Numpy libraries (close to C performance)

# Functions

1. Reading and writing *numpy* arrays with *VLSV* files
2. Various *analysis* tools
  - 2.1 time-evolution of cells
  - 2.2 cut-throughs
  - 2.3 pitch angle distributions
  - 2.4 Accessing velocity distributions
  - 2.5 ..
3. Plotting Vlasiator *grids* using MayaVi library
4. An interface to Urs' superb *particle pusher*
5. Full easy-to-use *documentation* for every function
6. Can be combined with *every* python module and function

# Example

---

*# We are interested in reading data from the cell whose ID is 75*

**import** pytools as pt *# Import Analysator*

*# Open a vlsv file for reading*

vlsvReader = pt.vlsvfile.VlsvReader('bulk.0003710.vlsv')

*# Read a variable at cell id 75*

rho = vlsvReader.read\_variable( name='rho', cellids=75 )

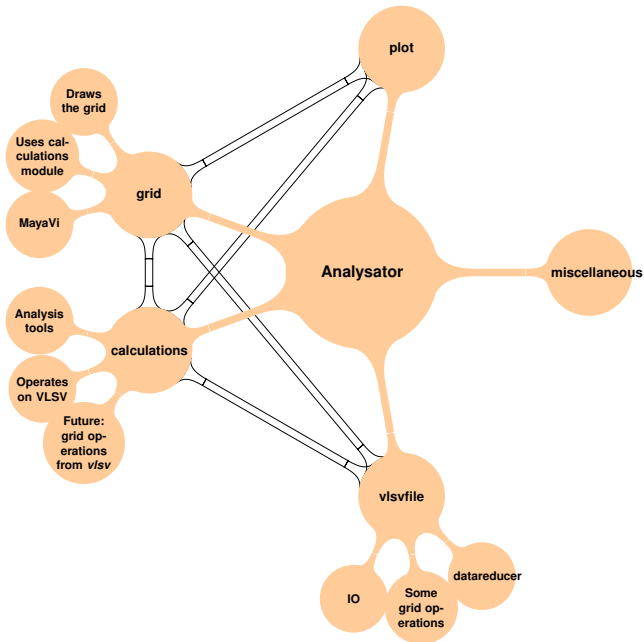
---

# Important notes

Documentation can be found at

<https://github.com/fmihpc/analysator/wiki>

# Modules in Analysator



# Navigation

## *Navigating* through the code important

---

```
# Import analysator
import pytools as pt

vlsvReader = pt.vlsvfile.VlsvReader('test.vlsv') #What?

cut_through = pt.calculations.cut_through(vlsvReader, point1=[0,0,0], point2=[2,5e6,0])
```

---

### 1. Otherwise you need to remember

- 1.1 The name of the cut\_through function
- 1.2 The first function argument: *vlsvReader*
- 1.3 The second argument: *point1*
- 1.4 The third argument: *point2*
- 1.5 The second and third argument's format and dimensions  
(3d list)



# Navigation (the *most* important part)

---

```
# Import analysator
import pytools as pt

pt.
```

---

tab

---

```
In [2]: pt.
pt. calculations    pt. grid        pt. plot
pt. filemanagement  pt. miscellaneous pt. vlsvfile
```

---

# Navigation (the *most* important part)

---

```
# Import analysator
import pytools as pt

pt.calculations.
```

---

tab

---

```
pt.calculations.cell_time_evolution
pt.calculations.cut3d
pt.calculations.cut_through
pt.calculations.fit
pt.calculations.fourier
pt.calculations.gyrophase_angles_from_file
pt.calculations.lineout
pt.calculations.pitch_angles
pt.calculations.VariableInfo
```

---

# Navigation (the *most* important part)

---

```
# Import analysator
import pytools as pt

pt.calculations.cut_through?
```

---

Enter

---

```
In [2]: pt.calculations.cut_through?
Definition: pt.calculations.cut_through(vlsvReader, point1, point2)
Docstring:
Returns cell ids and distances from point 1 for every cell in a line between
given point1 and point2

:param vlsvReader:      Some open VlsvReader
:type vlsvReader:       :class:'vlsvfile.VlsvReader'
:param point1:          The starting point of a cut-through line
:param point2:          The ending point of a cut-through line
:returns: an array containing cell ids, coordinates and distances in the following
format: [cell ids, distances, coordinates]
```

.. code-block:: python

Example:

```
vlsvReader = VlsvReader("testfile.vlsv")
cut_through = cut_through(vlsvReader, [0,0,0], [2,5e6,0])
cellids = cut_through[0]
distances = cut_through[1]
print "Cell ids: " + str(cellids)
print "Distance from point 1 for every cell: " + str(distances)
```

---

# Navigation summary

---

```
pt . calculations .
```

---

**tab** Autocompletion

---

```
pt . calculations ?
```

---

**Enter** Getting documentation

# Basic usage

1. Open a *v/sv* file
2. Read from the *v/sv* file
3. Operate on the data

# Basic usage

---

```
# Import analysator
import pytools as pt

# Open a vlsv file
vlsvReader = pt.vlsvfile.VlsvReader('test.vlsv')

# Read vlsv data
rho = vlsvReader.read_variable('rho')
```

---

## Hands-on

## Hands-on

## Summary of the basics:

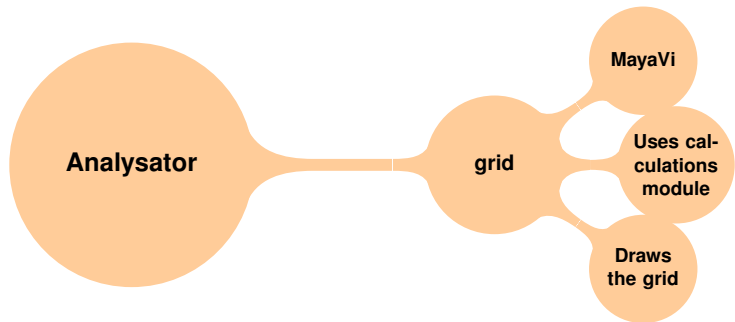
1. Remember to *import analysator*
2. Nearly every script starts by opening a `v/sv` file
3. `tab` to navigate
4. `? + Enter` to get documentation

Note: if you have virtualbox you have to set up a shared folder:

```
sudo mount -t vboxsf -o rw,uid=1000,gid=1000 \
vlsv data $HOME/share
```



# Plotting





# Plotting

The most important concepts

1. How to plot
2. How to use MayaVi
3. How to use the *Analysator's pointnclick* interface

# Plotting

## 1. How to plot

Plotting can be done simply by feeding a vlsv file to the grid class as follows:

---

```
# Import Analysator
import pytools as pt

# Open a vlsv file
vlsvReader = pt.vlsvfile.VlsvReader('test.vlsv')

# Plot rho
grid = pt.grid.MayaviGrid(vlsvReader, variable='rho')
```

---

# Plotting

1. How to plot
2. How to use MayaVi

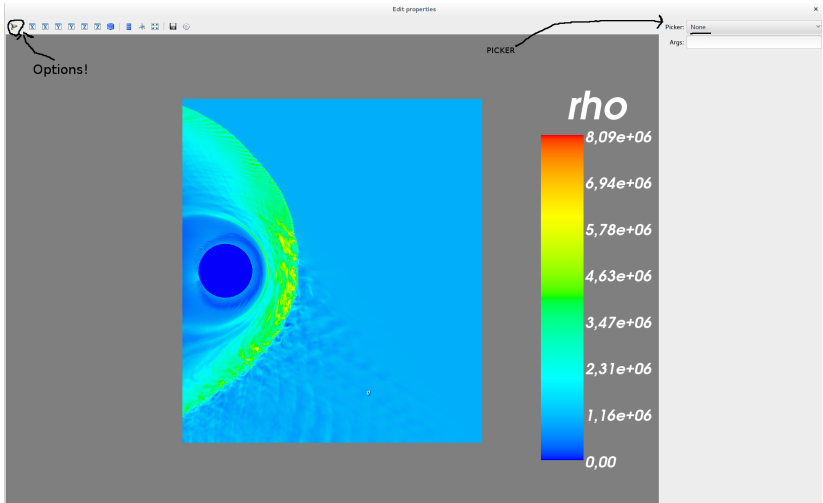
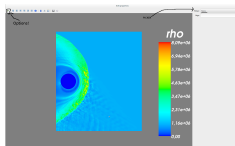


Figure : Example plot with MayaVi, highlighting options and pointclick tool.

# Plotting

1. How to plot
2. How to use MayaVi



**Figure :** Example plot with MayaVi, highlighting options and pointnclick tool.

1. Scroll to zoom
2. Mouse 3 to move the image
3. Mouse 1 + Hold to pan the image
4. Mouse 1 to click

# Plotting

1. How to plot
2. How to use MayaVi
3. How to use the Analysator's *pointnclick* interface

*Pointnclick* options:

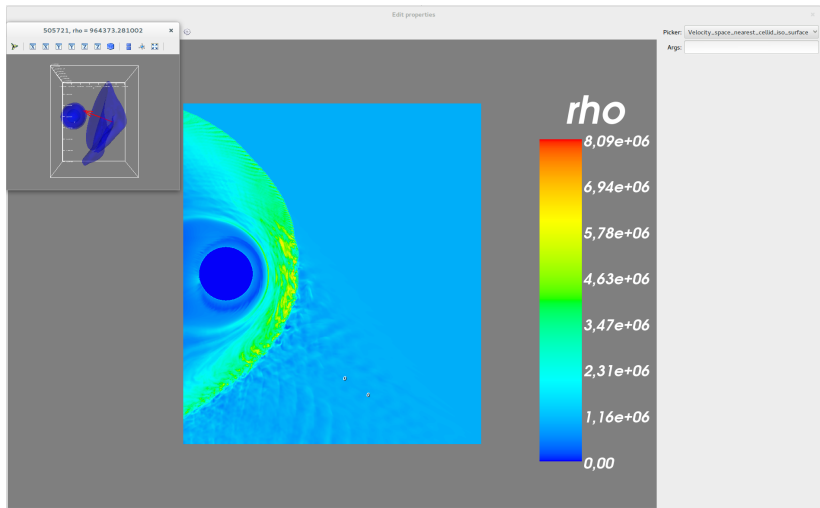
1. None
2. Velocity\_space\_nearest\_cellid
3. Velocity\_space\_nearest\_cellid\_iso\_surface
4. Pitch\_angle
5. Gyrophase\_angle (Made by Yann, yay)
6. Cut\_through

Click Mouse 1 somewhere on the *grid*

# Plotting

1. How to plot
2. How to use MayaVi
3. How to use the Analysator's *pointnclick* interface

Sorry about the horribly small text..



# Hands-on

## To get started:

---

```
grid = pt.grid.MayaviGrid(vlsvReader, 'rho')
```

---

## Summary:

1.  to zoom
2.  to move the image
3.  +  to pan
4.  to use the Analysator *pointnclick*

Note on *pointnclick* **cut-through** option:

Press  in two places, and there is a *field* where you have to type:

```
plot rho
```

# Example from *calculations*



---

```
# Import analysator
import pytools as pt

# Open a vlsv file
vlsvReader = pt.vlsvfile.vlsvReader('testfile.vlsv')

# Get a cut-through starting at (x=0, y=0; z=0) to (x=2, y=5e6, z=0) :
cut_through = pt.calculations.cut_through(vlsvReader, point1=[0,0,0], point2=[2,5e6,0])

# We now have the cut_through, so now we want to print cellids:
cellids = cut_through[0]
print cellids
```

---