Visualization and Post Processing of OpenFOAM results — a Brief Introduction to VTK

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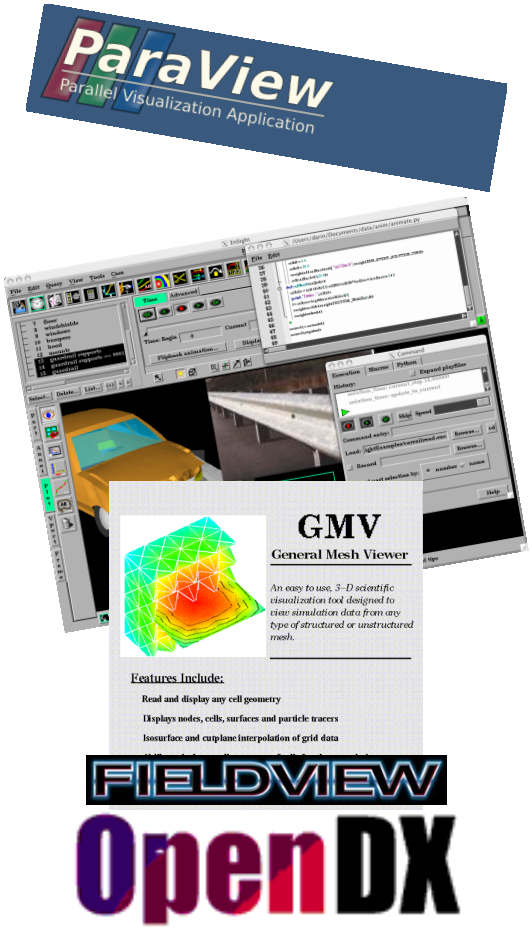
OpenFOAM Introdutory Course
Chalmers University of Technology

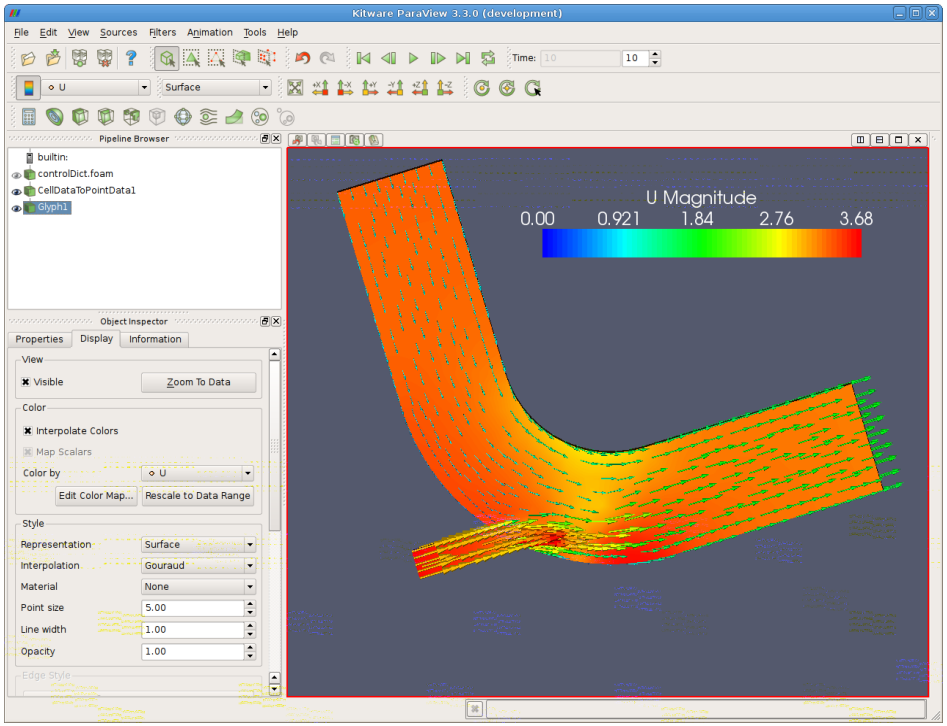
Post Processing in OF



No built in post processing tool.
Choose your weapon.

- Ensight, Fieldview, OpenDX, ParaView, GMV
- Converters (VTK, Fluent, GMV) or readers (Ensight, OpenDX, Paraview)

ParaView



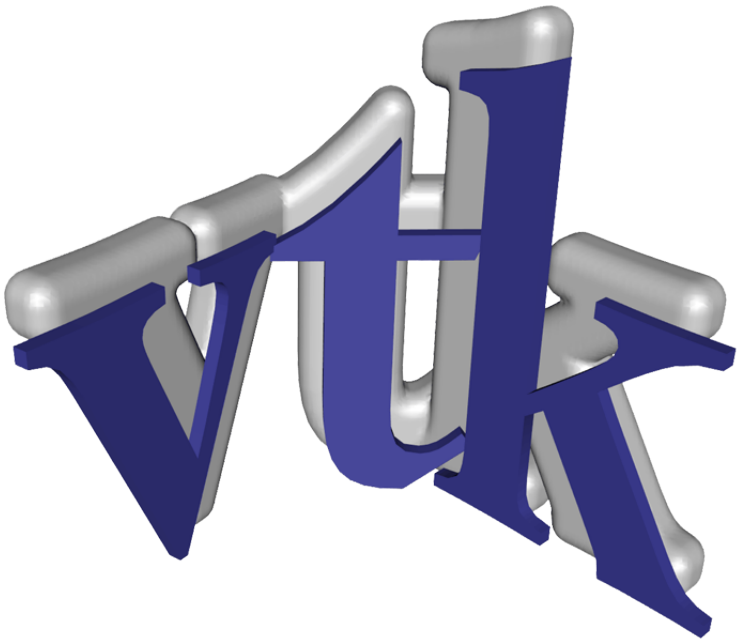
- ParaView. Developed since 2002 by Kitware Inc and Los Alamos National Laboratory (USA).
- Open Source
- Can do parallel visualization of large meshes ($>$ 1 billion cells)
- Plotting, meshing, probing, vectors, volumetric visualization
- Scriptable (Python)

ParaView and OpenFOAM

Different ways of connecting ParaView to OF.

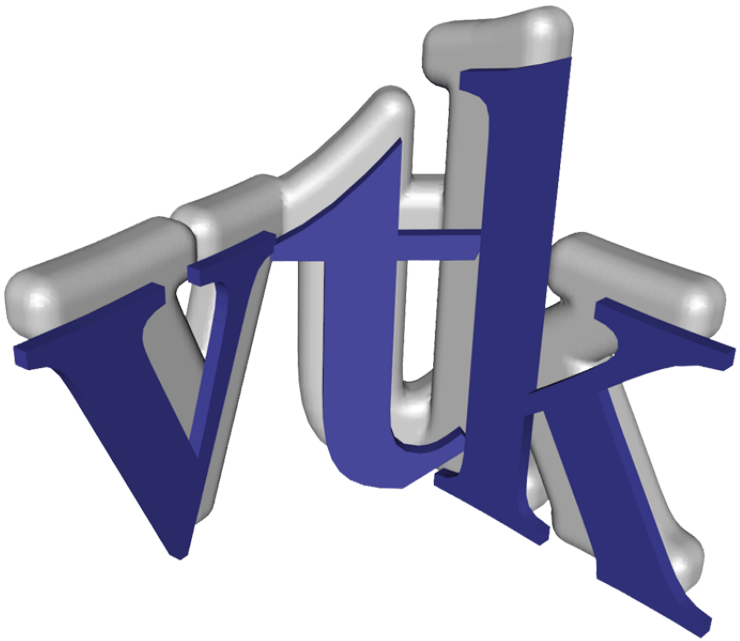
- With paraFoam (included in distribution)
  - + Easy to use, just a wrapper script around ParaView
  - – Old version
- With ParaView from `www.paraview.org`.
  - + Easy to use
  - – Need to run foamToVTK every time
- Compile ParaView from `www.paraview.org`.
  - + Can read foam files directly (With reader from foam mailing list)
  - + Better animations (divX)
  - – More work involved

Paraview (below the surface)



ParaView is a graphical user interface to the *VTK*-library. VTK (The Visualization Toolkit). It is an open source, freely available software system for 3D computer graphics, image processing, and visualization. Written in C++. Wrappers exists for Java, Tcl and Python.

Paraview (below the surface)



With some knowledge in VTK, most visualization/post-processing/data-handling needs can be handled automatically.

Example

Want to display the pressure field of the elbow tutorial and output the result to an image file.

- Step 1. Run the case: **icoFoam . elbow**
- Step 2. Run the utility `foamToVTK` on the case so that we get VTK-readable files.
  foamToVTK . elbow.
  This creates a VTK-folder in elbow directory.
- Step 3. Run python-script on output.

Example

- Step 3. Run python-script on output. **./plotElbow.py**

```
 import os
from vtk import *

#set the fileName for the current case
myFileName = 'elbow/VTK/elbow200.vtk'
```

Example

```
 #Need a reader for unstructured grids
reader = vtkUnstructuredGridReader()
reader.SetFileName(myFileName)
reader.Update()

#In OpenFOAM all results are Field-data.
#This has no concept of cells or nodes.
#Need to filter to cells.

toCellFilter = vtkFieldDataToAttributeDataFilter()
toCellFilter.SetInput(reader.GetOutput())
toCellFilter.SetInputFieldToCellDataField()
toCellFilter.SetOutputAttributeDataToCellData()
```

Example

```
 Assign here which field
#we are interested in.
toCellFilter.SetScalarComponent(0,'p',0)

#This is all we need to do do calculations.
#To get 3D image, need some more components.

#First a window
renWin = vtkRenderWindow()
```

Example

```
 #Then a renderer.  Renders data to an image.
ren1 = vtkRenderer()

#Add renderer to window
renWin.AddRenderer(ren1)

#Add pressure data to the renderer.
#Mapping assigns data to colors and geometry.
mapper = vtkDataSetMapper()
mapper.SetInput(toCellFilter.GetOutput())
```

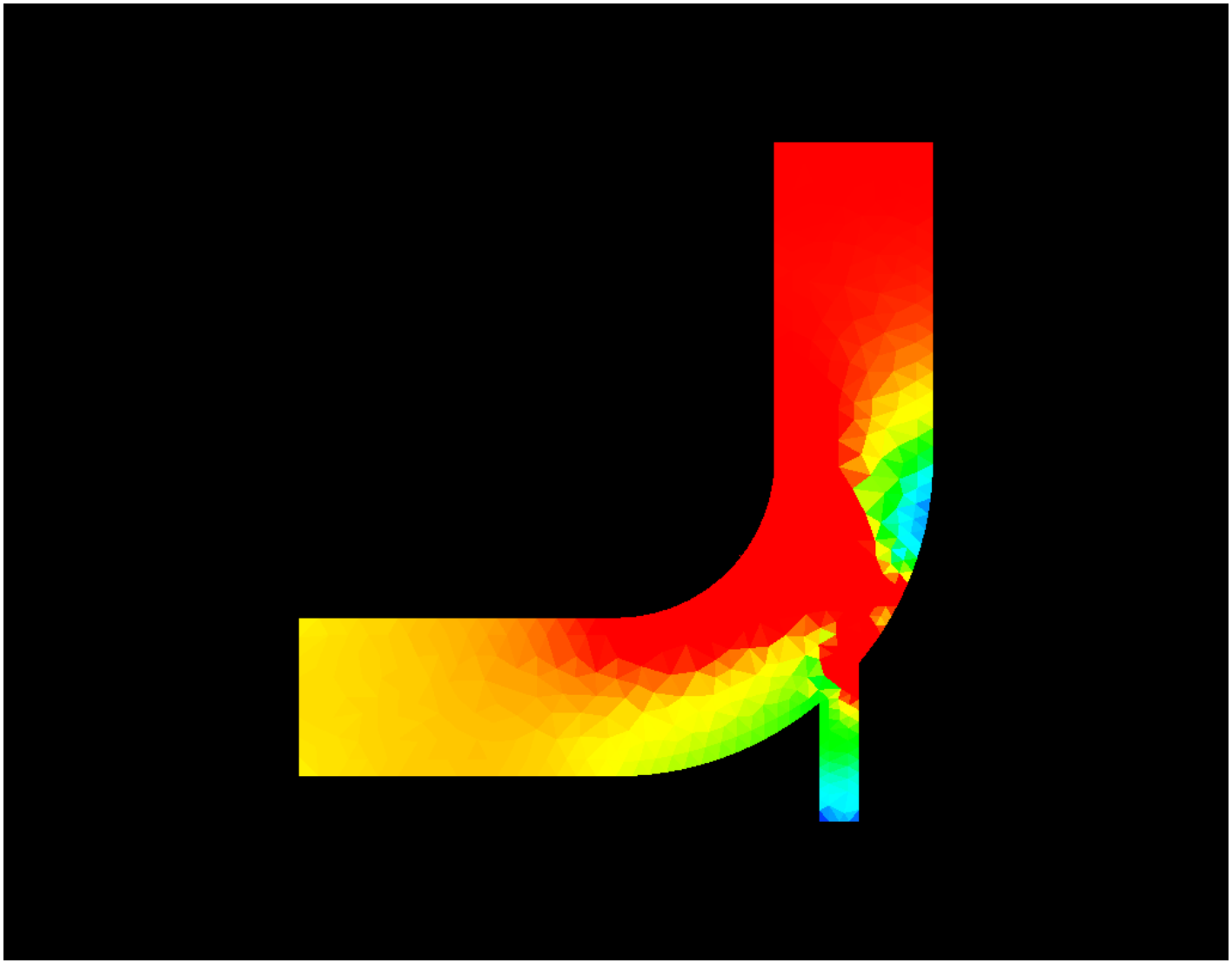
Example

```
 #The object is assigned to an actor.
actor = vtkActor()
actor.SetMapper(mapper)

#Add actor to renderer.
ren1.AddActor(actor)

#Finally render image
renWin.Render()
```

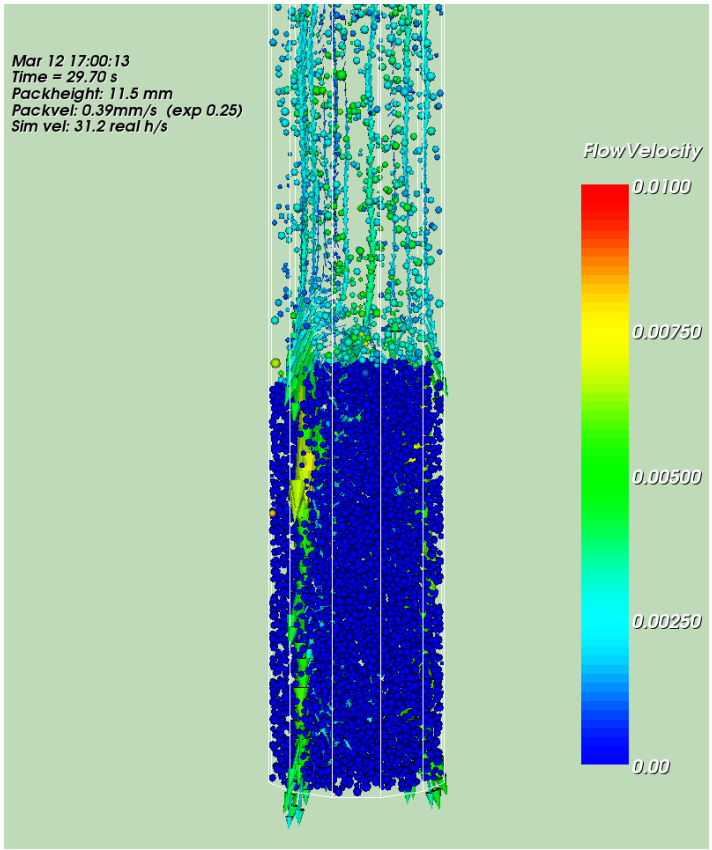
Example



Basic work flow with VTK

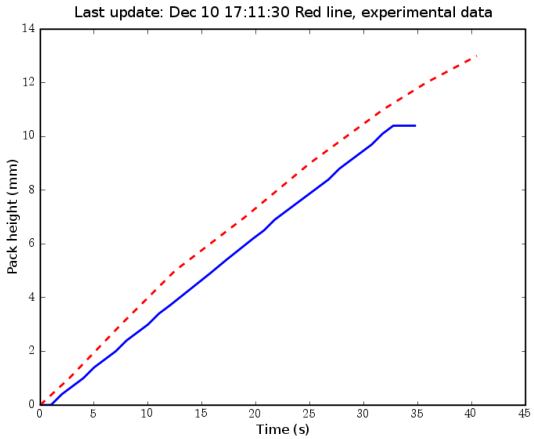
- Read file
- Filter data (Extract regions, create vectors etc)
- Map data to colors
- Render image

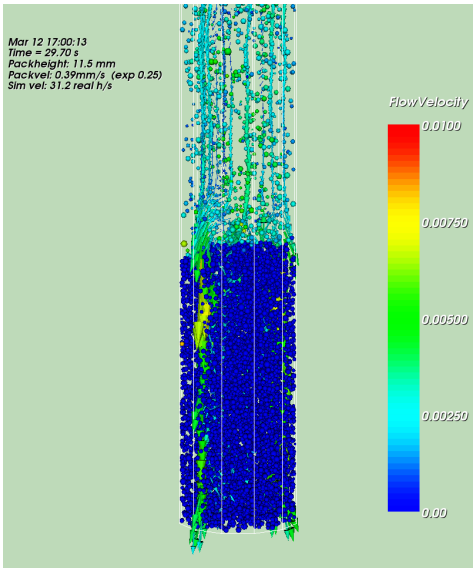
More examples – ideas



- Keep track of long simulations. Publish image on web server.
- Difficult to do probing or data treatment.
- Simple custom GUI creation (through Tk).
- Advanced animations. Image maps.
- ”Anything” – by help of Python modules. :

More examples – ideas





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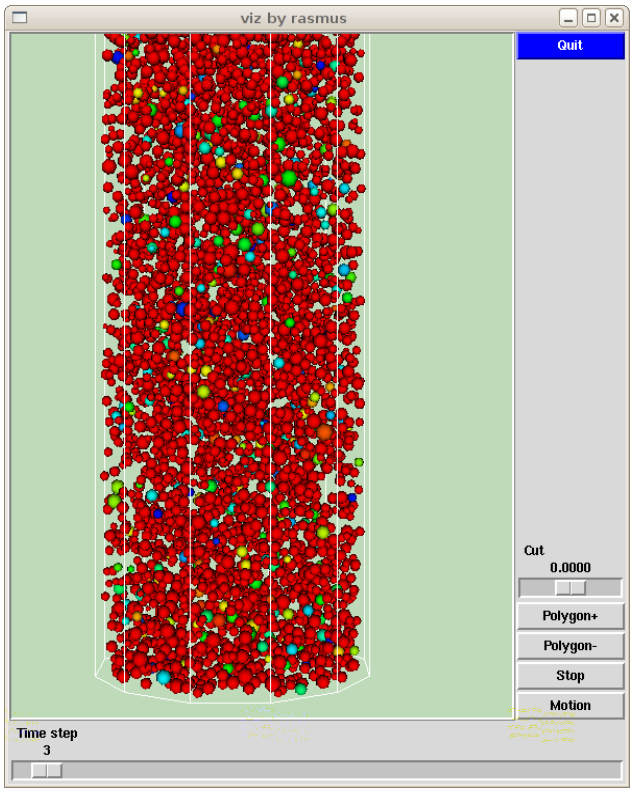

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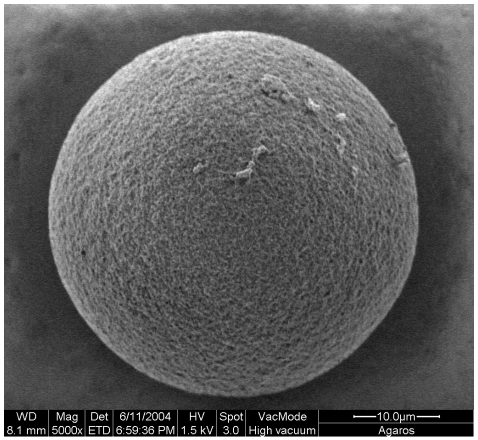

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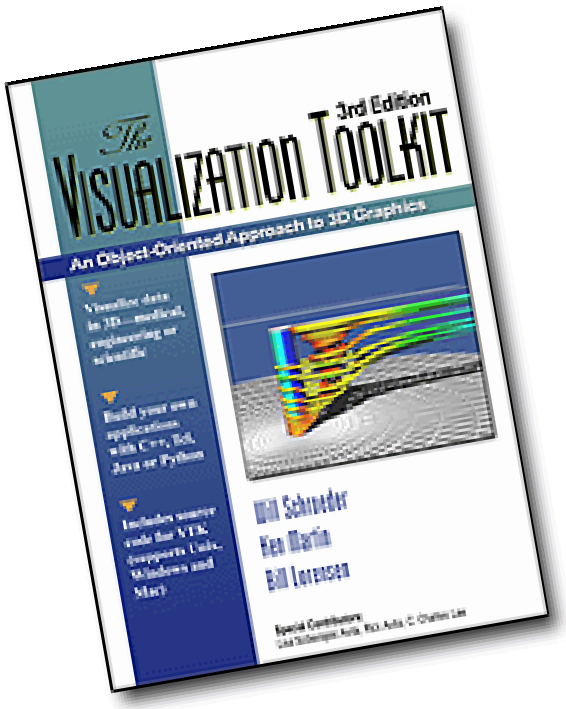
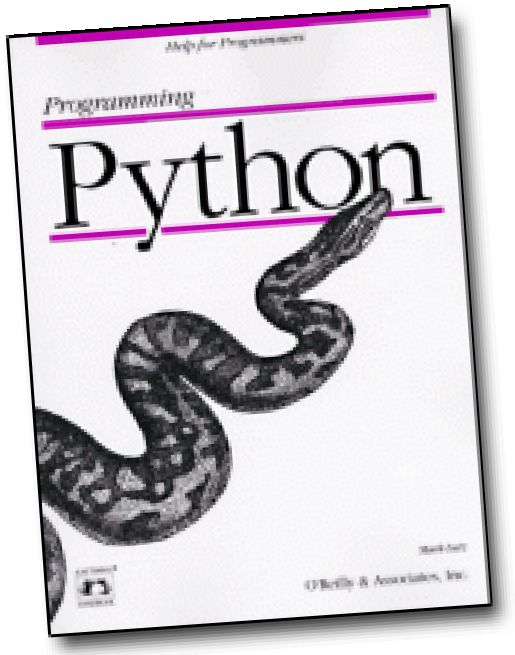
Learn More





- VTK books
- NGSSC Course in scientific visualization (?)
- VTK Wiki

The End