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CastNet and OpenFOAM® in chemical plant engineering applications

Challenges in chemical plant engineering

Workflow

Customization for on-site usage

Sixth OpenFOAM Workshop
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The Pennsylvania State University, USA

DHCAE Tools UG

DHCAE Tools:

- Engineering company in Krefeld, Germany
- Engineering projects and software development (CastNet)

CFD for in house usage:

- Service: Close cooperation: E.g. base model setup by DHCAE Tools, further runs and modifications done by customer

- Many customers: Chemical plant engineering

  Typical application:

  - Absorbers for droplets
  - Absorbers for dust

- Basic needs for CFD at customer site:

  Low Cost, time effective, reliable, easy to use

GUI based OpenFOAM solutions

For more information please visit: www.dhcae-tools.com

CFD Usage

DHCAE Tools

Chemical plant engineering projects:

Purpose for CFD analysis:

- To judge if something will work or not
- To localize areas where damage may occur
- To optimize from “bad” design to “reasonable” design (e.g. pressure losses)

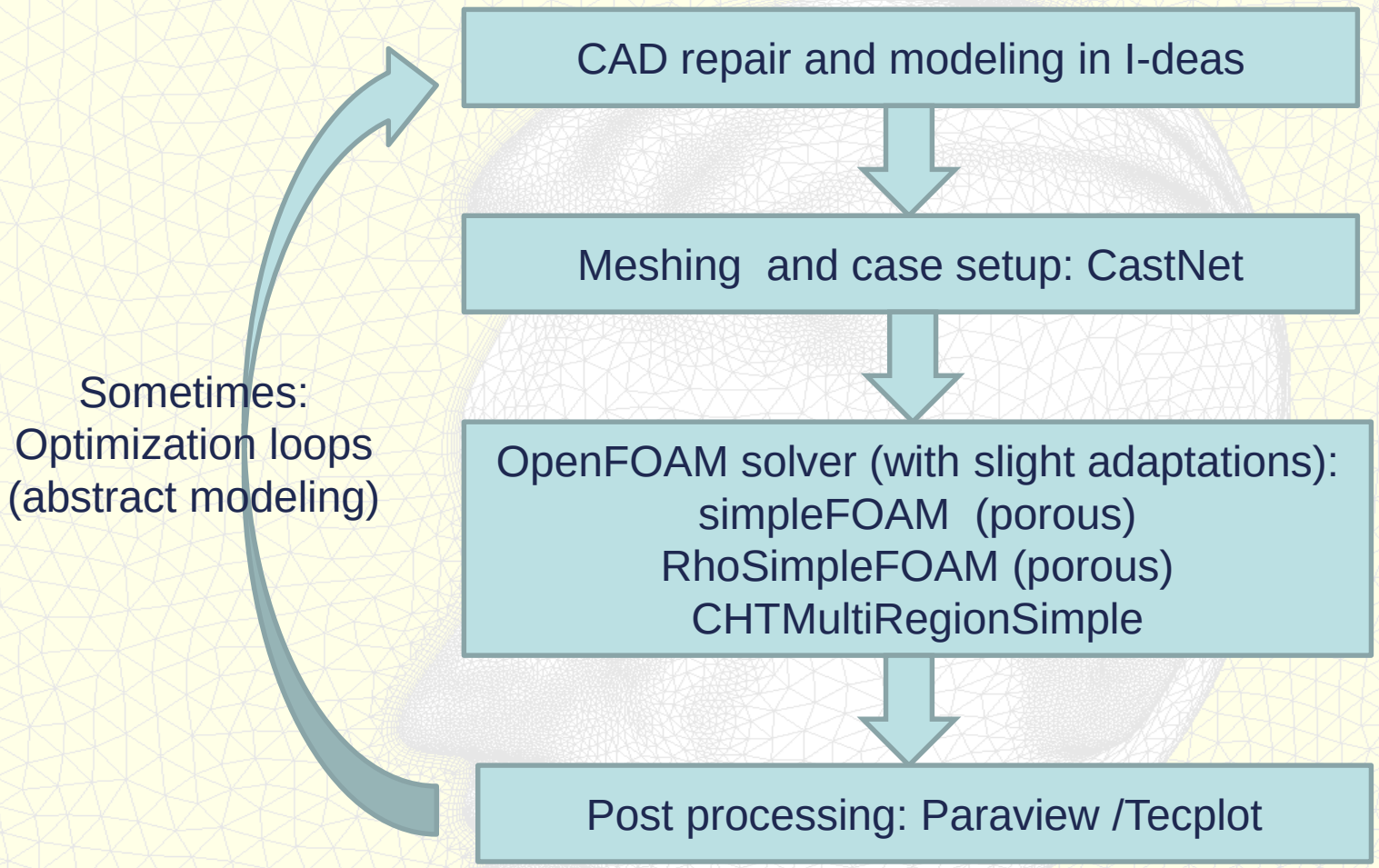
Different from other CFD usages e.g. automotive, turbo machinery

Design optimization means:

- Larger design changes possible (e.g. inflow or tube modifications)
- Insertion of flow redirectors (baffle faces) to guide the flow
- Insertion of flow resistance (e.g. perforated plates) for more uniform flows

Workflow

DHCAE Tools

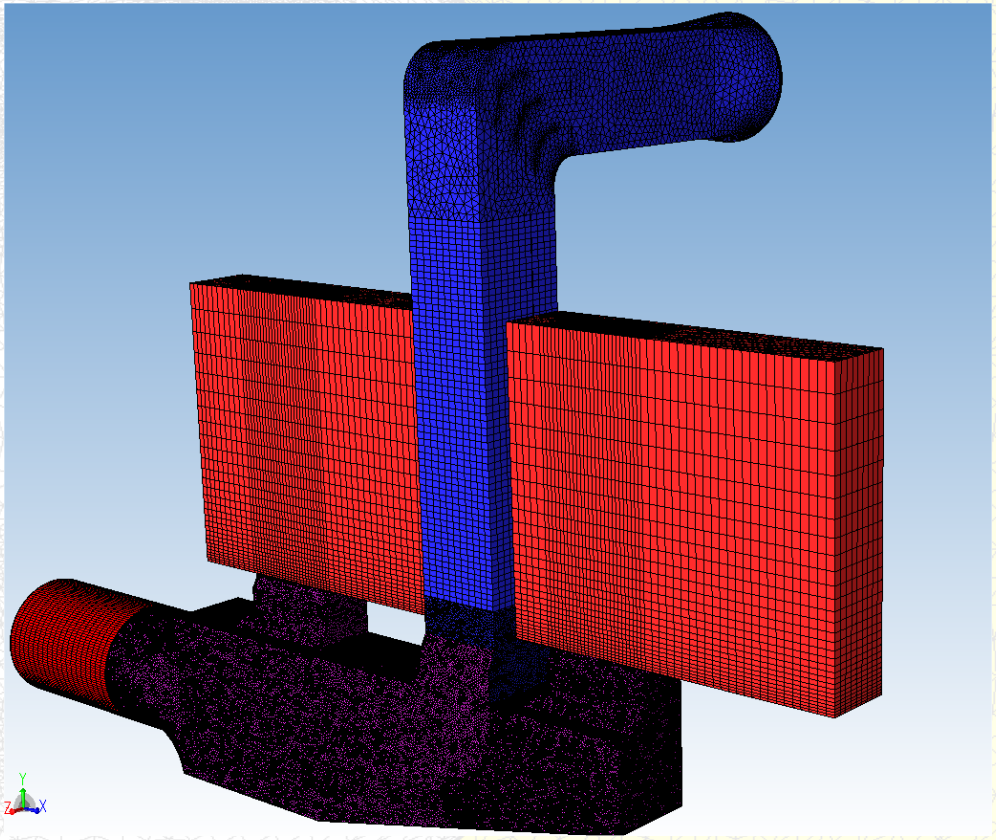


Example

DHCAE Tools

Major challenges:

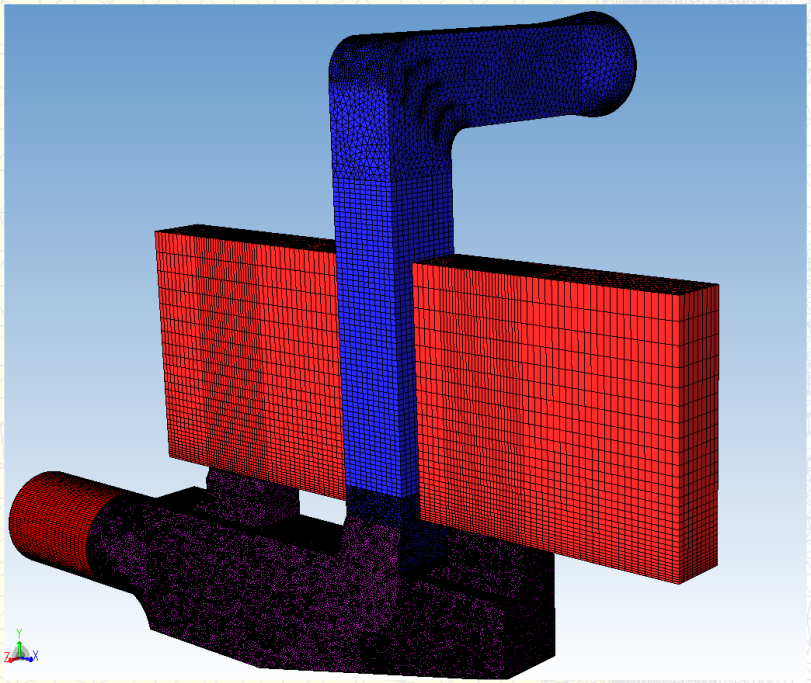
- Time: CFD-model setup and improvement of component in 1-2 weeks (from CAD to results)
- Reliable CFD: Components have to be built without a prototype
- Transferable: Customer will often go on with CFD analysis

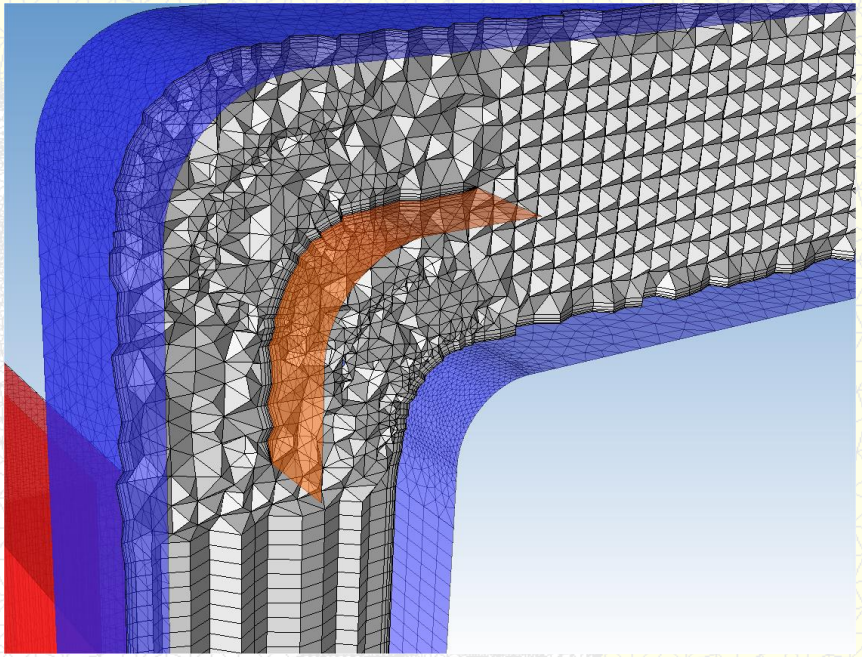


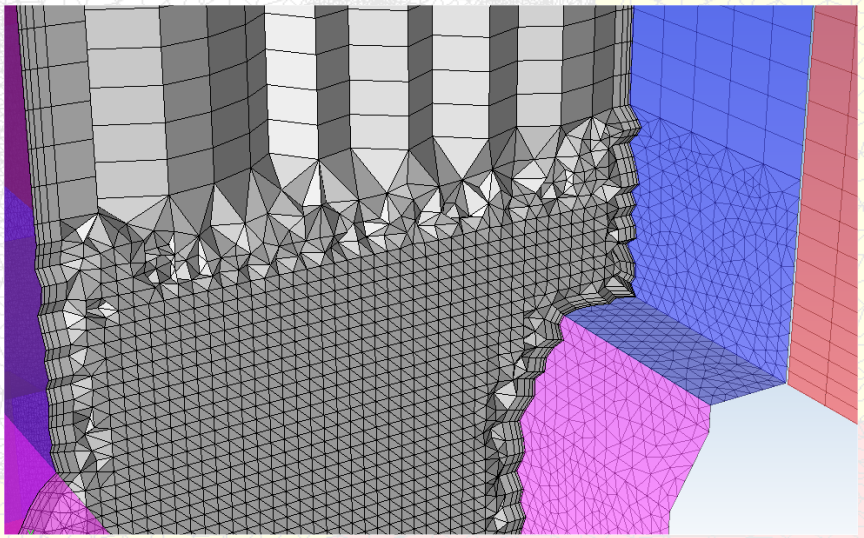
CastNet CAD input and meshing

DHCAE Tools

Effective and fast model generation
(less than one day)
CAD-model based
Reliable CFD-meshing



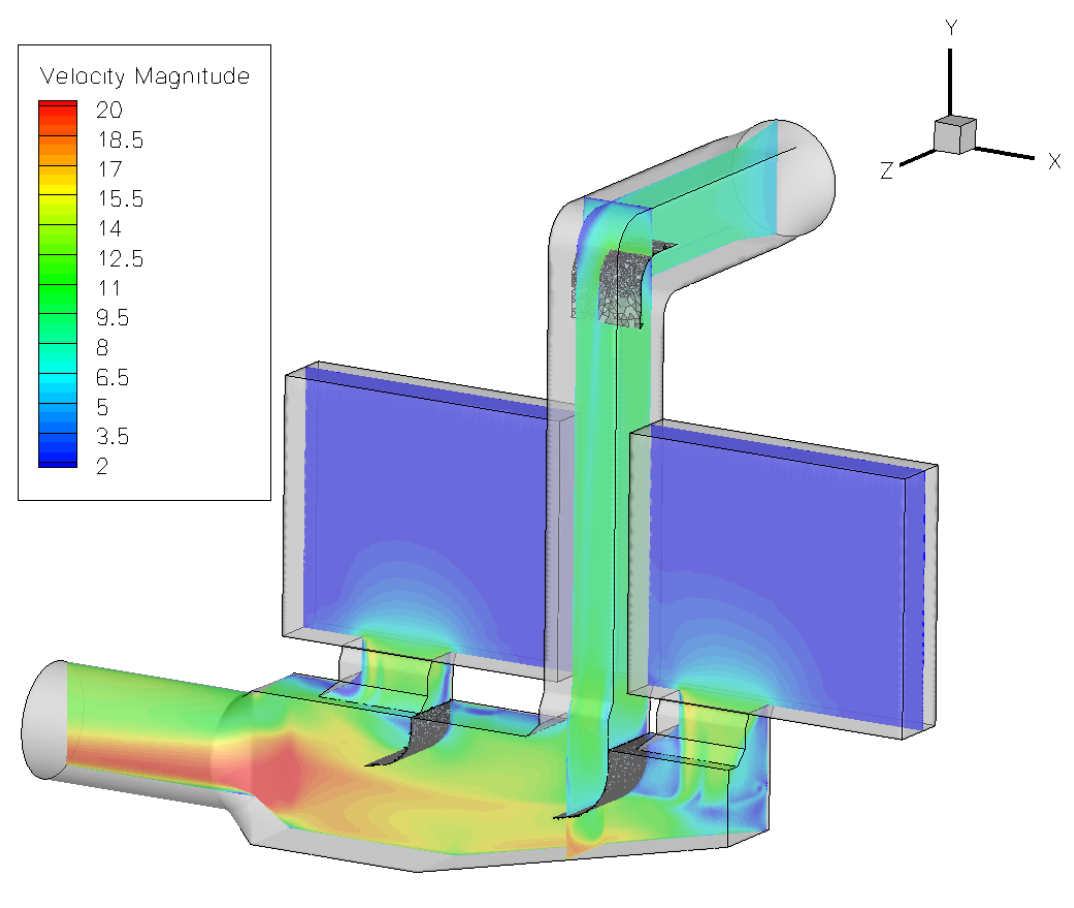




Solving

DHCAE Tools

- Solving with simpleFOAM (steady state SIMPLE solver with linearUpwind for momentum, mesh study (mapFields))
- Post processing/Optimizations

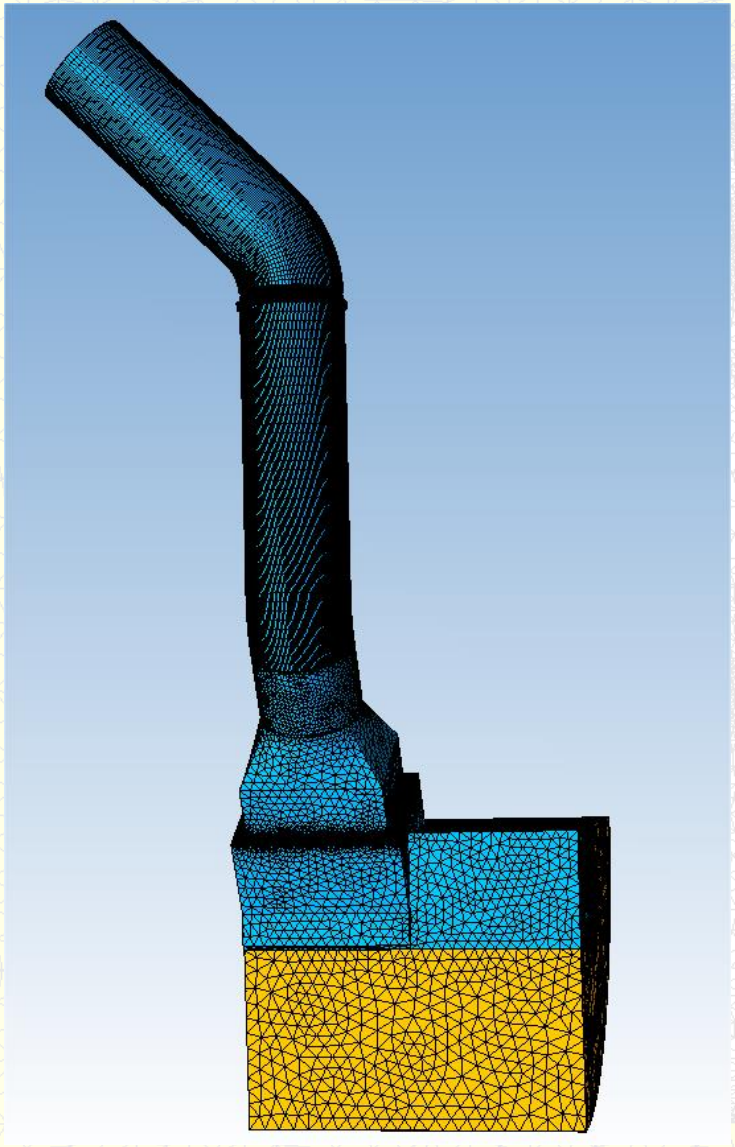


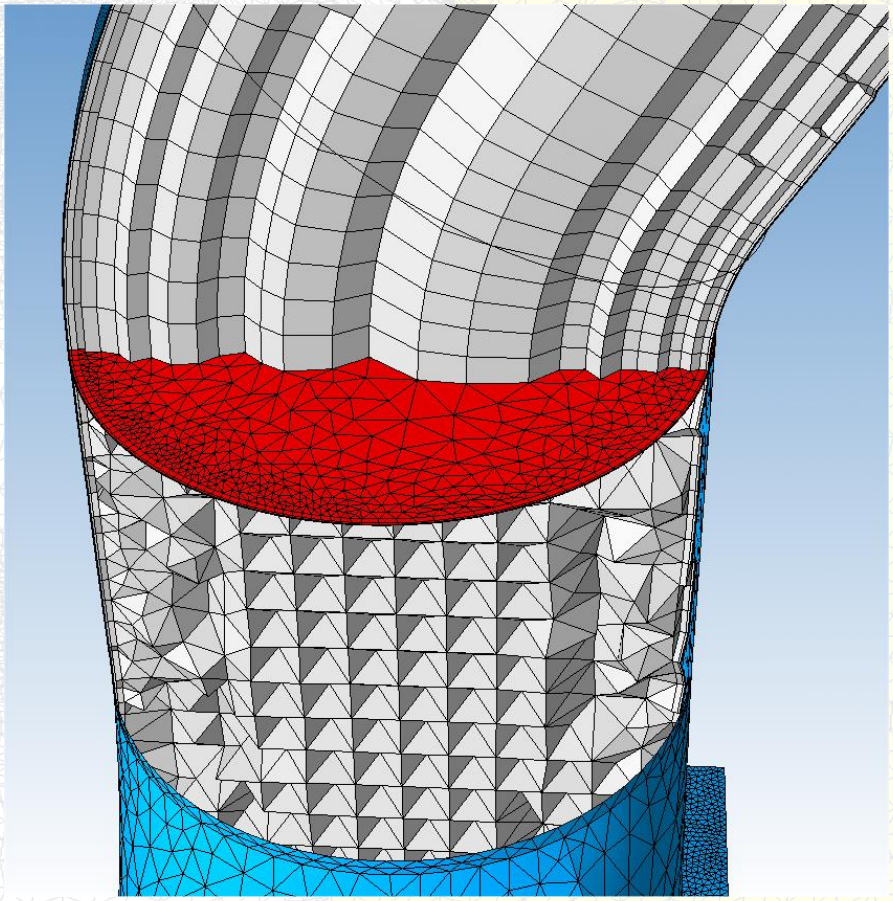
Improvements:

- Already prepared in first case
- Or usage of abstract modeling

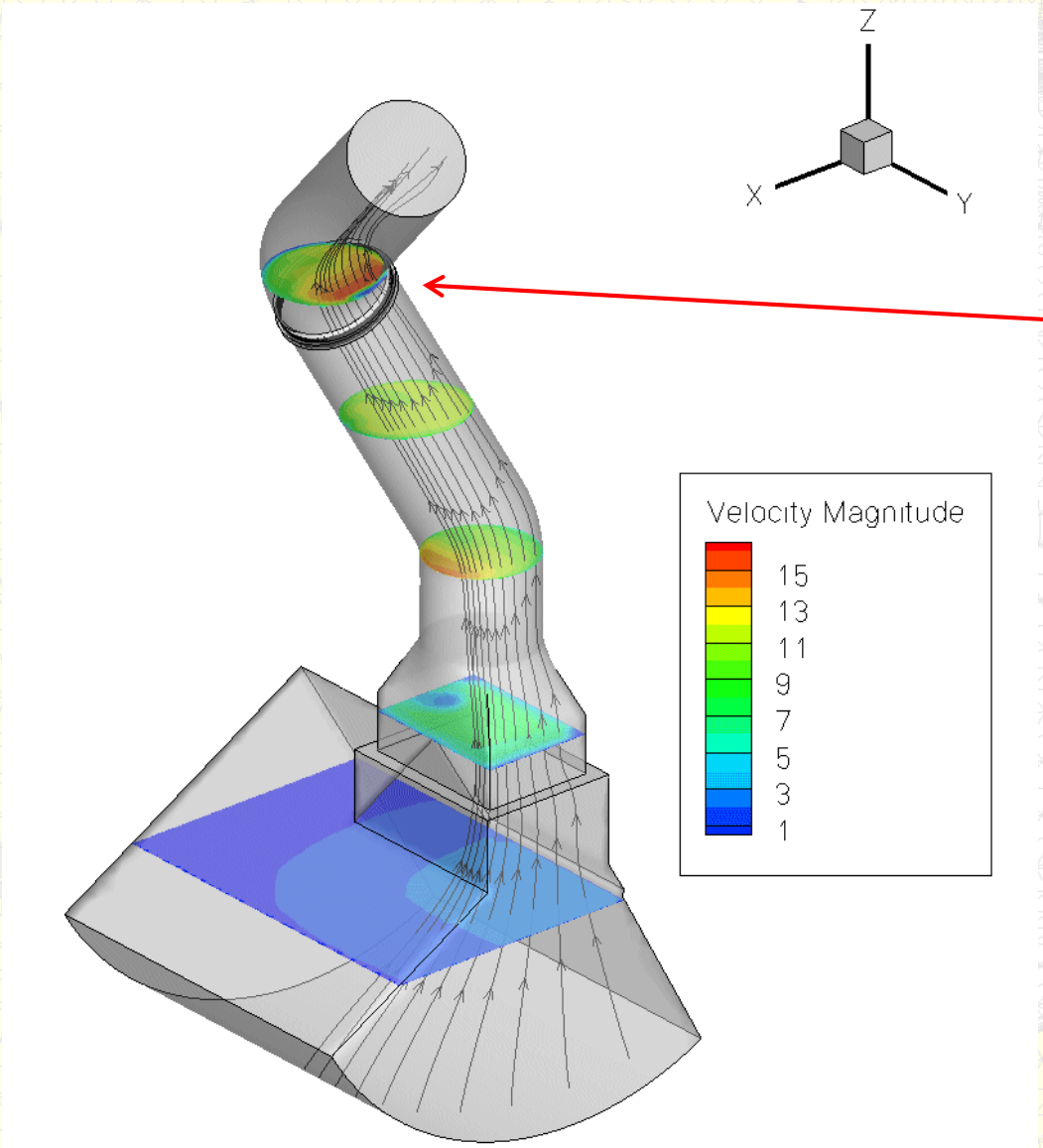
Example 2

DHCAE Tools





Solving



Flow separation causing problems in compensator

CFD onsite usage

DHCAE Tools

CFD engineers on-site:

- No OpenFOAM experts
- No Linux experts
- Used to work with GUIs

Meshing and case setup: CastNet (GUI based)

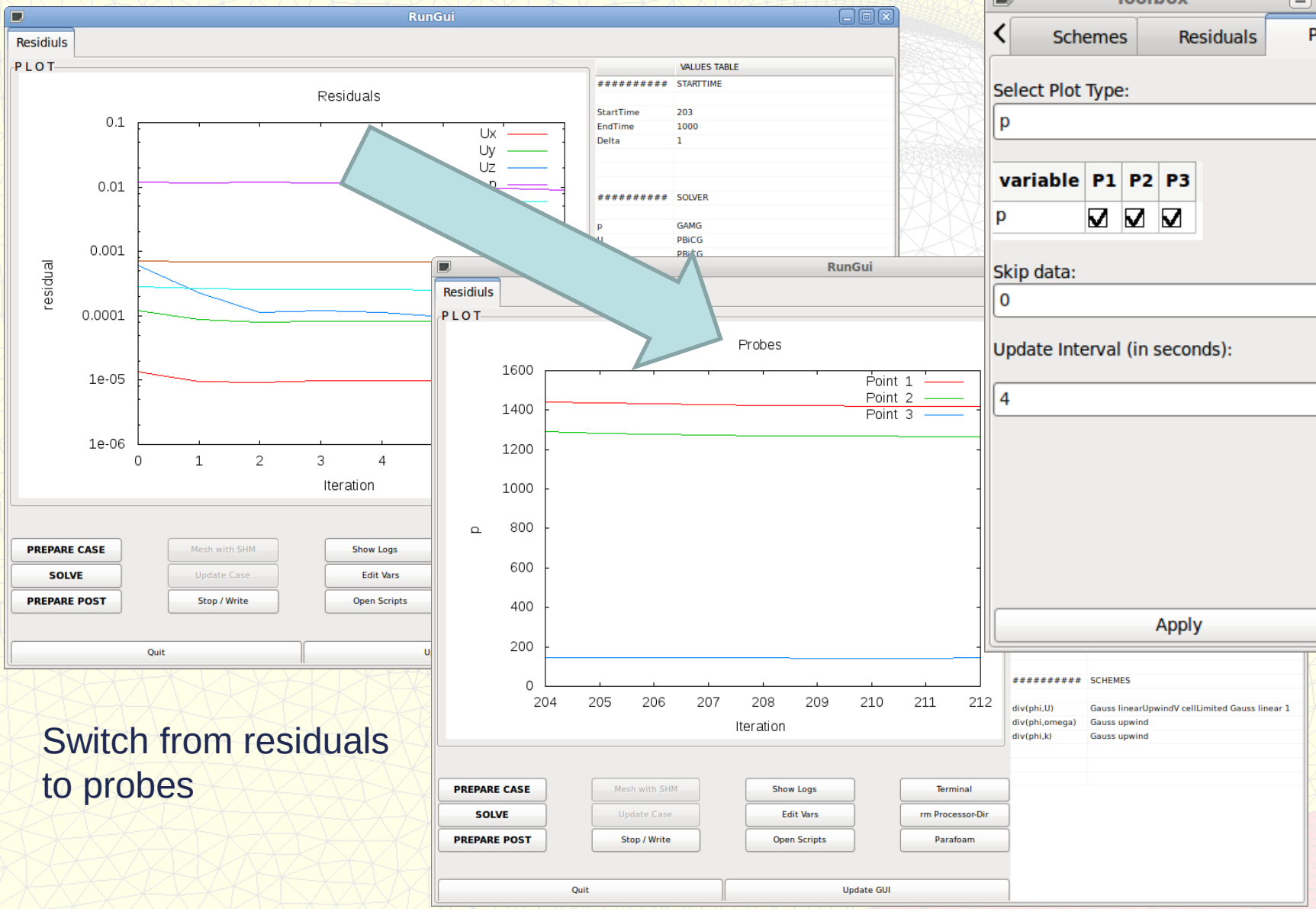
Solution: GUI to run the case:

- Important: Visual result control: Residuals and even more important probes
- Why GUIs?

  Our experience: OpenFOAM feature (e.g. probes) will not be used if there is no

  - possibility of an easy definition
  - graphical visualization

Rungui example 1



Switch from residuals to probes

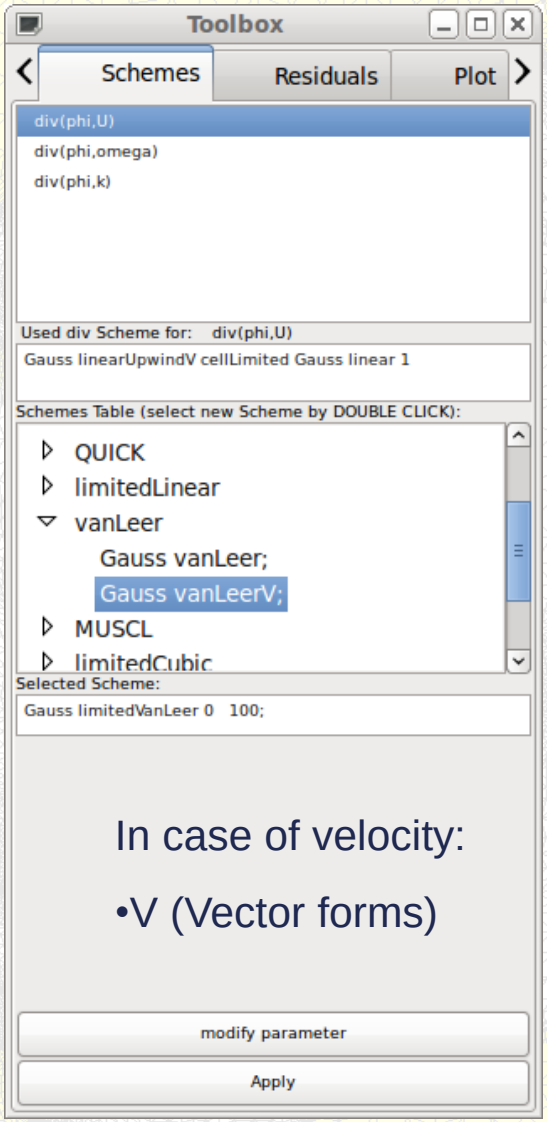
Rungui example 2

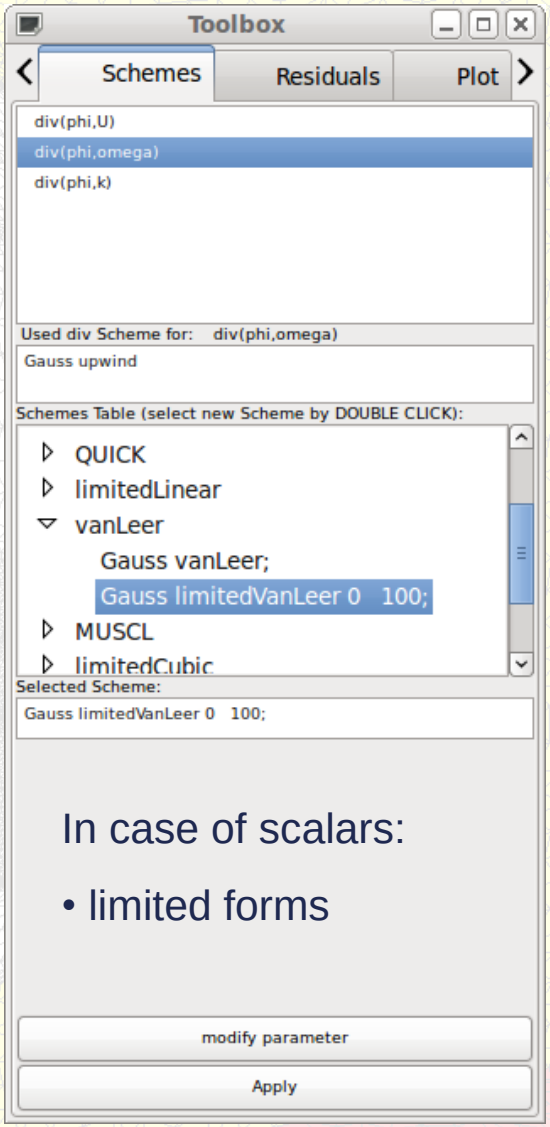
DHCAE Tools

Switching to higher order schemes after some iterations

Which schemes can be used?

GUI shows possible schemes





Conclusion

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OpenFOAM can substitute commercial CFD systems

- Not only license costs but also strong features
  - Very good integration into workflow
  - Very strong solution capabilities

Additional GUIs may help:

- Make use of the OpenFOAM capabilities
- More reliable job control resulting in more accurate results
- Time effective case setup and control

Future Goals:

- Stronger support of the extend-version in CastNet
- Provide GUIs to OpenFOAM community if possible (may need some adaptations)