Ulrich Heck, Martin Becker

CastNet: OpenFOAM setup and job control for Windows, Linux and Gompute's cluster environment.

Introduction

CAD model based workflow

CastNet for the Gompute users

CastNet/OpenFOAM-Example case

Conclusion

DHCAE Tools

DHCAE Tools GmbH, Germany

CFD-Solutions based on OpenFOAM® -Technology

Engineering:

CFD-Services with OpenFOAM

Software

Standard/ Customized:

GUIs, Extensions

User Support Training:

OpenFOAM/our Extensions

DHCAE-Tools

Our philosophy: More pragmatic then dogmatic

We have to accept the reality of our customers. Not always but often:

- Commercial CAD systems with proprietary kernels
- Windows systems (IT says “NO” to Linux)
- New software must be productive from the first second
- GUI based working is preferred for certain tasks

Can not be covered with OpenFOAM directly

Combine proprietary solutions with OpenSource

Try to share open source part of work (e.g. OpenFOAM-extensions)

Major tools:

CastNet:	**Preprozessor for OpenFOAM**
Rungui for CastNet	**Job-Control**

CastNet: Pre-Prozessor for OpenFOAM

DHCAE Tools

Major goals for CastNet:

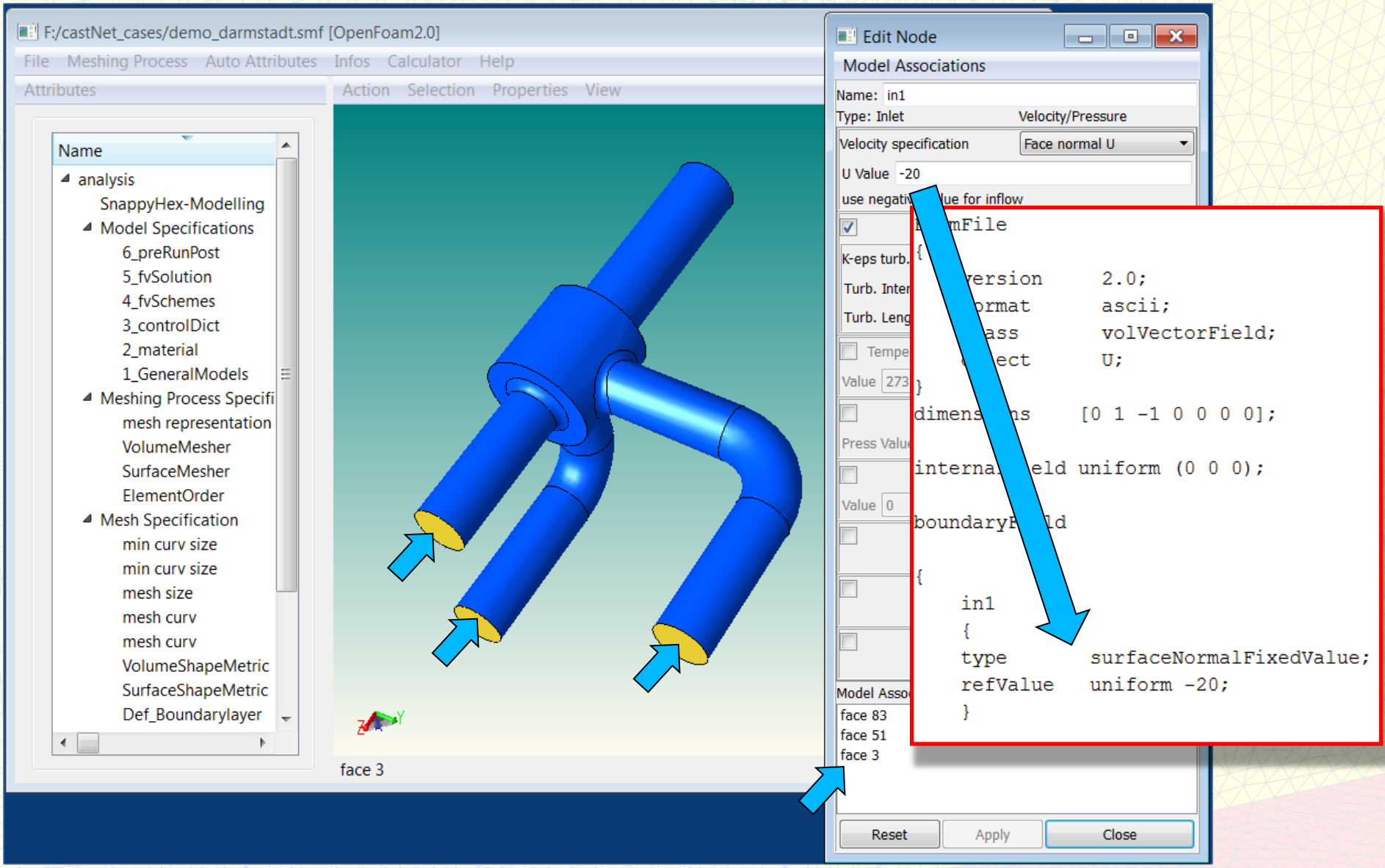
- Providing access to reliable, robust and high quality CFD-meshing based on CAD geometry (commercial CFD-meshing and CAD import technology)
- Establishing complete GUI based environment: Access to strong OpenFOAM® - solution capabilities without editing text files or detail knowledge of keyword-structure (e.g. “turbulentMixingLengthFrequencyInlet”)
- Reducing the time from CAD model to OpenFOAM® run-ready case

Fully compatible: User can switch anytime from GUIs to text-based model setup

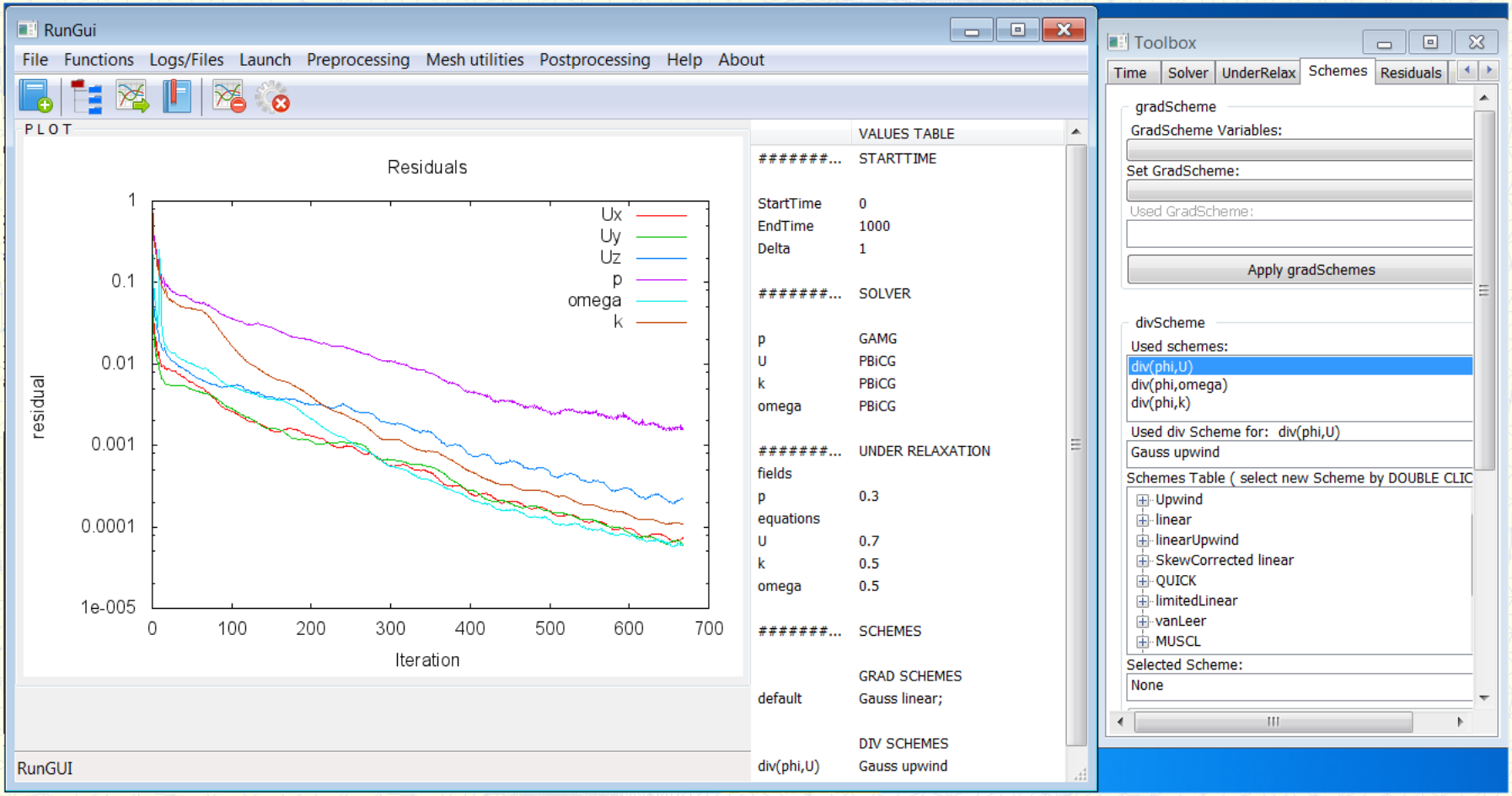
User can extend the CastNet model output for specific needs

Helps to learn the usage/keywords of OpenFOAM

CastNet's OpenFOAM® Interface



Job Control


RunGui
File Functions Logs/Files Launch Preprocessing Mesh utilities Postprocessing Help About
PLOT
Residuals
residual
Iteration
Ux
Uy
Uz
p
omega
k
VALUES TABLE
STARTTIME
StartTime 0
EndTime 1000
Delta 1
SOLVER
p GAMG
U PBiCG
k PBiCG
omega PBiCG
UNDER RELAXATION
fields
p 0.3
equations
U 0.7
k 0.5
omega 0.5
SCHEMES
GRAD SCHEMES
default Gauss linear;
DIV SCHEMES
div(phi,U) Gauss upwind
RunGUI
Toolbox
Time Solver UnderRelax Schemes Residuals
gradScheme
GradScheme Variables:
Set GradScheme:
Used GradScheme:
Apply gradSchemes
divScheme
Used schemes:
div(phi,U)
div(phi,omega)
div(phi,k)
Used div Scheme for: div(phi,U)
Gauss upwind
Schemes Table (select new Scheme by DOUBLE CLIC
Upwind
linear
linearUpwind
SkewCorrected linear
QUICK
limitedLinear
vanLeer
MUSCL
Selected Scheme:
None

Workflow

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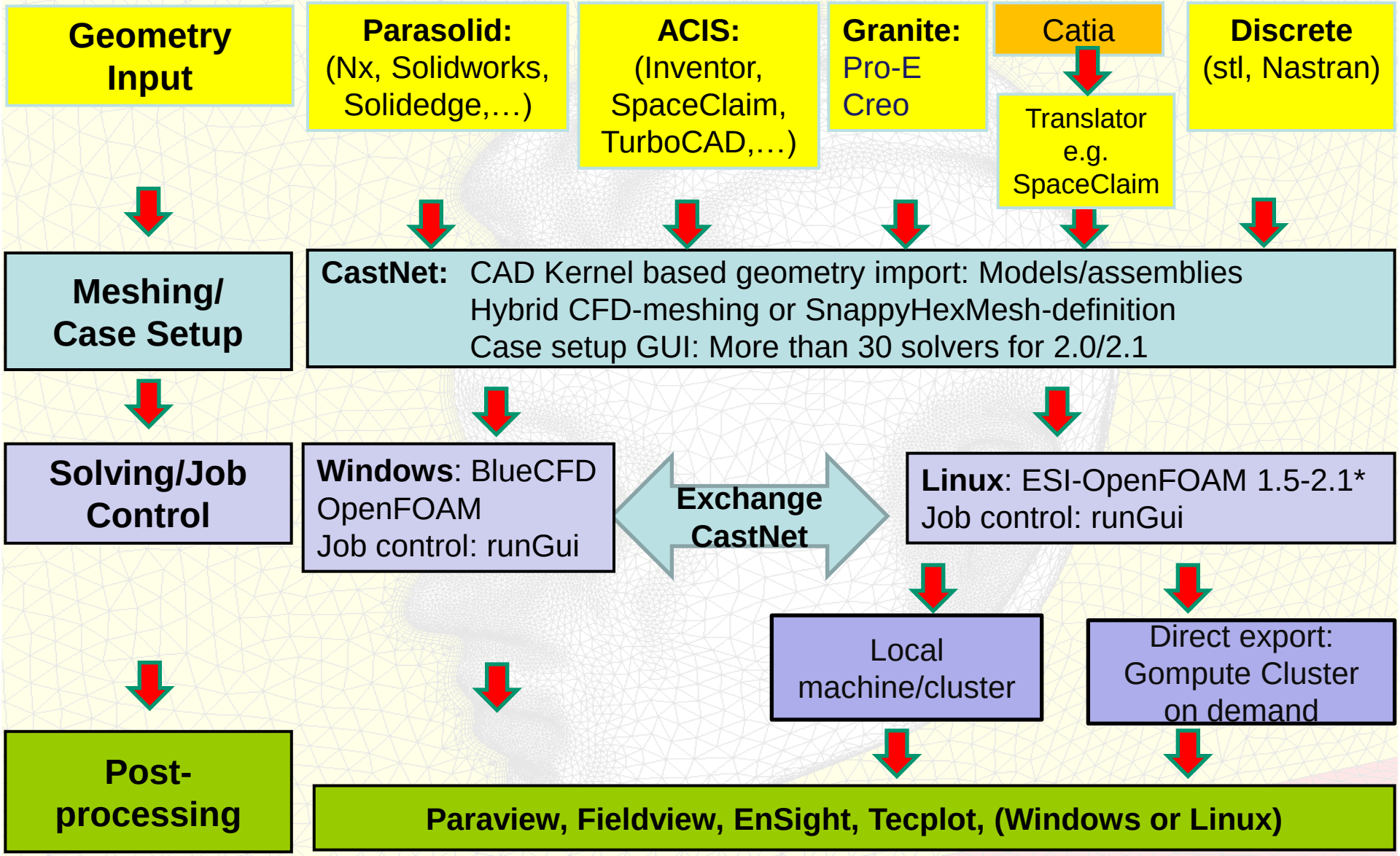


Options for the Gompute User

DHCAE Tools

Combined local/Cluster

Pre-Processing:
Locally Windows/Linux

Running case:
Locally Windows/Linux or move the case to the Gompute Cluster

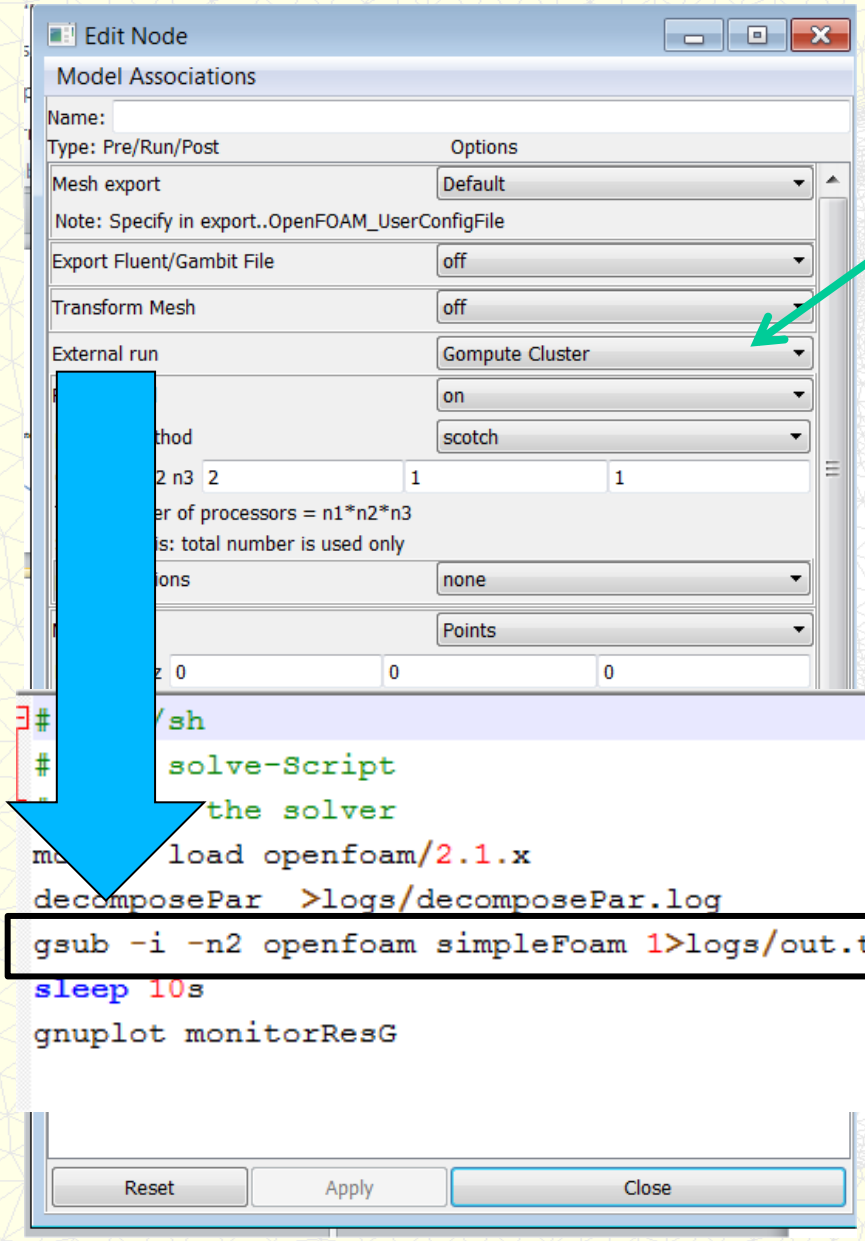
Exchange CastNet:
No need to decide at the start

Cluster only

Pre-Processing (Coming soon)
Using CastNet on cluster (on-demand)

Running case:
Gompute Cluster
Job control with Rungui

Gompute Setup

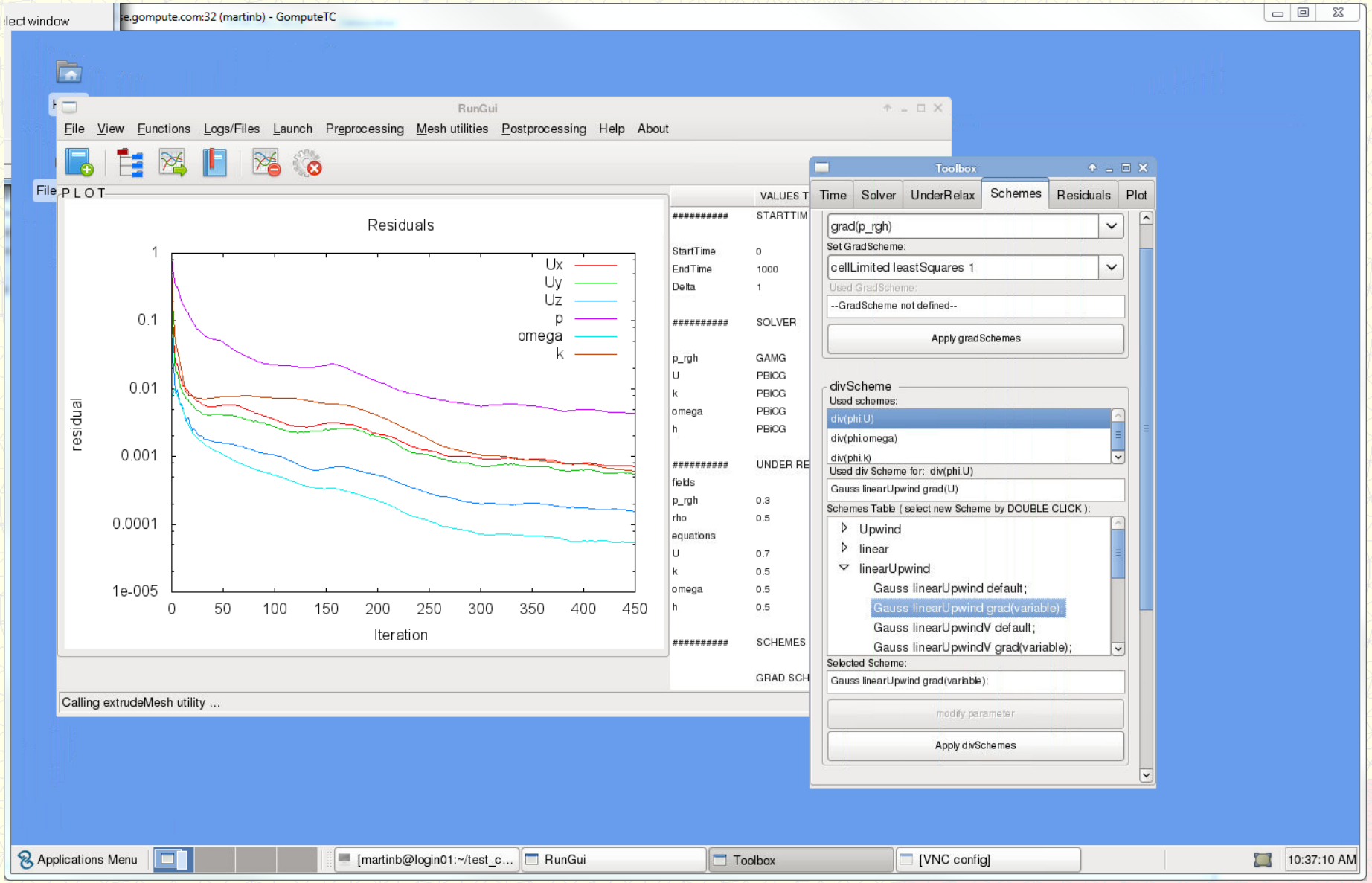


Setting CastNet:
Entry in CastNet for Pre-Run-Post options

Case setup and solver call is done using Gompute Commands

```
#    /sh
#     solve-Script
      the solver
m     load openfoam/2.1.x
decomposePar  >logs/decomposePar.log
gsub -i -n2 openfoam simpleFoam 1>logs/out.txt 2>logs/solver_err.log >logs/solver.log &
sleep 10s
gnuplot monitorResG
```

Runing in Gompute environment



Benefit for Gompute users

High flexibility

- Windows/Linux-usage with all exchange options to Cluster/local run

Effective resource management

- Run cases locally for small/medium sized problems or pre-studies
- Switch to Gompute's HPC environment for higher resources /faster results (transient, design studies, large models…)
- Pre-Processing can be conducted locally e.g. if network-connection is not fast enough for external GUI access
- If memory restrictions occur locally (large mesh cases): Pre-processing can be conducted on the Gompute cluster

Minimized OpenFOAM-care

- No need to keep the Linux OpenFOAM environment up to date (Gompute will care for git-updates)

Optimal support options

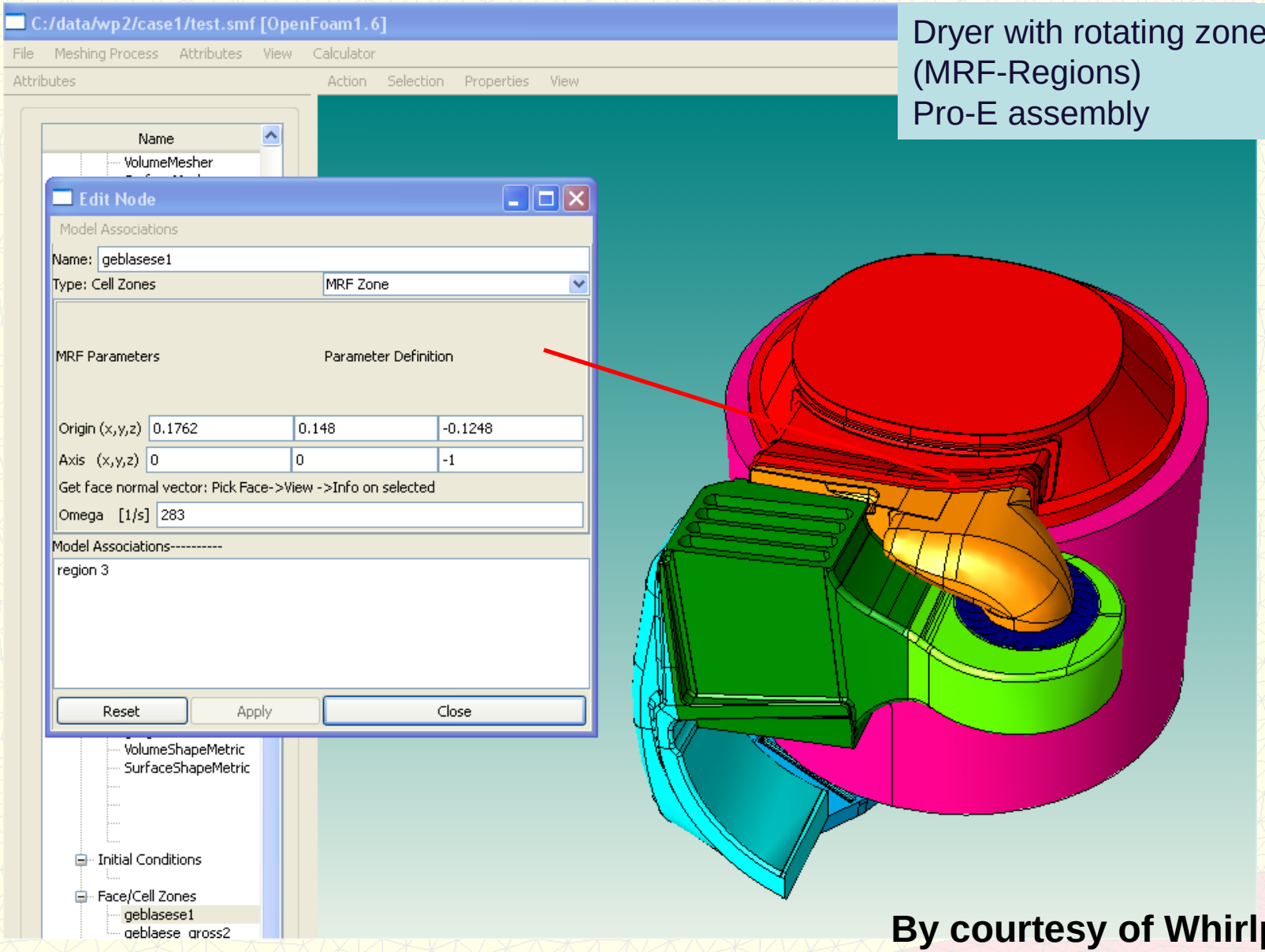
- DHCAE Tools can provide support of OpenFOAM usage and CastNet by screen sharing, conference calls etc.

DHCAE Tools

CastNet / OpenFOAM

- features
- example cases
- technical field

CastNet-Meshing

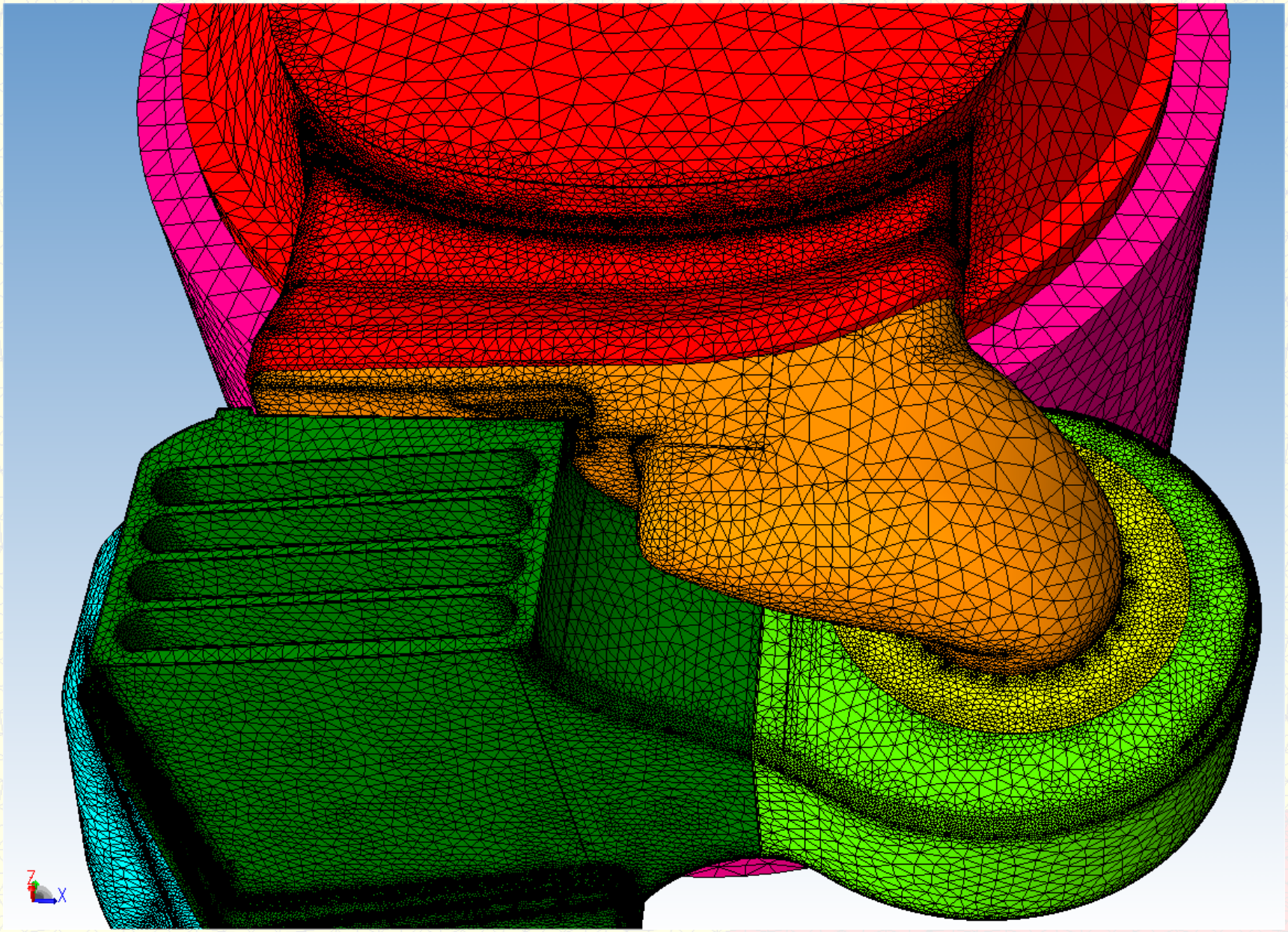


Dryer with rotating zones
(MRF-Regions)
Pro-E assembly

By courtesy of Whirlpool

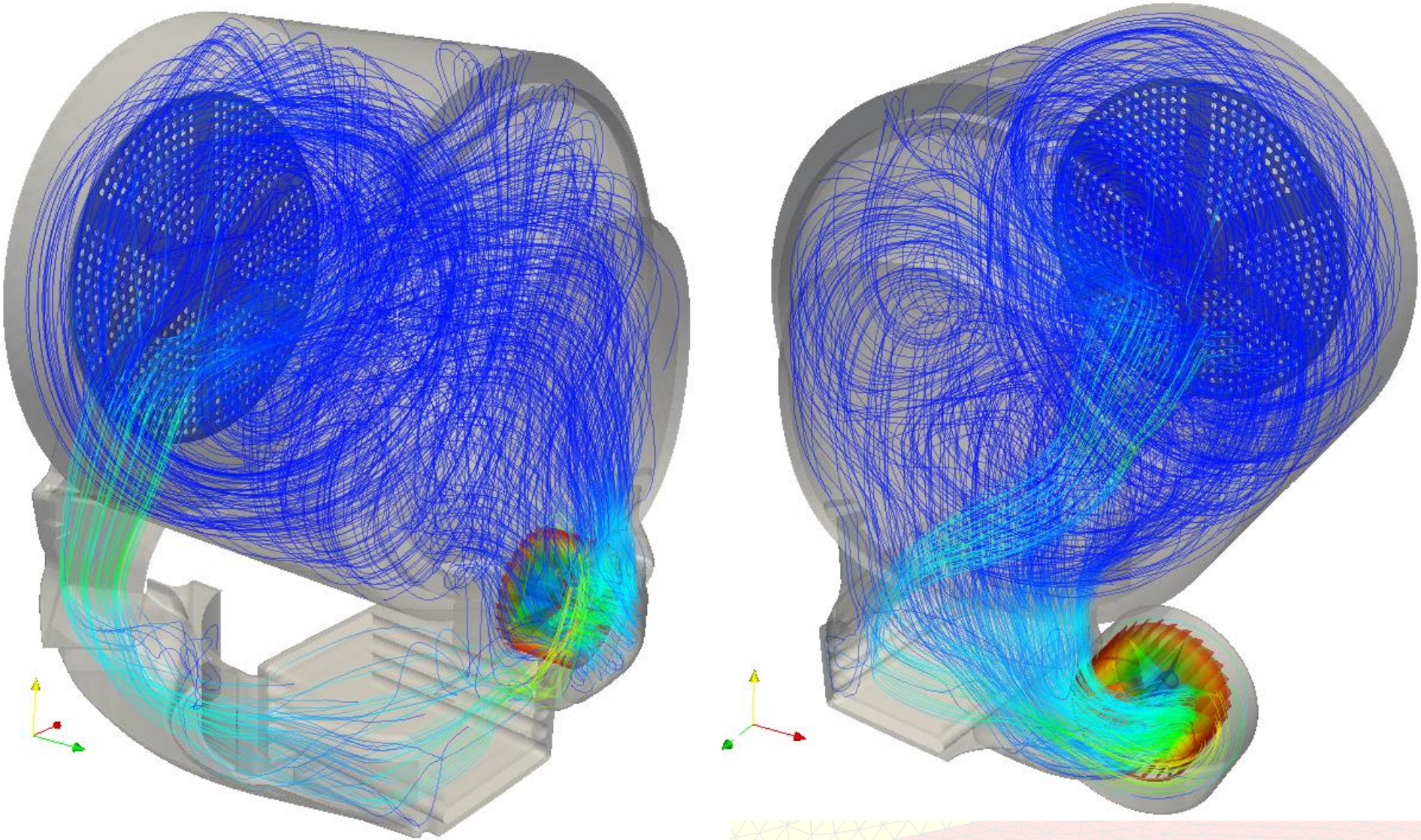
CastNet-Meshing

DHCAE Tools



Dryer

DHCAE Tools



Chemical Engineering

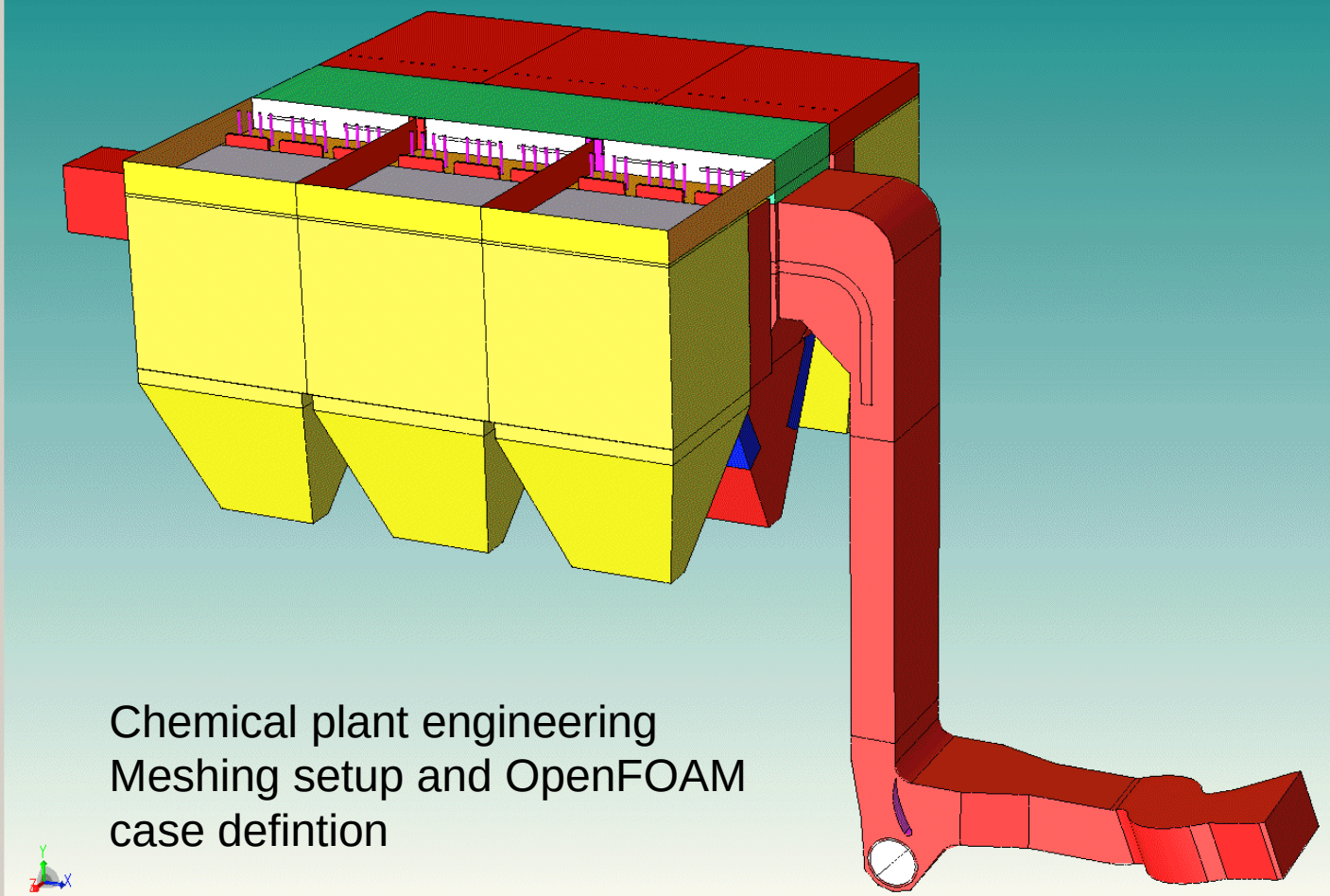
DHCAE Tools

File Meshing Process Auto Attributes Infos Calculator Help

Attributes

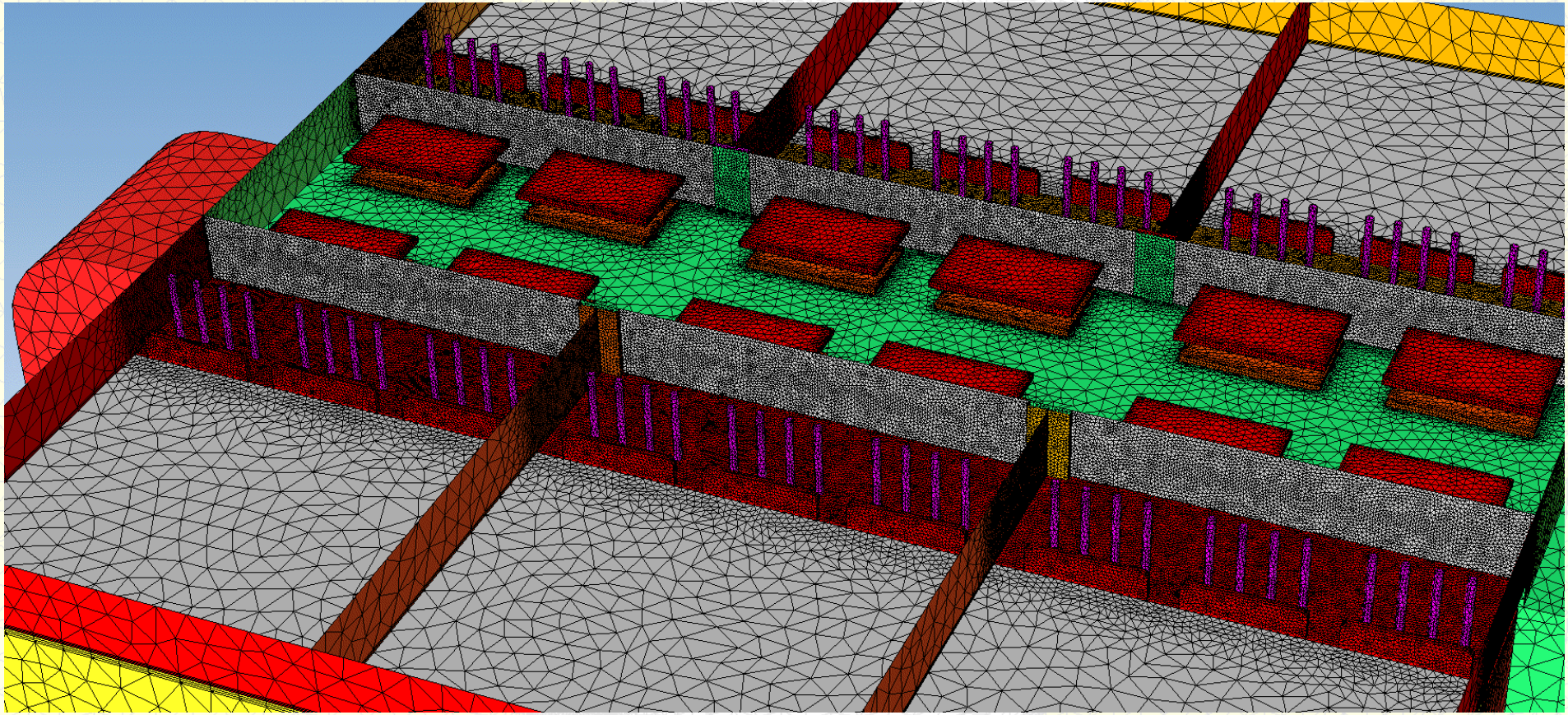
Action Selection Properties View

Name	InfoType
analysis	analysis
SnappyHex-Modelling	SnappyHex-Mode
Model Specifications	Model Specificatio
	Control Dict
	General Models
	Materials
	Solution Settings
	Pre/Run/Post
Meshing Process Specification	Meshing Process
mesh representation	Mesh Representat
VolumeMesher	Volume Mesher
SurfaceMesher	Surface Mesher
ElementOrder	Element Order
Mesh Specification	Mesh Specificatior
top_ground	3D Boundary Lay
top_durchgang	3D Boundary Lay
rohre	3D Boundary Lay
regs	Mesh Size
refine1	Refinement Sourc
refine1	Refinement Sourc
out	Classic Extrusion
no_mesh	No Mesh
mesh size	Mesh Size
kanten_hauben	Mesh Size
ex_kanal	Gen. Extrusion M
ex5	Gen. Extrusion M
ex4	Gen. Extrusion M
ex3	Gen. Extrusion M
ex2	Gen. Extrusion M
ex1	Gen. Extrusion M
deckel_hauben_rand	Mesh Size
VolumeShapeMetric	Volume Shape Me
SurfaceShapeMetric	Surface Shape Me
3d_blPorb	3D Boundary Lay
	Gen. Extrusion M
	Allow Refinement
	3D Boundary Lay
Initial Conditions	Initial Conditions
	General Internal F
Face/Cell Zones	Face/Cell Zones
rotor	Cell Zones
lochblech	Cell Zones
filter	Cell Zones
baffle_zustroem	Face Zones
baffle_sammelrunpf	Face Zones
baffle_hauben	Face Zones
baffle_filter	Face Zones
Boundary Conditions	Boundary Conditi
in1	Inlet
P-out	Outlet



Chemical plant engineering
Meshing setup and OpenFOAM
case defintion

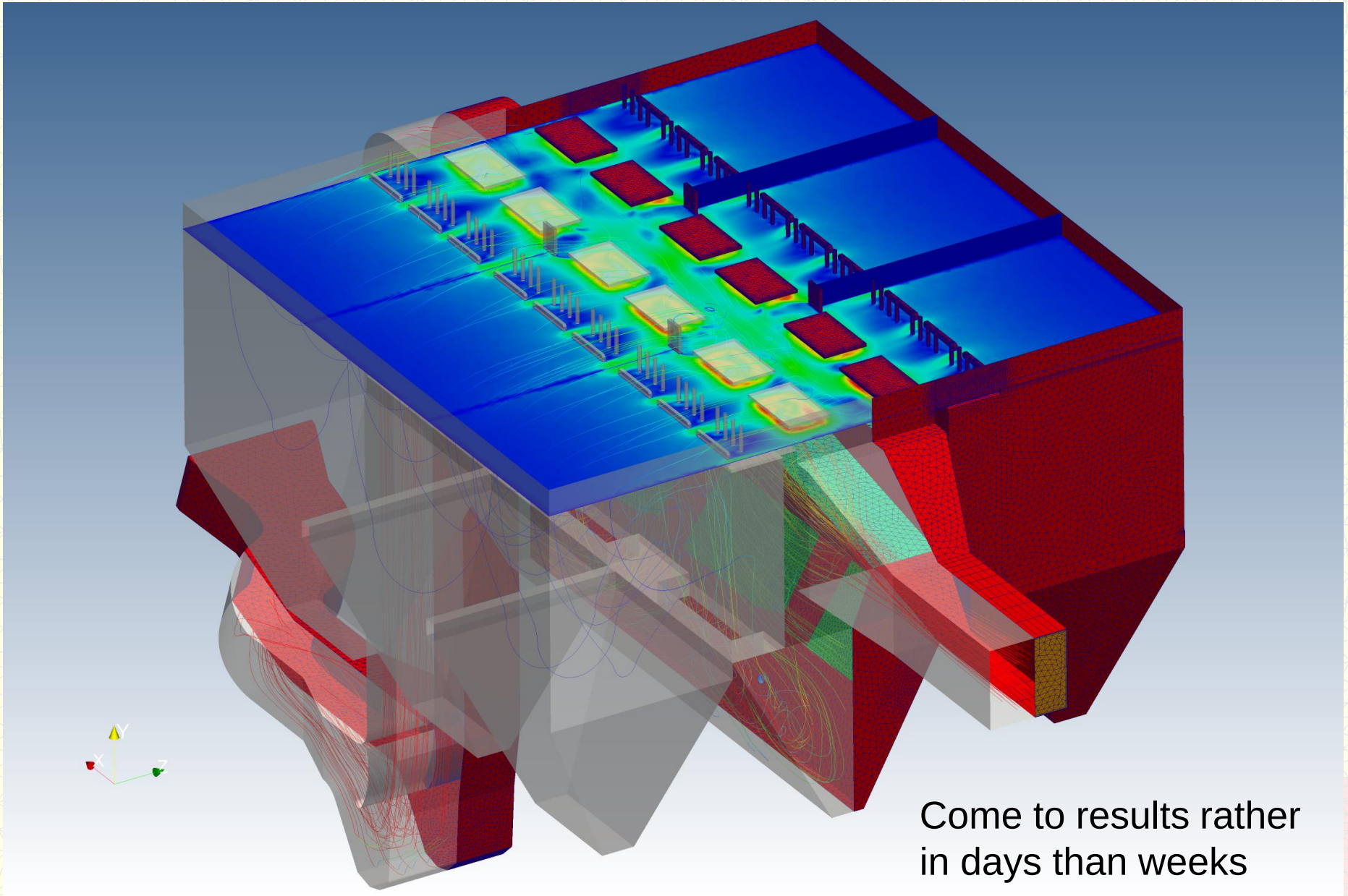
face 30848



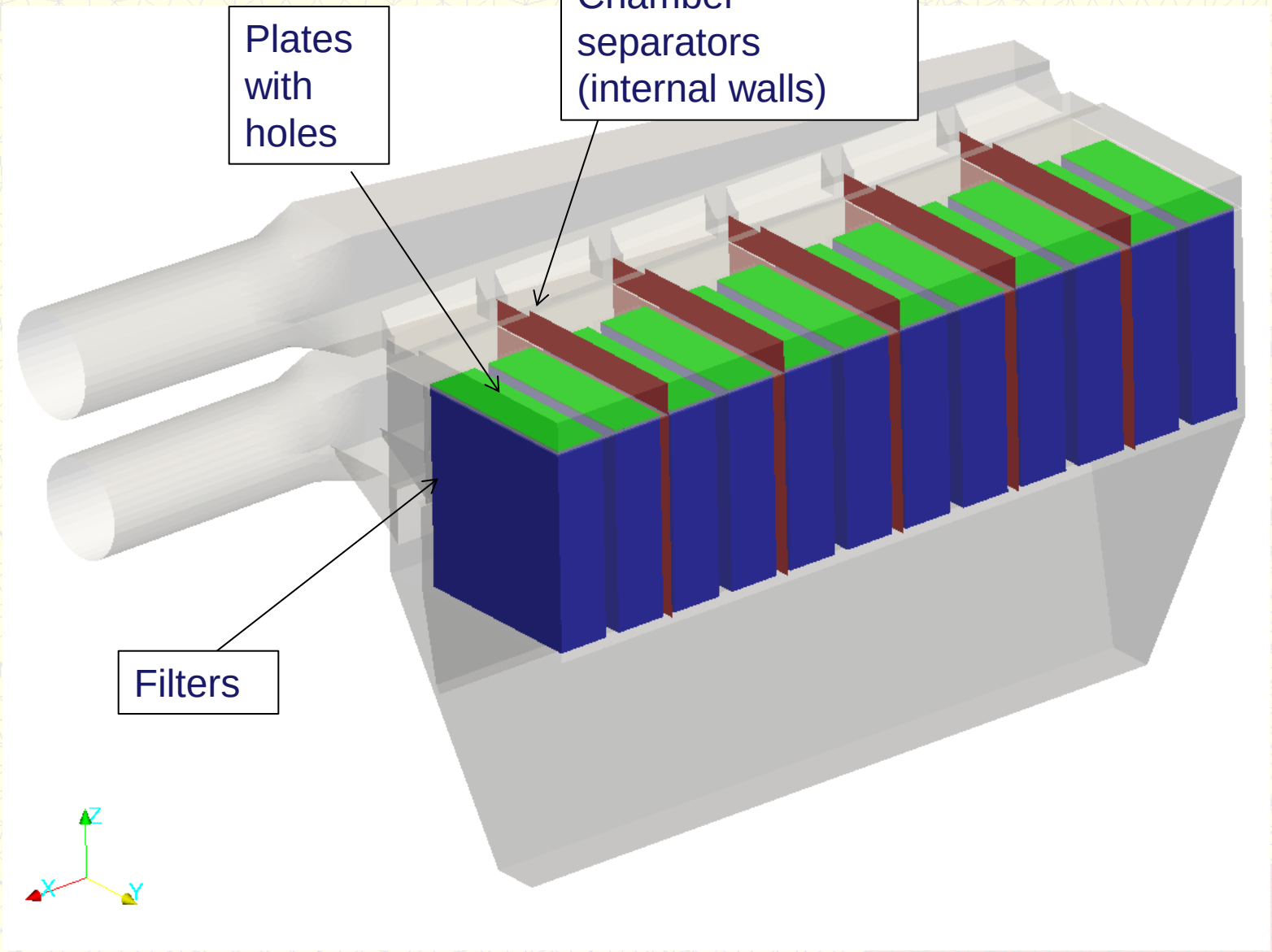
Roof section

Chemical Engineering

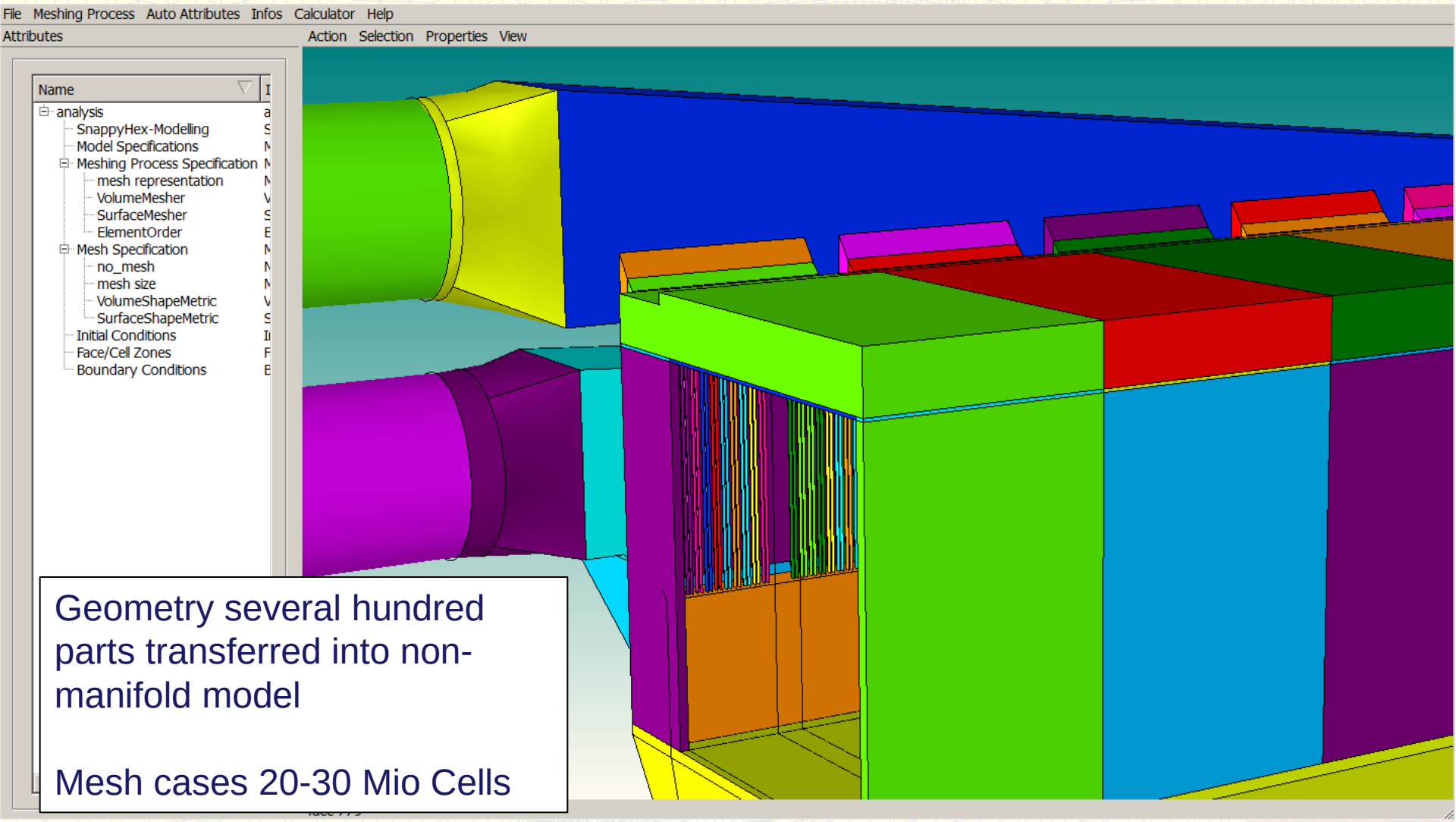
DHCAE Tools



Come to results rather in days than weeks


Plates with holes
Chamber separators (internal walls)
Filters
Z
X
Y

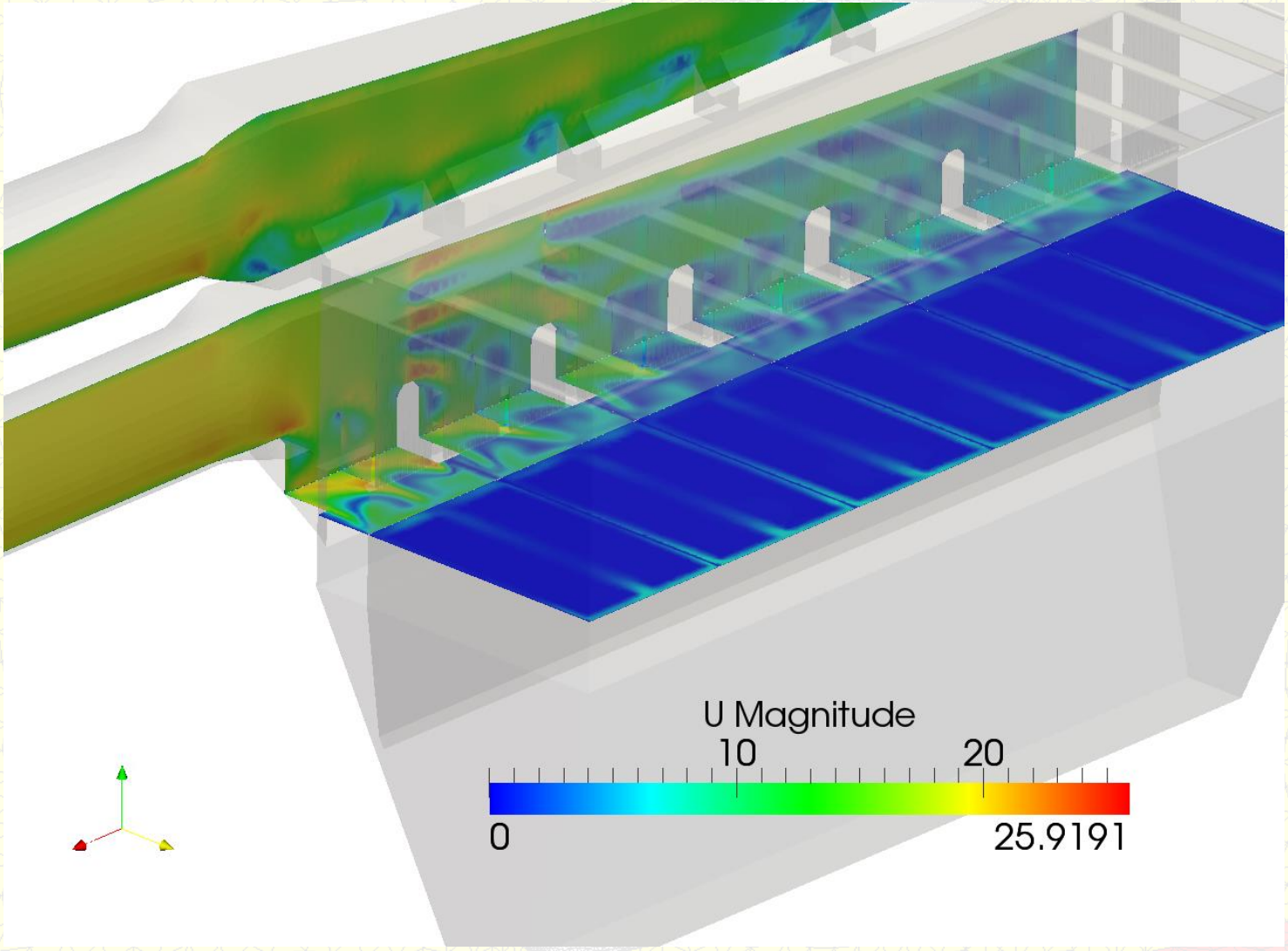
Chemical Engineering



Geometry several hundred parts transferred into non-manifold model

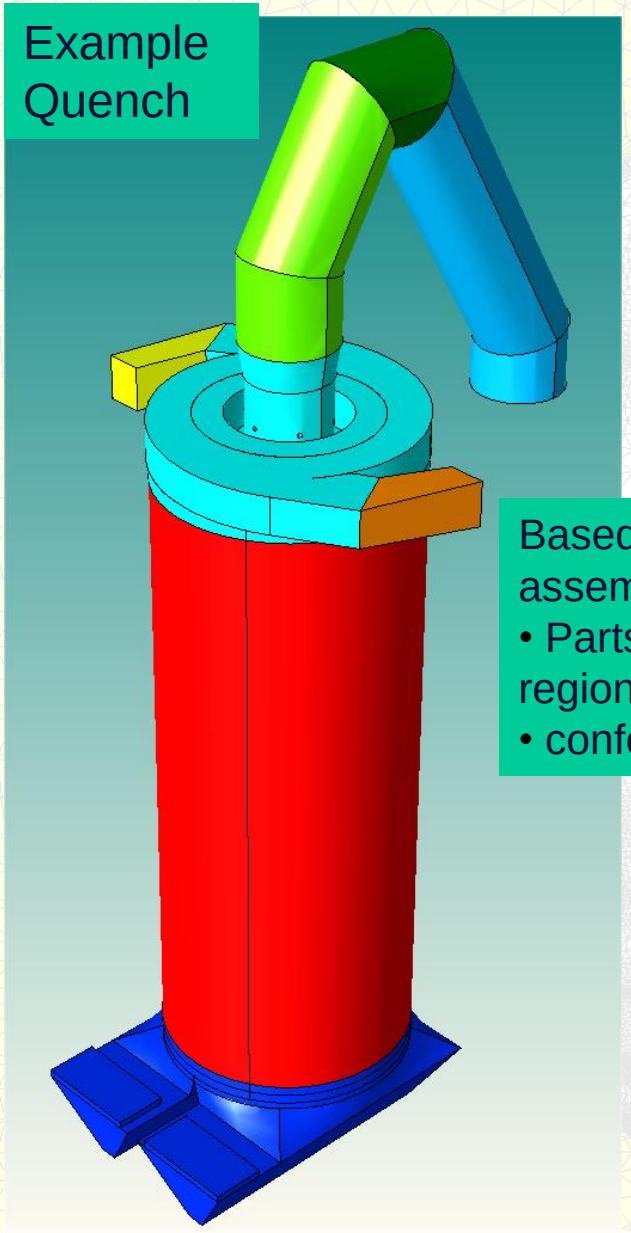
Mesh cases 20-30 Mio Cells

Chemical Engineering

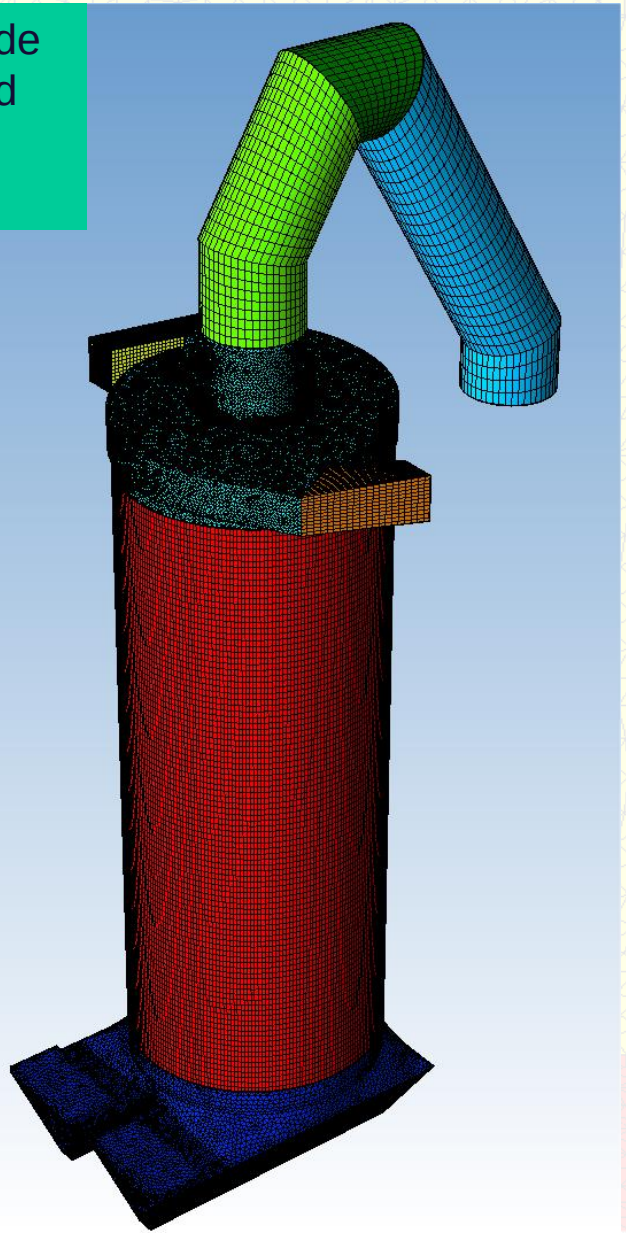


CastNet-Meshing

Example Quench



Usage of extrude regions to avoid tetrahedral elements



Based on Parasolid-assembly:

- Parts are transferred into regions
- conformal mesh transition

CastNet-Meshing

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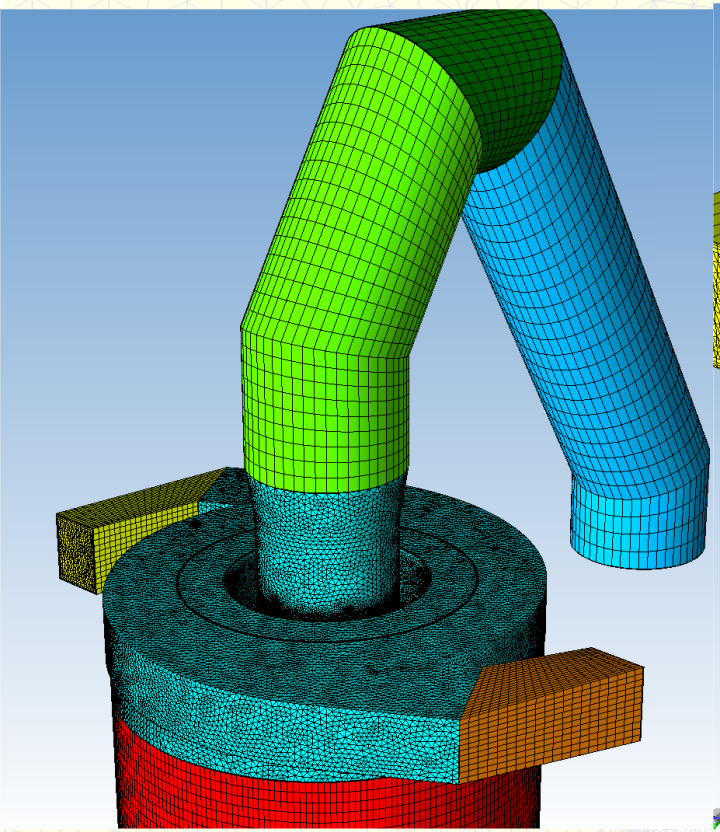
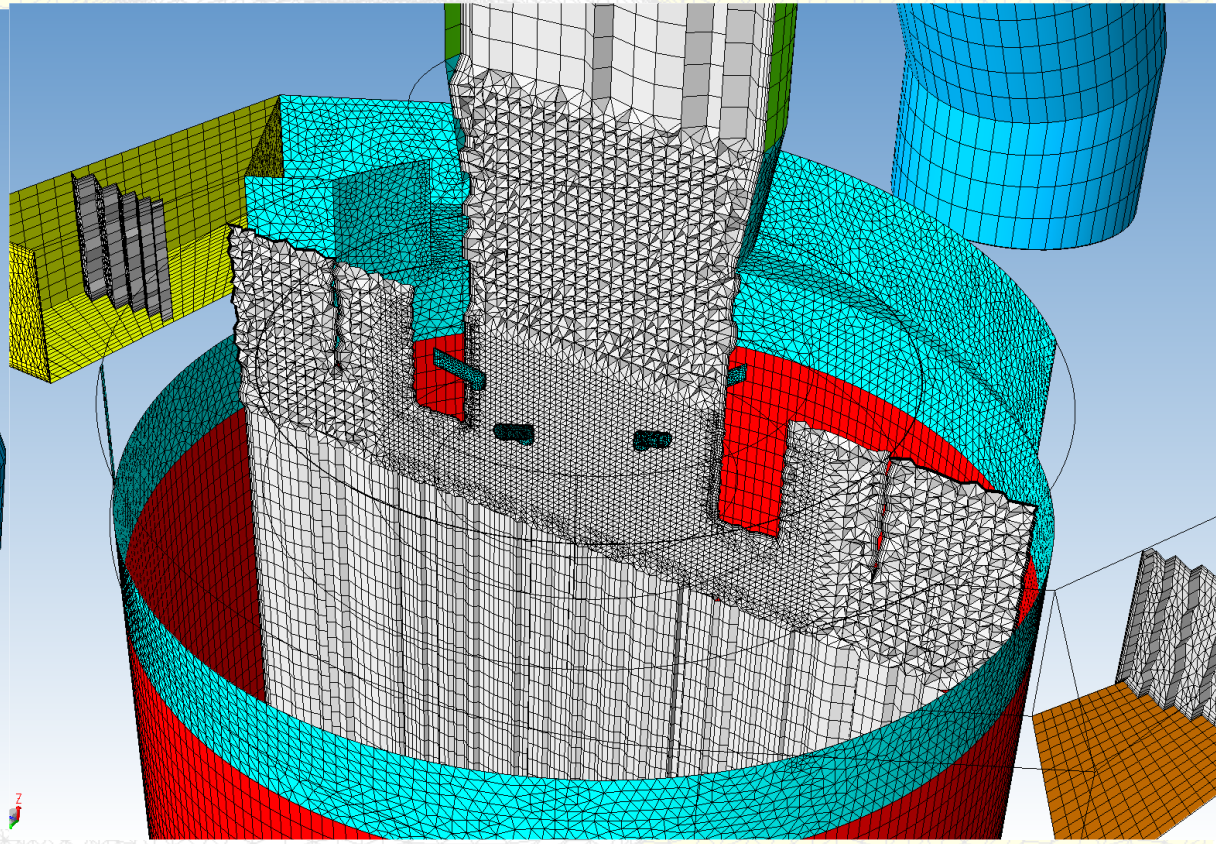
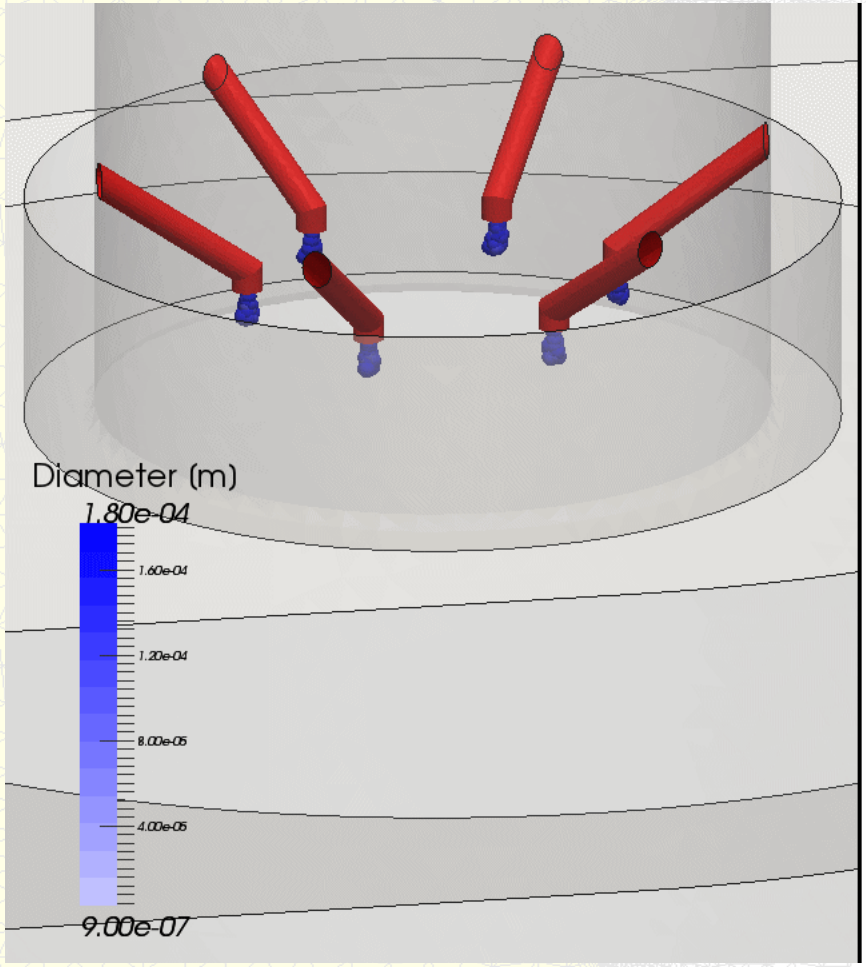
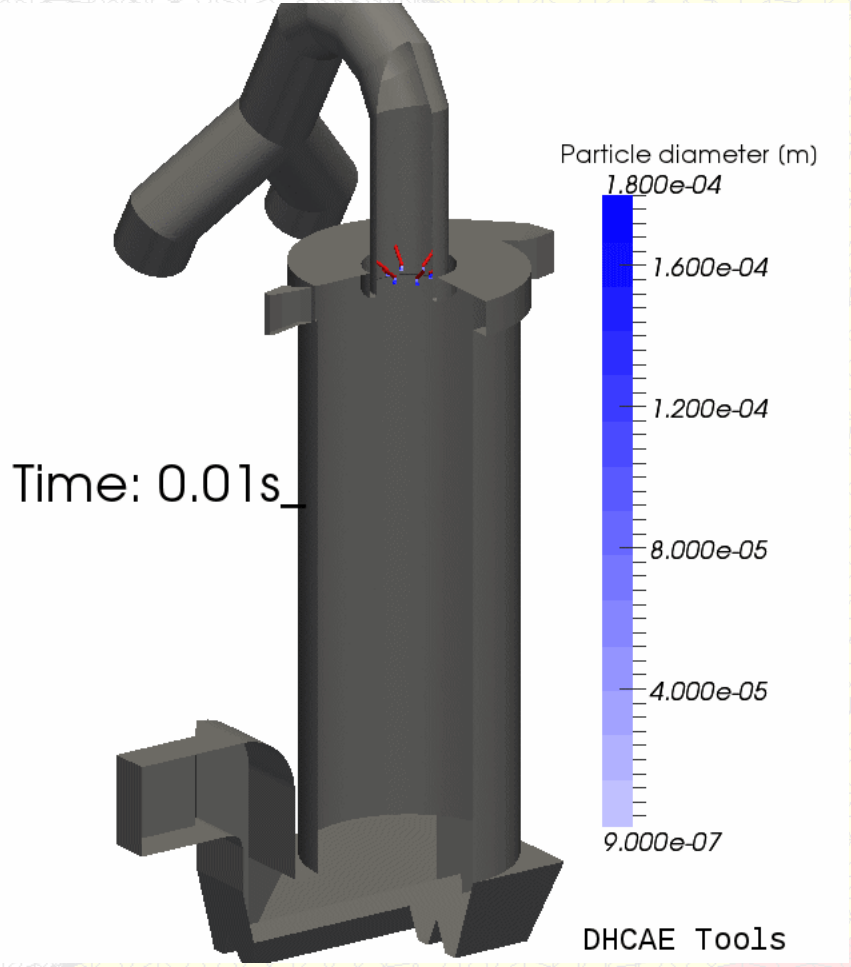




Boundary Layer from extrude to free mesh regions


Diameter (m)
1.80e-04
1.60e-04
1.20e-04
8.00e-05
4.00e-05
9.00e-07


Time: 0.01s
Particle diameter (m)
1.800e-04
1.600e-04
1.200e-04
8.000e-05
4.000e-05
9.000e-07
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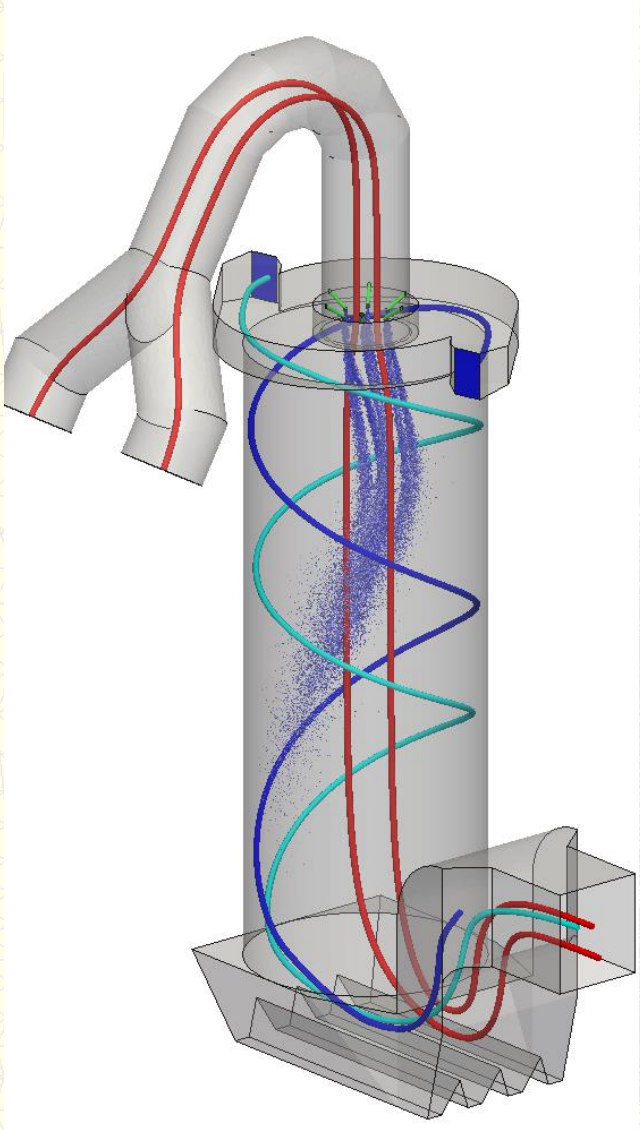
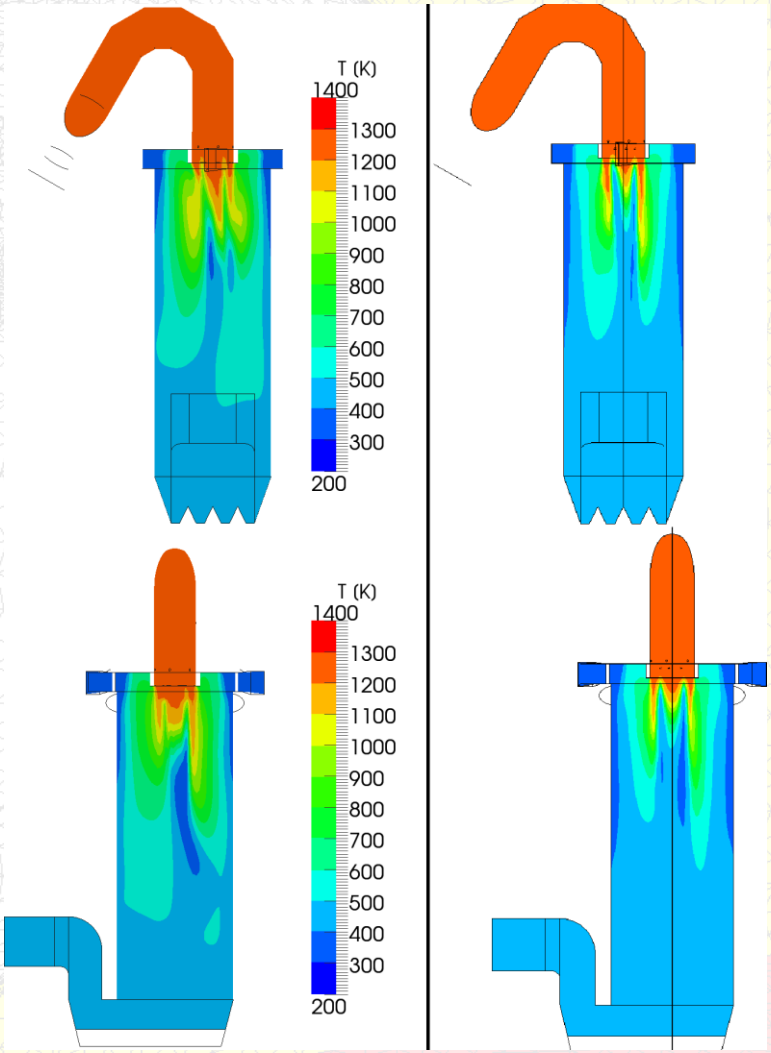
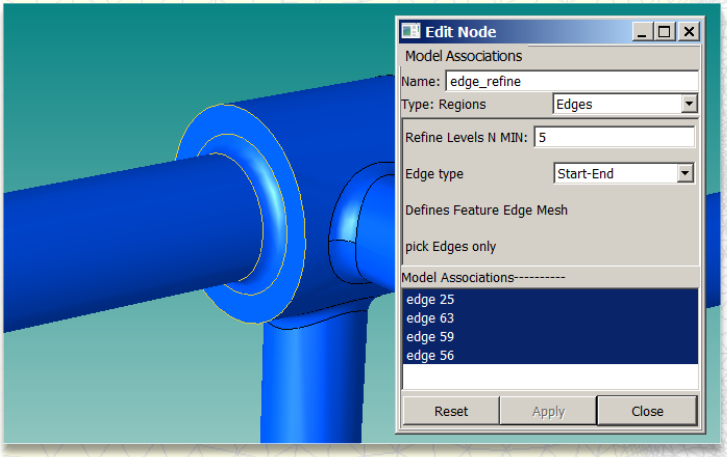
Temperature distribution

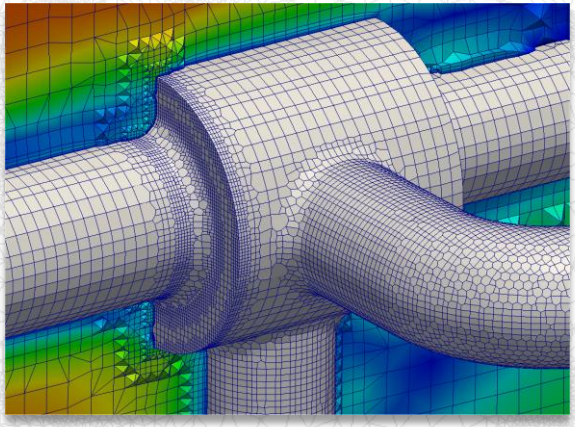


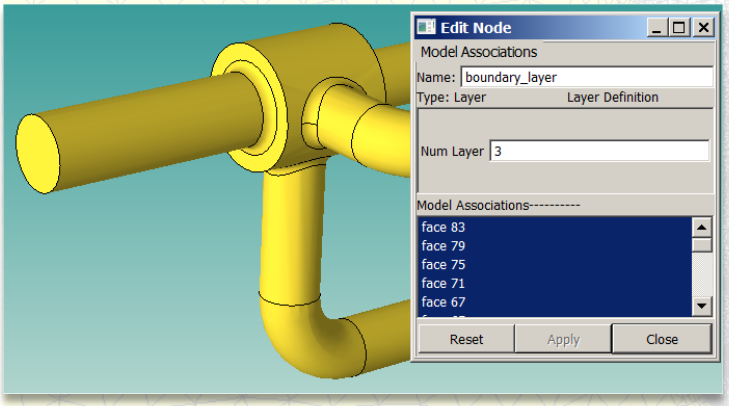


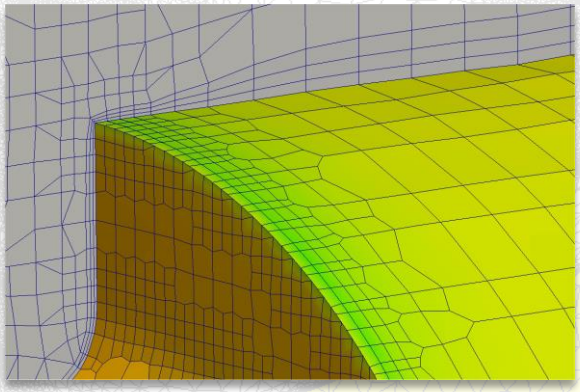
SnappyHex-Mesh Support

OpenFOAM internal Mesher: Hex-dominated Polyhedral Cells
CAD model based SHM setup





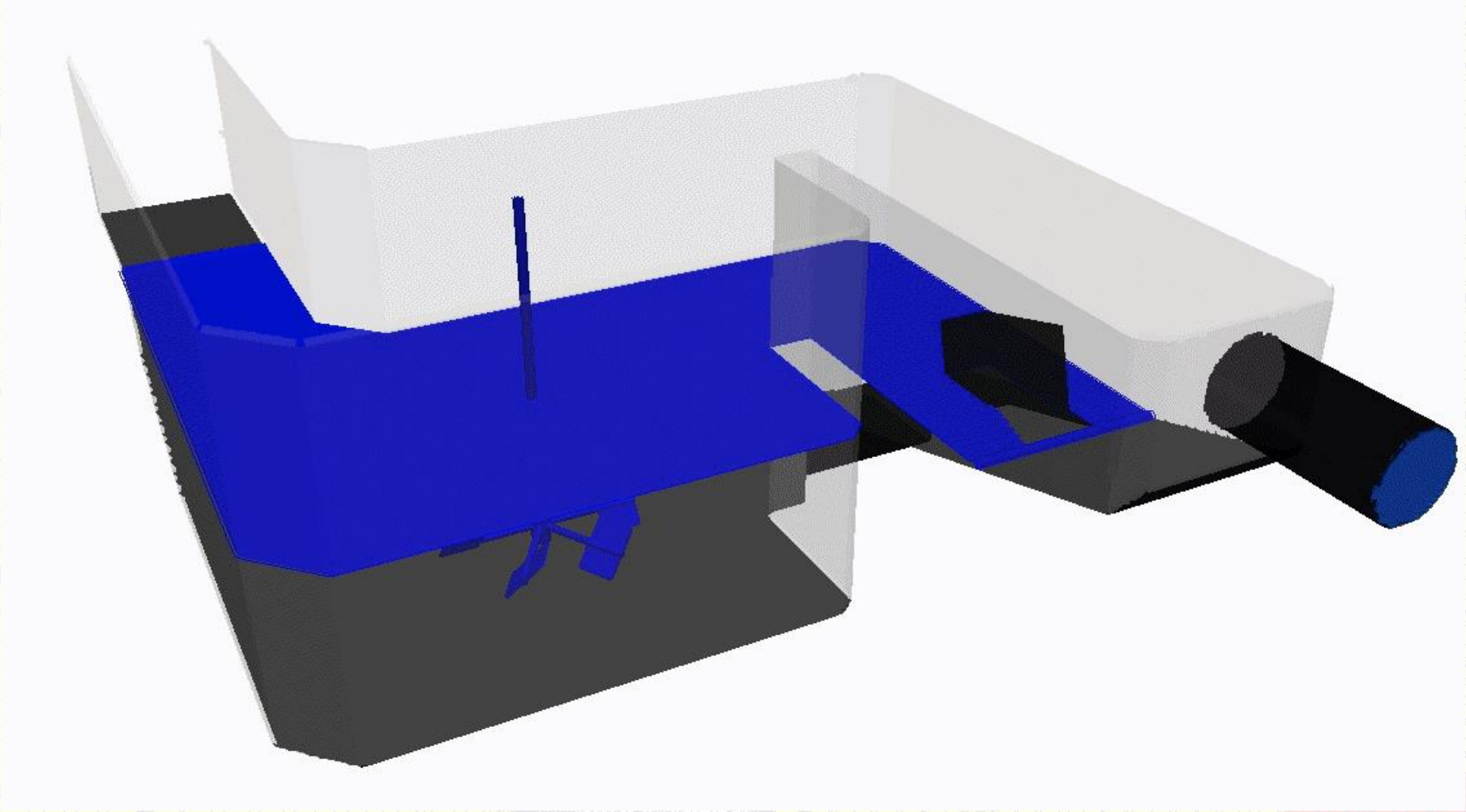




- Region support (e.g. porous or MRF) based on CAD geometry
- AMI support for sliding meshes
- Local initial conditions for CAD regions
- Manual or automated feature edges
- CAD related edge refinement
- CAD model related face refinement
- Volume region refinement with primitive geometry or CAD regions
- Boundary layer meshing

…

VOF



Transient particle transport in steady flow

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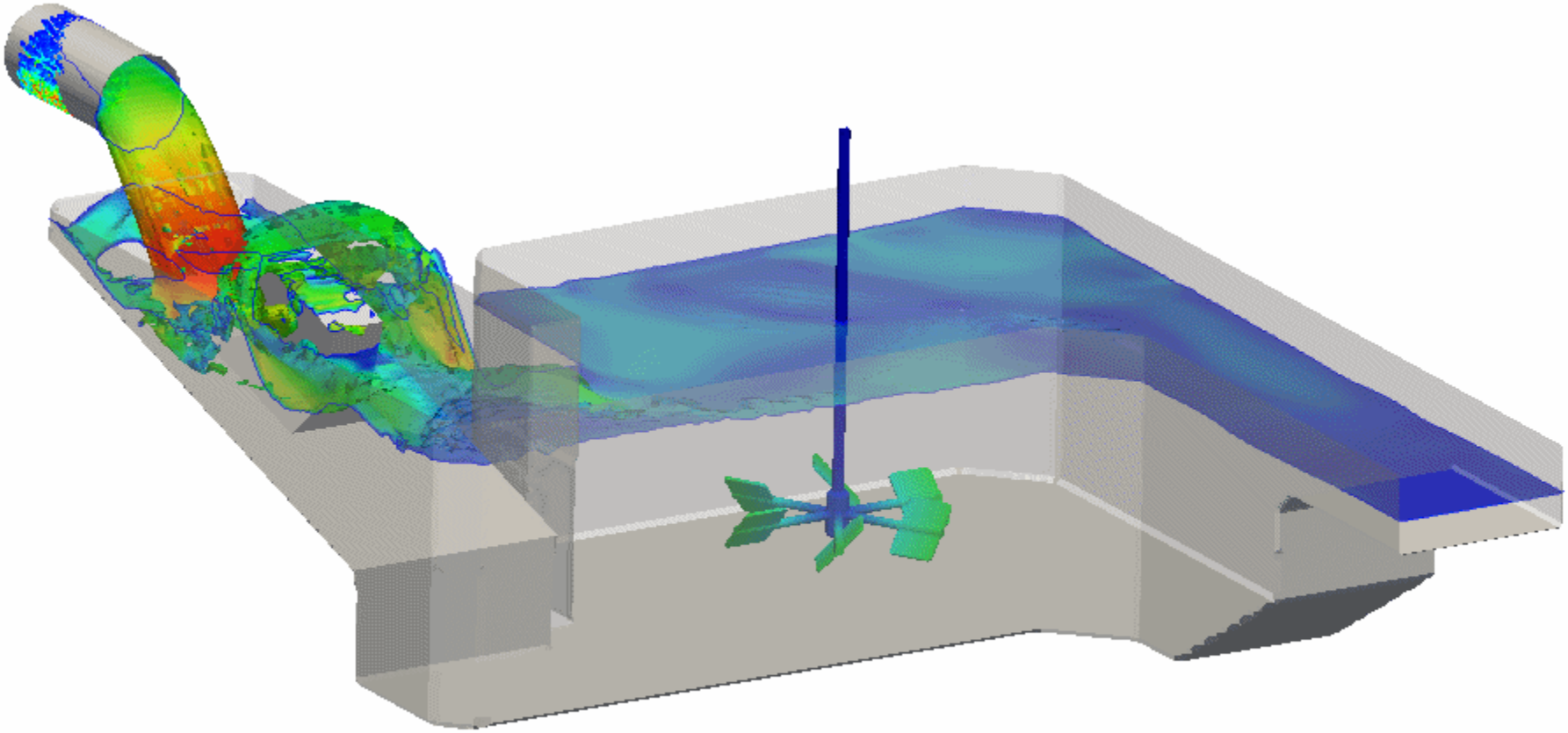

performed by DHCAE

DHCAE Tools

CastNet : Complete GUI based workflow of

OpenFOAM allowing a flexible usage:

- CAD model based case setup
- CFD meshing
- solving
- graphical job control and
- post processing.

Demonstration: Please visit our booth!

For complex physics and complex geometry

In the Gompute environment or stand-alone