

Post processing in CFD

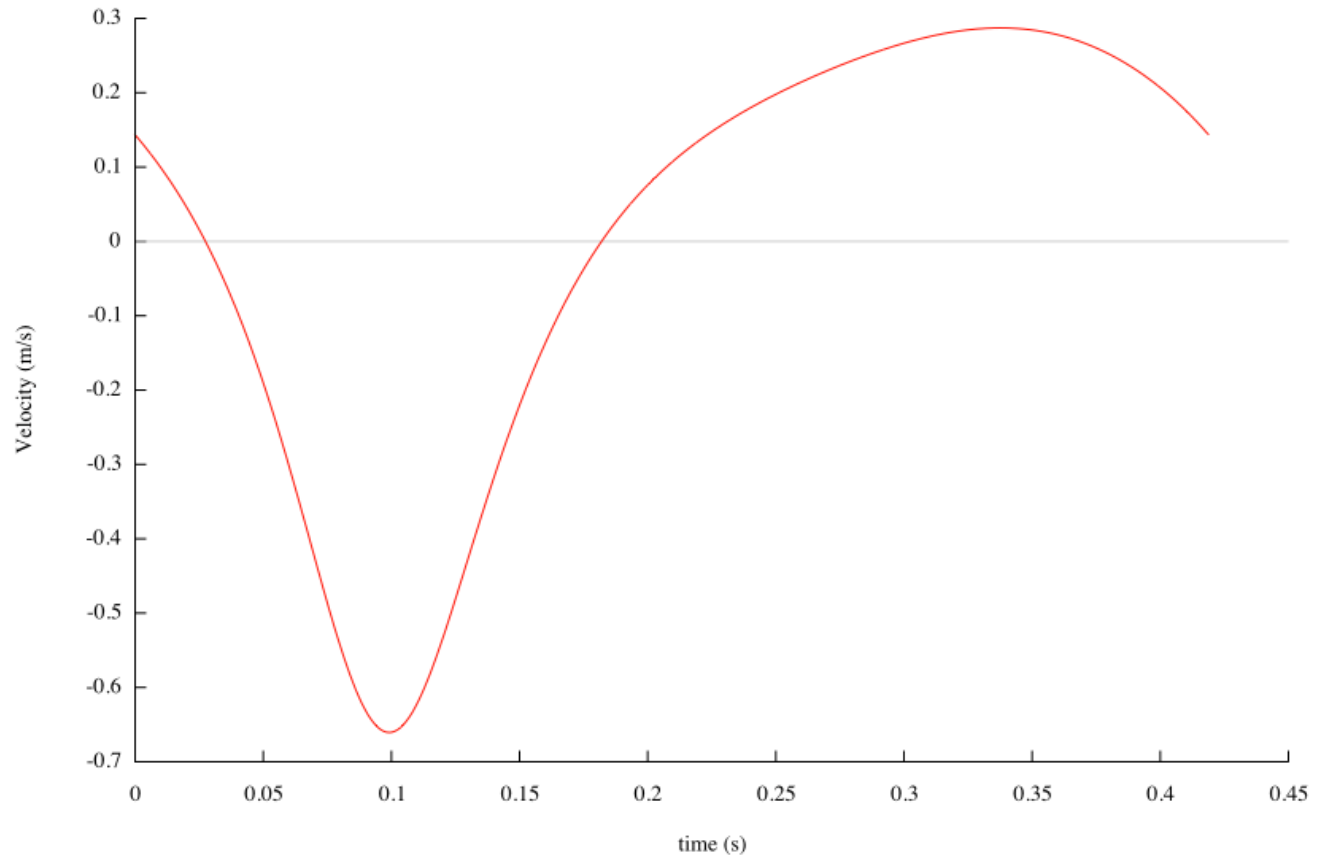
Outline

- What/Why Post-Processing
- Introduction to Ateles (Atl)-Harvesting
- Scripting the Atl-Harvesting
- Example of post-processing with Atl-harvesting
- Visualization and interpretation of results

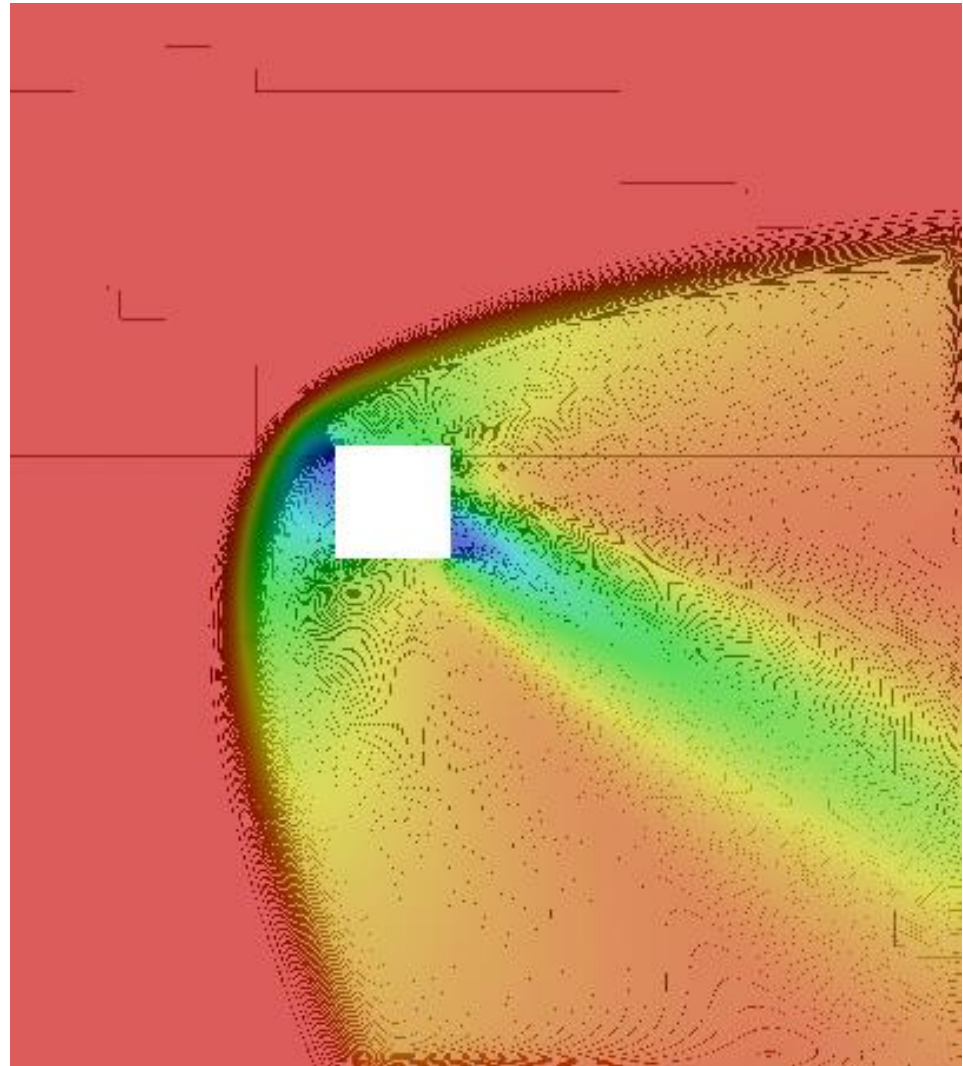
What is post-processing

- A set of operations on the output of CFD simulations
- To visualize the physical properties in interpretable form
- Calculation:
 - Variables: Velocity, Pressure, Mach number
 - Turbulent Quantities: Reynold stresses, energy spectra
- Visualization:
 - XY Plots (Pressure/Velocity over time)
 - 2D/3D Contour plots
 - Streamlines

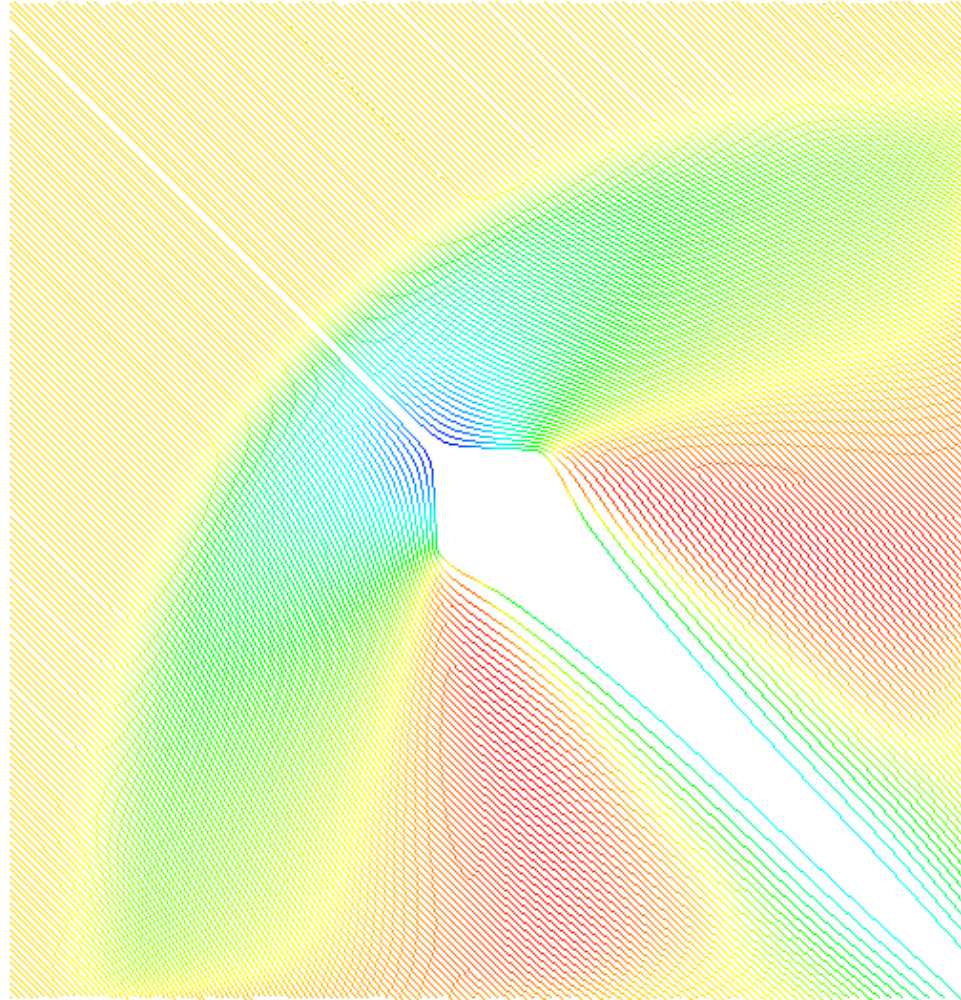
XY Plots



Contour



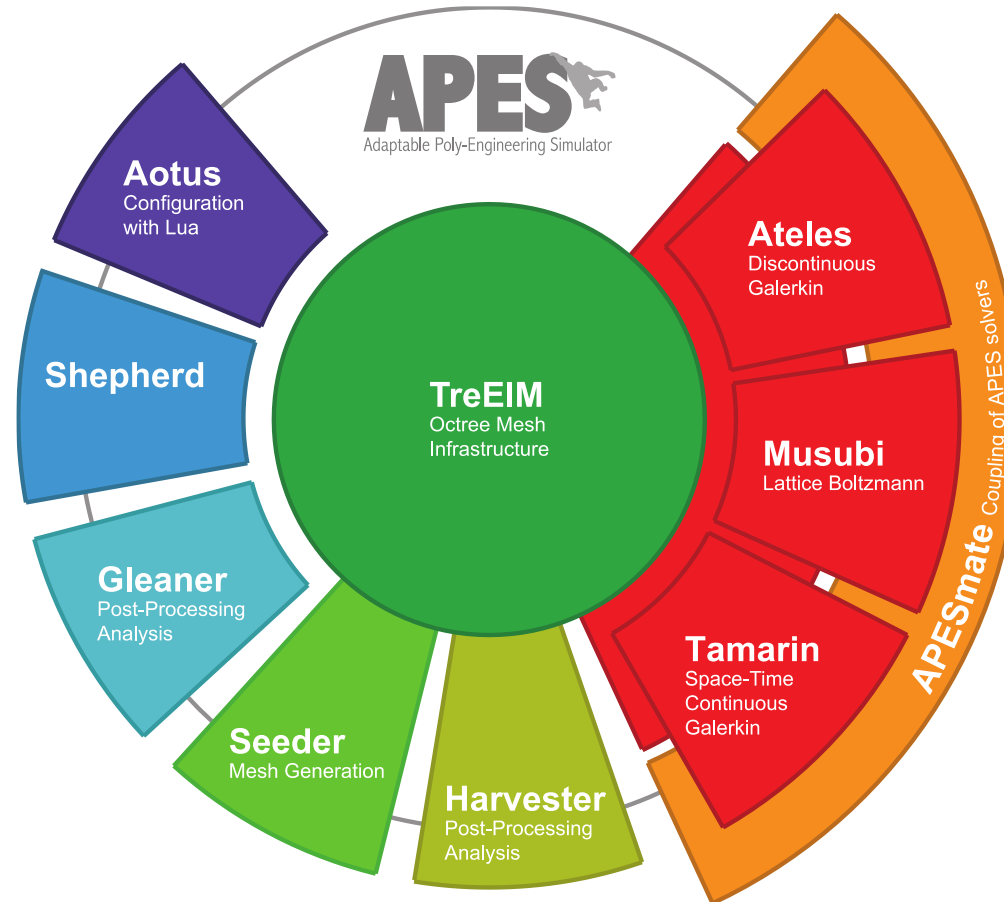
Streamlines



Why do we need it

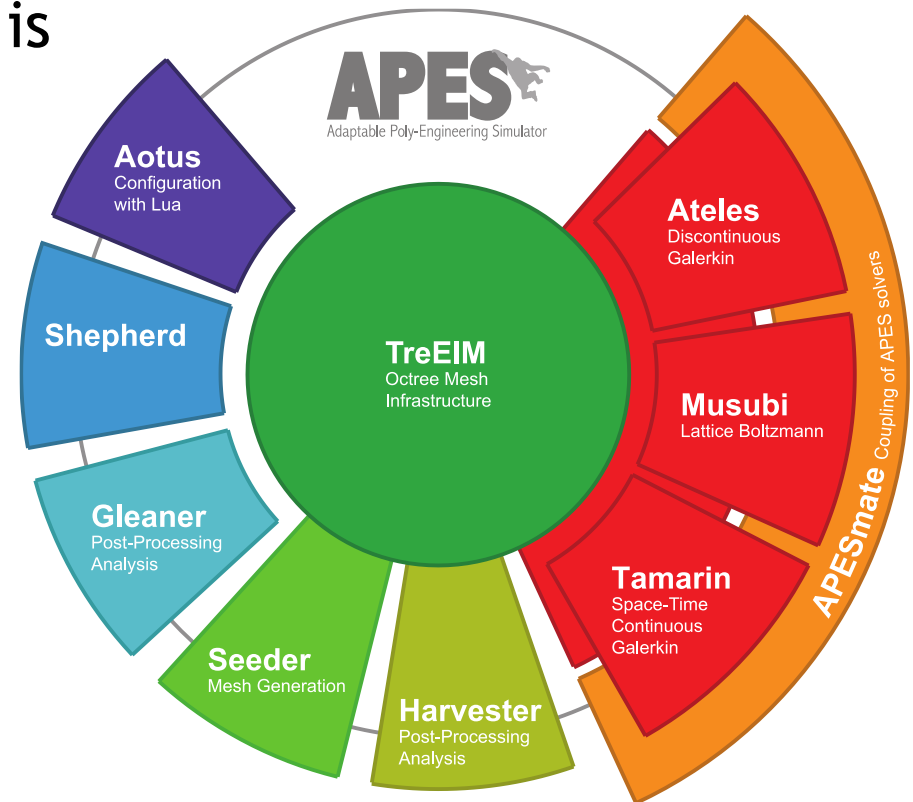
- Simulations usually write data to disk in a crude form
- The data can be directly interpreted in some cases
- In most cases the data needs to be modified in an interpretable form
- More advanced variables
 - Mach number, gradients
 - Turbulent Quantities: Reynold stresses, energy spectra
- Extract data on a local region
 - E.g. velocity field over a plane
- Convert the data in a visualization format for software (e.g. vtk format)

Atl-Harvesting (former: Harvester)



Atl-Harvesting (former: Harvester)

- Operates on the data that is written by solvers (Ateles)
- Scriptable by Lua scripts
- Can generate visualization files in parallel
- Automated scripts for the creation of animations



Sample Lua script for Atl-harvesting

```
require 'ateles'  
logging = {level=3}  
restart.read = 'restart/mach3/simulation_header_10.000E+00.lua'  
ply_sampling = { nlevels = 3 }  
tracking = {  
  {  
    label='cube',  
    variable = { 'density', 'pressure', 'velocity' },  
    shape = { kind = 'global' },  
    folder = 'harvest/mach3/',  
    output = {  
      format = 'vtk',  
      write_pvd = true  
    }  
  }  
}
```

Sample Lua script for Atl-harvesting

```
read.restart = Restart file which should be read (Lua)
tracking = {
  {
    label = 'name', A name, which will be used as prefix for
              storing the output
    variable = { The variables which need to be processed
      'density',
      'pressure',
      'velocity'
    },
    shape = { kind = 'global' }, The whole domain is tracked
    folder = 'harvest/mach3/', Folder name, where output should be saved
    output = { Format for the output
      format = 'vtk',
      write_pvd = true
    }
  }
}
```

Atl-Harvesting output

- The VTU and PVD files are readable by the visualization software: Paraview
- Paraview can also compute several things on the data:
 - Velocity gradients
 - Plots over several space/time domains
- Some main Paraview features
 - Scaling of data according to desired color legend
 - Clipping/slicing of domain
 - Visualization of contours, streamlines etc.

harvest_series to process multiple files

series.config

```
files: restart/*.lua

lua: /data/horse/ws/nhr420-
hpcfd/bin/lua

harvester: /data/horse/ws/nhr420-
hpcfd/bin/at1_harvesting

template: harvest_series.template

out: harvest/

...
```

harvest_series.template

```
require 'ateles'

restart.read = '$!file!$'

ply_sampling = {nlevels=3}

tracking = {
  label = 'simulation',
  variable = { 'density', 'pressure' },
  shape = { kind = 'global' },
  folder = '$!out!$',
  output = { format = 'vtk' }
}
```