Experience of Substitution of commercial CAD, CAE Software Components with freeware Analogues

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Substitution of commercial software components with freeware analogues is not simple task

Reasons for substitution:

Administrative

imposing restrictions on the use of proprietary software by sanctions, import substitution, sending "usage reports" by proprietary software via the network to the servers of the rights holder, which is undesirable for companies

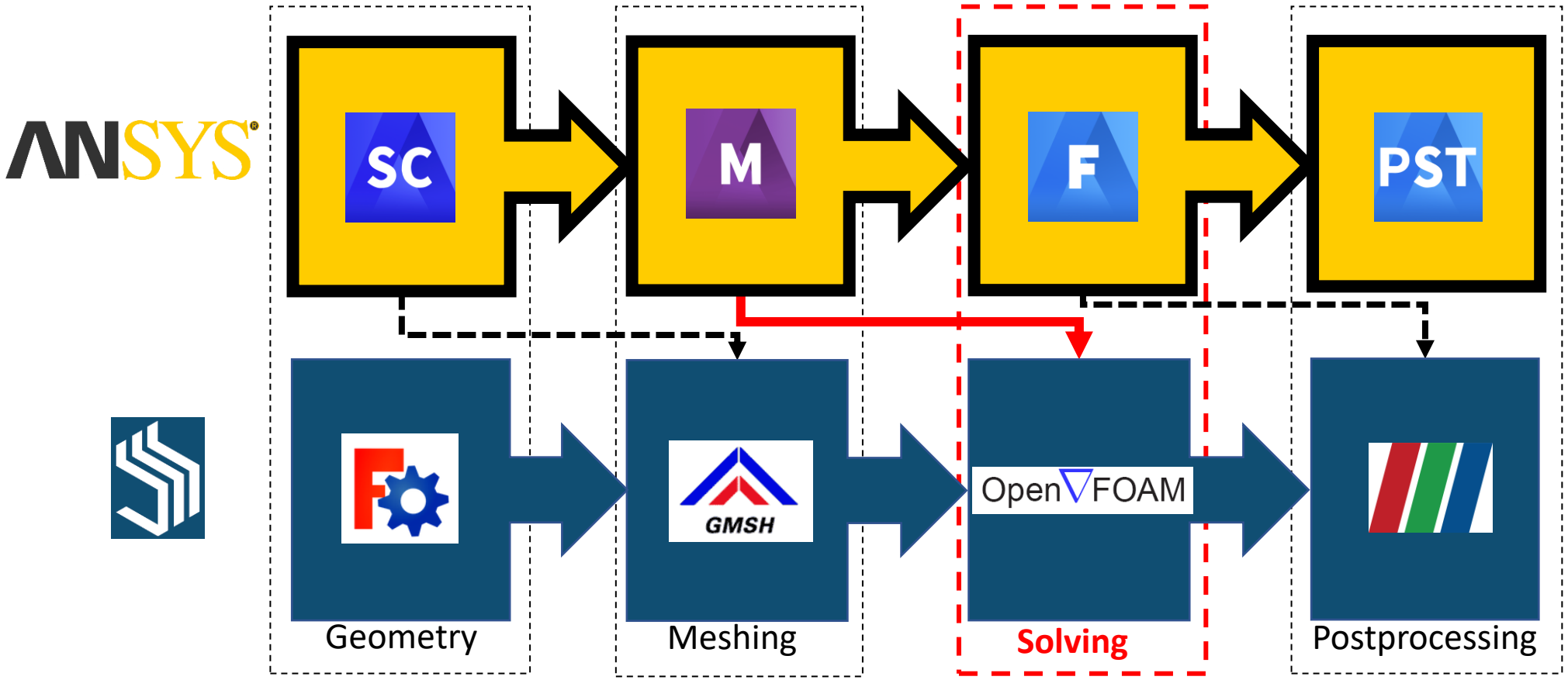
Financial

proprietary software licences are very expensive, and paralleling into a cluster involves the additional purchase of a package of separate licences

Difficulties

- **Poor compatibility between proprietary and freeware.**
- **Juridical restrictions.** Customisation of proprietary software often relies on data structures. Usually, the right holder extends intellectual property to one as well. However, it is not prohibited to make such projects in the enterprise, gradually replacing or supplementing the proprietary software with free software.
- **Weaker free software GUI** compared to proprietary software.
- Employees in the company usually already have their own proprietary software in place and have received appropriate training; **additional training is required to switch to free software.**

CAD/CAE Workbench



ANSYS

SC SpaceClaim

M Meshing

F FLUENT

PST CFD Post

WB Workbench

blueCFD-Core Project

FreeCAD

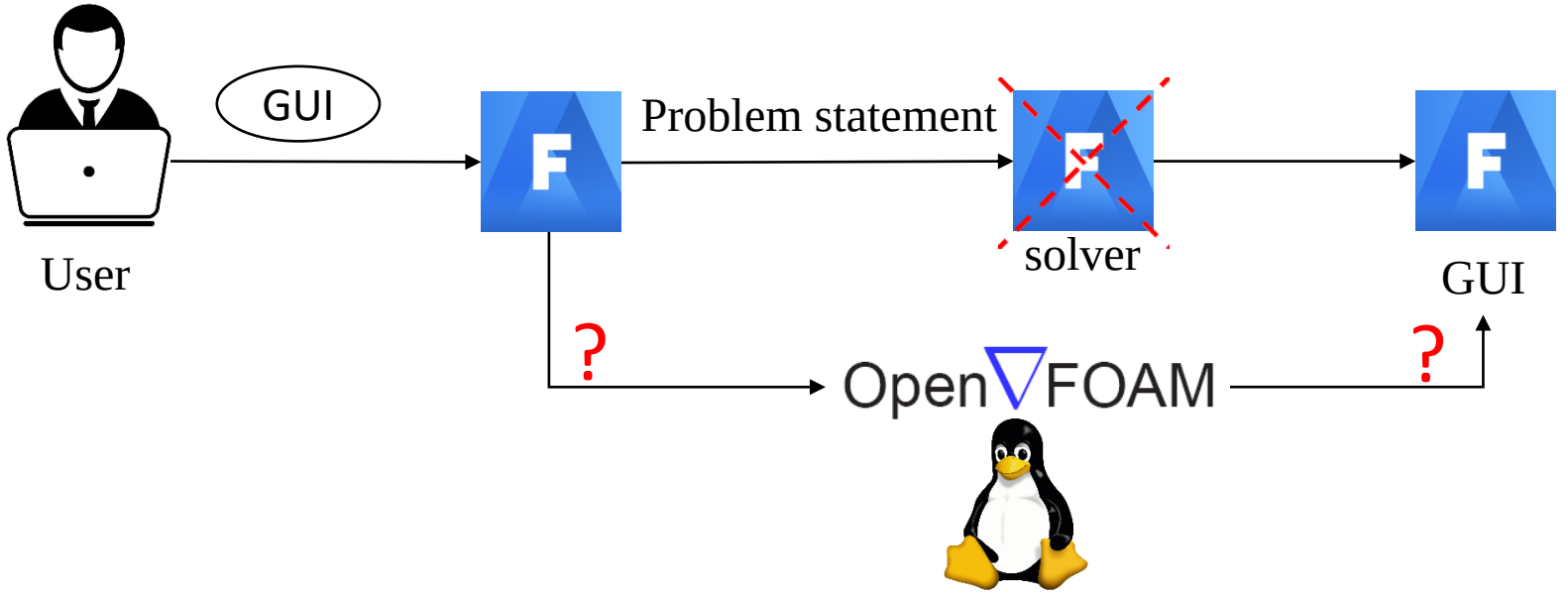
OpenFOAM

GMSH Meshing

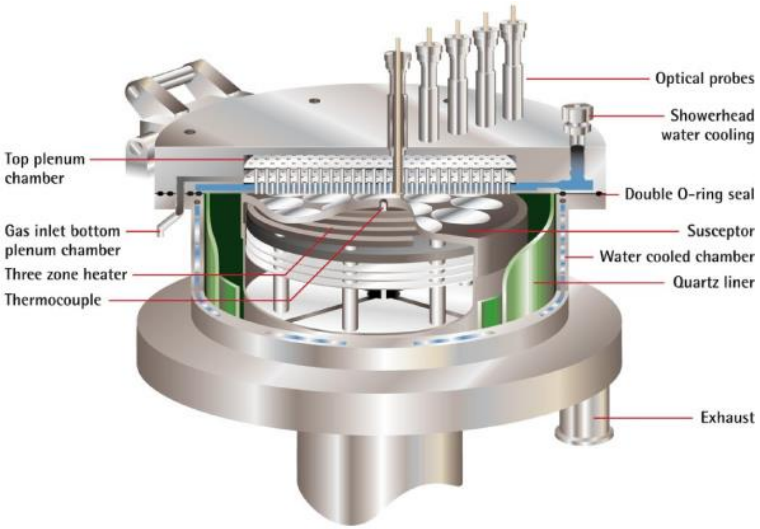
ParaView

Task definition

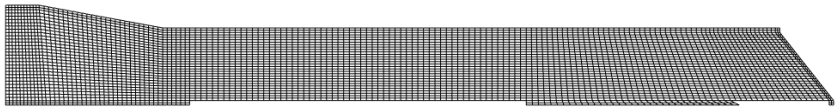
The task is to tune simulation in Fluent, convert it for OpenFOAM, calculate and convert the data for viewing in Fluent.

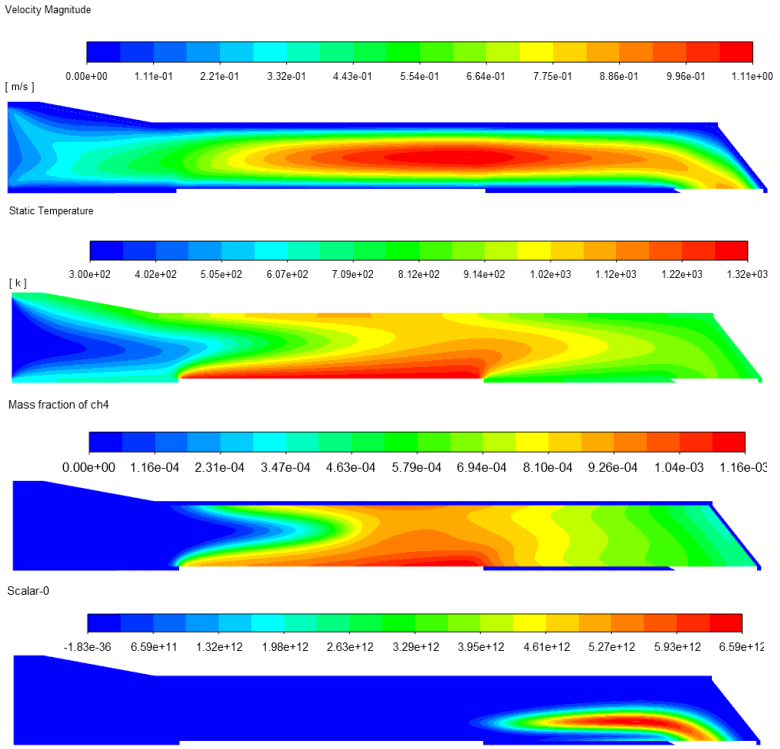


Task definition



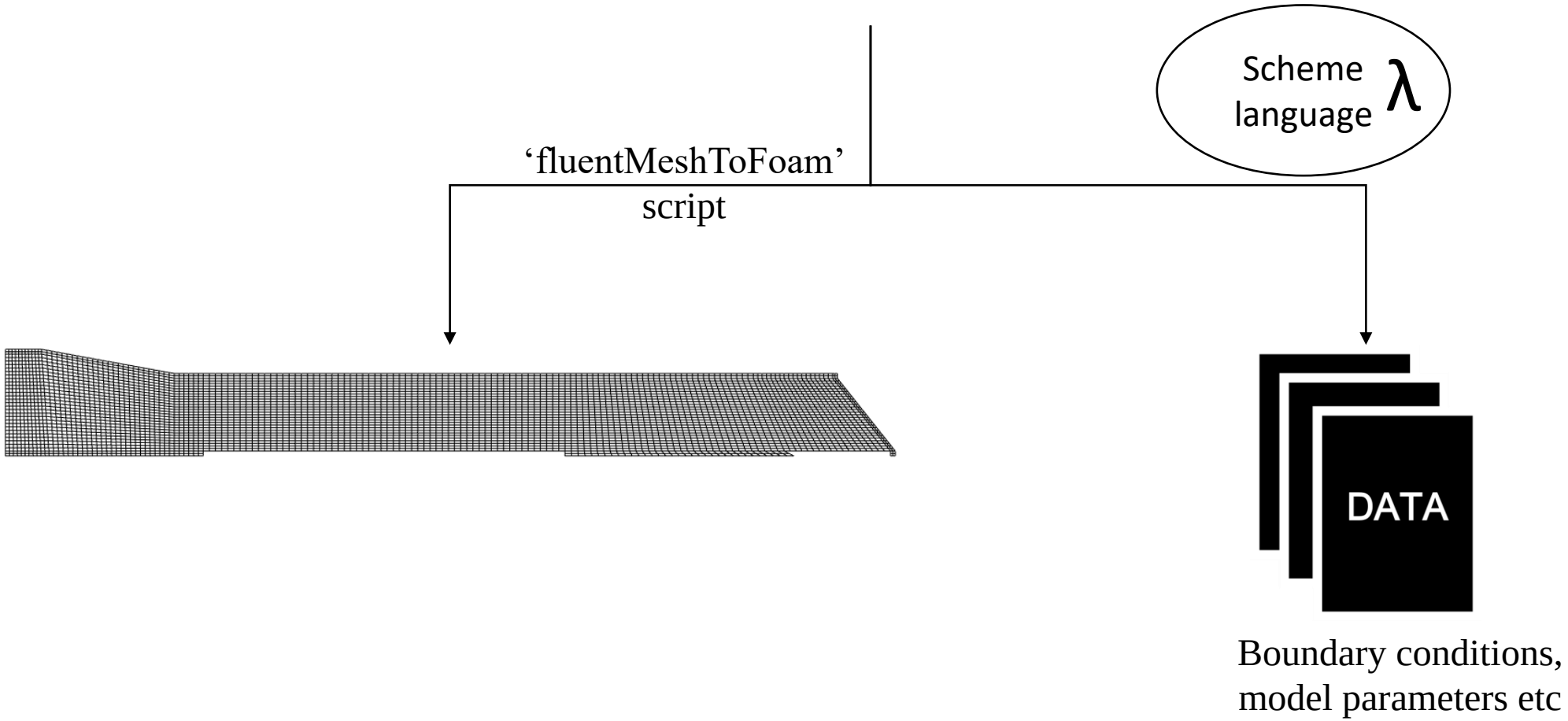
*Pierre Gibart: Metal organic vapour phase epitaxy of GaN and lateral overgrowth





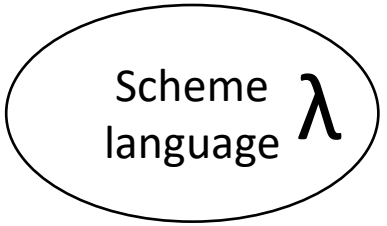
Simulation of flow of chemically reactive gas mixture in a reactor with crystal deposition from gas phase is considered.

Fluent-OpenFOAM problem conversion



Basics of working with scripts for Fluent

- The internal language of Fluent GUI is the Scheme language. It gives acess
- to simulation parametres
- to the primitive variables:

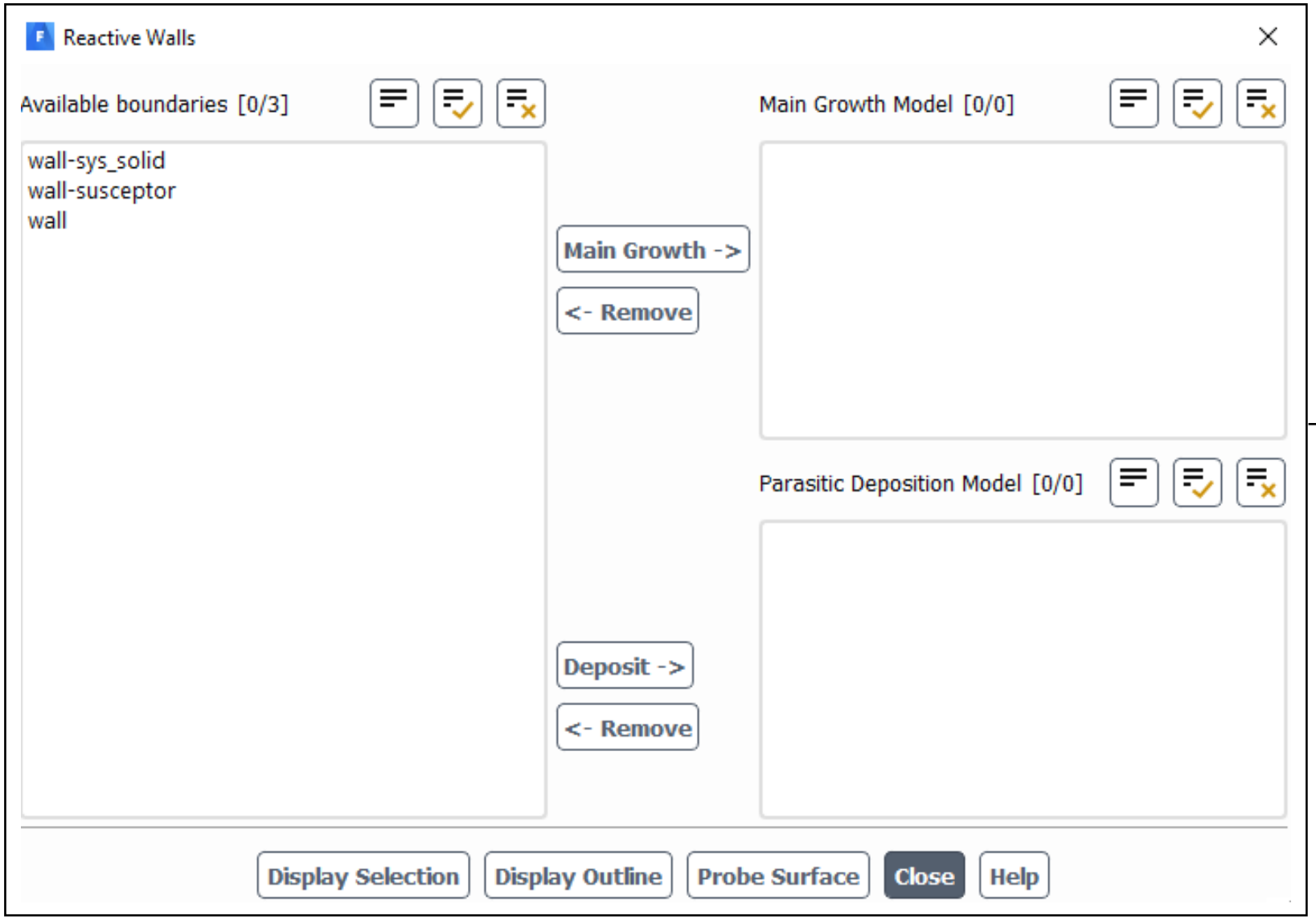



```
> (rpgetvar 'number-of-iterations)
100000
```

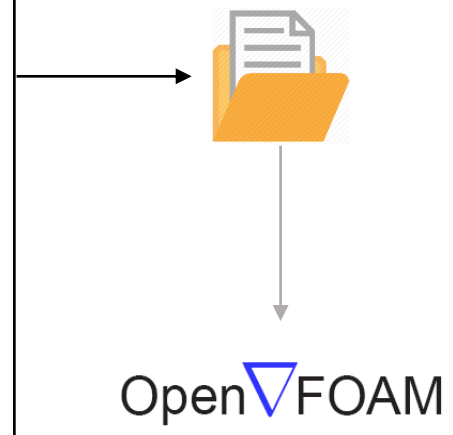
- and to so called ‘thread variables’ that provide complete information about the simulation:

```
> (get-thread-vars (%get-thread-by-name 'inlet))
((les-spec . 0) (mixing-plane-thread? . #f) (uds ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0)
(profile  )) ((constant . 0) (profile  ))) (uds-bc 1 1 1 1) (mf ((constant . 0.0236261) (profile  )) ((constant . 0) (profile
)) ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0) (profile  ))
((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant
. 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0) (profile  )) ((constant . 0)
(profile  )) ((constant . 0.75109) (profile  ))) (species-in-mole-fractions? . #f) (t (constant . 373.15) (profile  )) (omega-
swirl . 0) (z-origin . 0) (y-origin . 0) (x-origin . 0) (ak . 0) (aj . 0) (ai . 1) (nk (constant . 0) (profile  )) (nj
(constant . 0) (profile  )) (ni (constant . 1) (profile  )) (w (constant . 0) (profile  )) (v (constant . 0) (profile  )) (u
(constant . 0) (profile  )) (p_sup (constant . 0) (profile  )) (vmag (constant . 0.4) (profile  )) (frame-of-reference . 0)
(velocity-spec . 2))
```

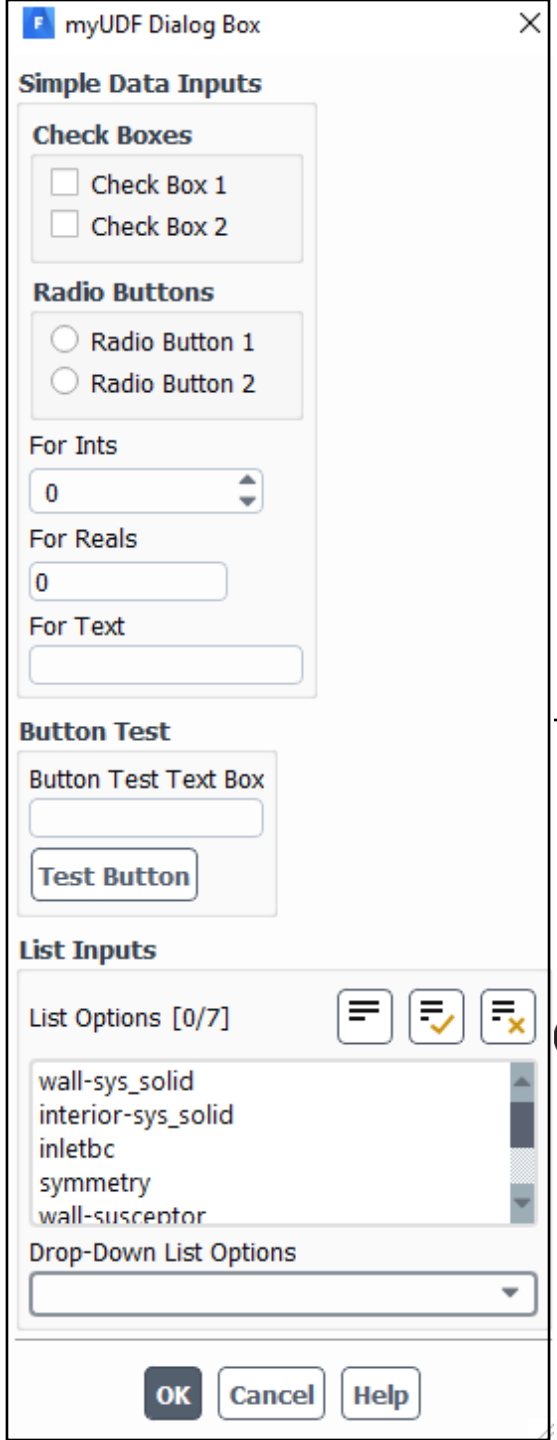
Examples of GUI customisation

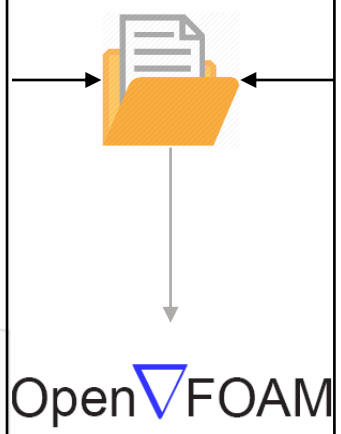


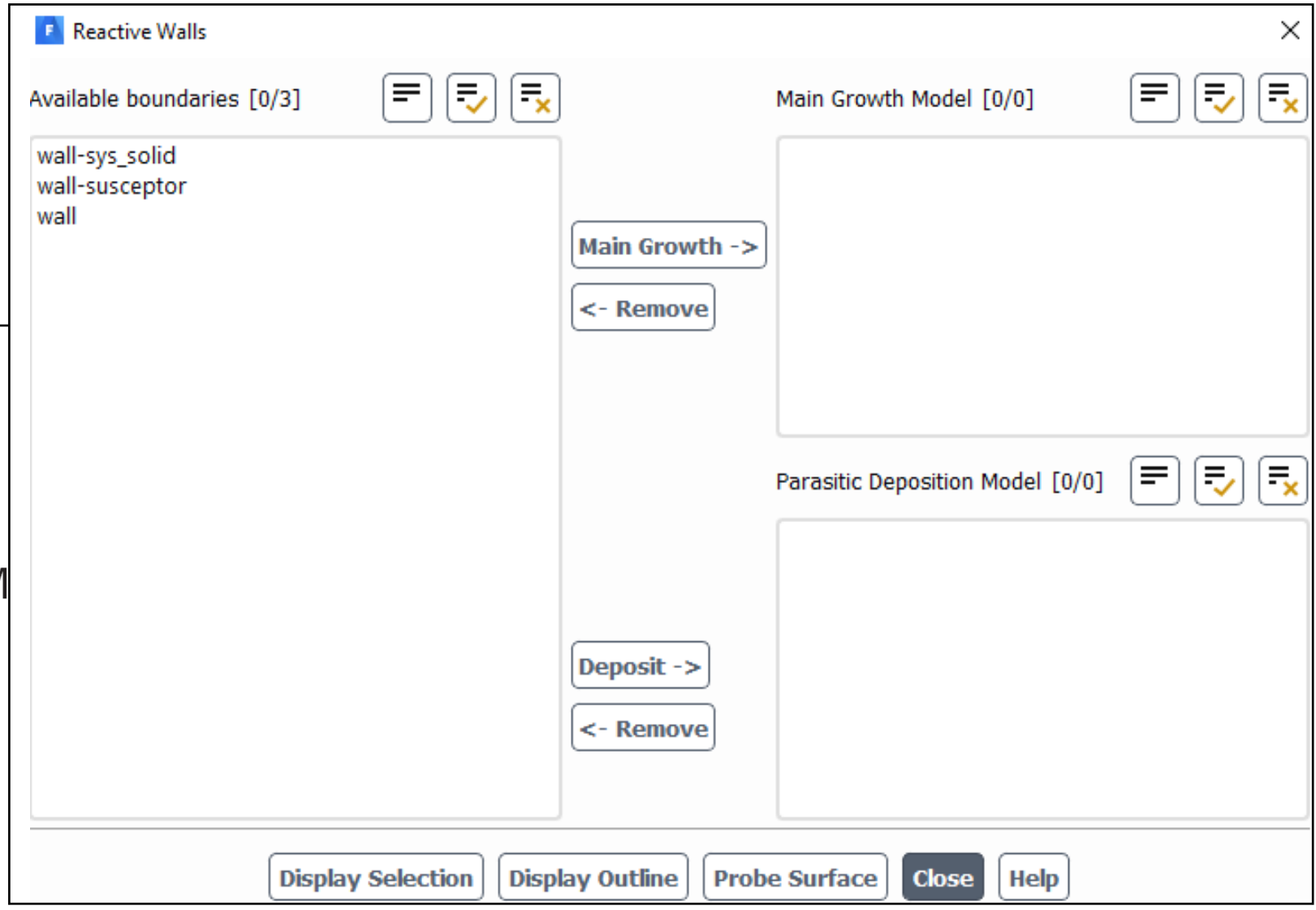
- Working with variables required to tune a simulation that were not included in Fluent



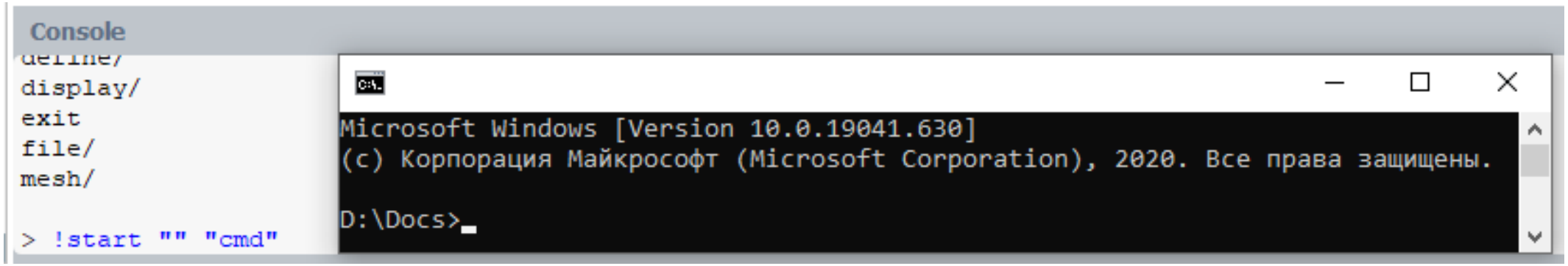
Examples of GUI customisation







Launch of third-party programs from the Fluent console



It is possible to run applications with parameters from under Fluent console, allowing the task to be run in OpenFOAM and the results to be converted back

GaNC_planetary Parallel Fluent@IGNATENKO-V.si.fi.ru [2d, dp, pbns, spe, lam]

File | Domain | Physics | User-Defined | Solution | Results | View | Parallel | Design | CVDSim | Quick Search (Ctrl... | ANSYS

Field Functions
Custom...
Units...
Parameters...

User Defined
Functions
Function Hooks...
Execute on Demand...
Memory...
Scalars...
Read Table...

Model Specific
1D Coupling...
Fan Model...

Outline View

Filter Text

- Setup
  - General
  - Models
  - Materials
  - Cell Zone Conditions
  - Boundary Conditions
  - Dynamic Mesh
  - Reference Values
  - Reference Frames
  - Named Expressions
- Solution
  - Methods
  - Controls
  - Report Definitions
  - Monitors
  - Cell Registers
  - Initialization
  - Calculation Activities
  - Run Calculation
- Results
  - Surfaces
  - Graphics
    - Mesh
    - Contours
      - contour-1
    - Vectors
    - Pathlines
    - Particle Tracks
  - Plots
  - Scene
  - Animations
  - Reports
- Parameters & Customization

Task Page

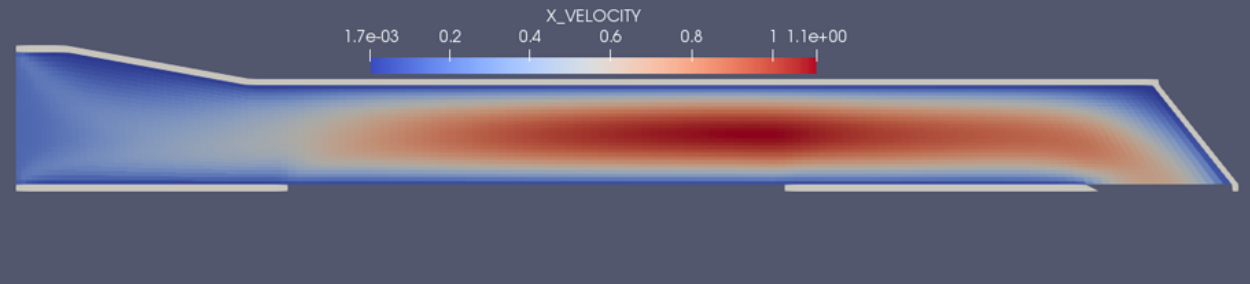
General

Mesh
Scale... | Check | Repo
Display... | Units...

Solver
Type: Pressure-Based / Density-Based
Velocity Fo: Absolu / Relativ
Time: Steady / Transient
2D Space: Plana / Axisy / Axisy

Gravity
Gravitational Acceleration
X (m/s2) 0
Y (m/s2) -9.8100004
Z (m/s2) 0

Contours of Velocity Magnitude (m/s)



Console

```
Writing "C:/STR_Users/2020-autumn/testagain/14_GaNC_planetary/en/GaNC_planetary.cst"...
Done.

Writing "C:/STR_Users/2020-autumn/testagain/14_GaNC_planetary/en/GaNC_planetary.cdat"...
Done.
```

Conclusion

- The partial Substitution of proprietary software with freeware is complicated by a proprietary software user agreement, but it can be bypassed if the work is done internally.
- It is possible to use the computational core from free software while using commercial GUI. This will eliminate retraining problems and reduce the cost of expensive commercial computing kernel.