

Meyer Turku

CSC LUMI HPC

Used for Resistance and
Propulsion CFD computations

CONFIDENTIAL

Heikki Piippo, 6.3.2025



AGENDA

- LUMI in CFD
 - workflow Geometry -> CFD
 - PyFoam
 - snappyHexMesh
 - OpenFoam two-phase computation
 - Paraview
 - LUMI interactive Session / Paraview
 - File Transfer / FileZilla
 - PuTTY / command window
 - SLURM for batch jobs

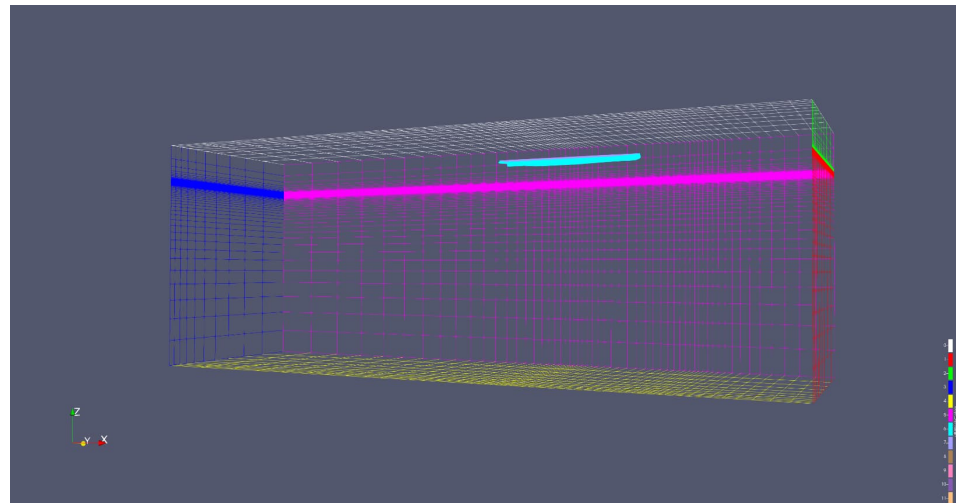
2 / Rhinoceros

- Hull surface imported from NAPA
- Holes in Geometry fixed
- Skeg is trimmed, deck is added and hull above is cut off
- Hull surface is exported to snappyHexMesh



3 / OpenFoam / snappyHexmesh / interFoam

- Hull surface imported to snappyHexMesh
- Mesh generation set up streamlined with PyFoam
- Volume Mesh is created
- interFoam Flow Solver is run (air-water interphase captured by VOF-method)



4 / LUMI Interactive Session / Login

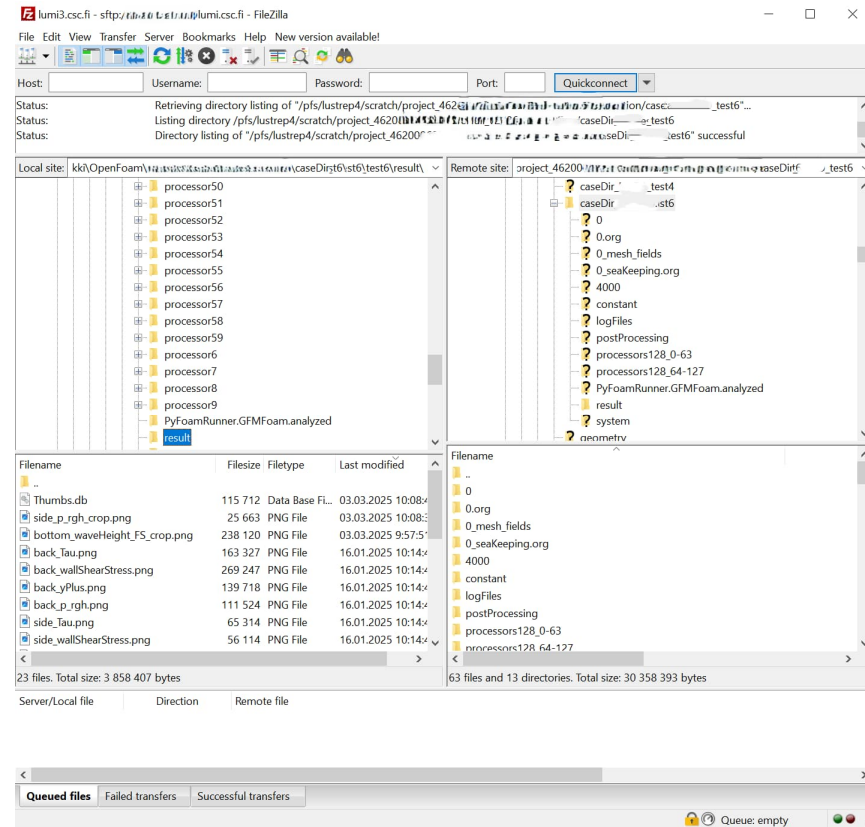


- Interactive session with normal desktop graphics is available through lumi.csc website

5 / File Transfer / Filezilla



- File transfer to/from LUMI can be done using FileZilla
- Works well

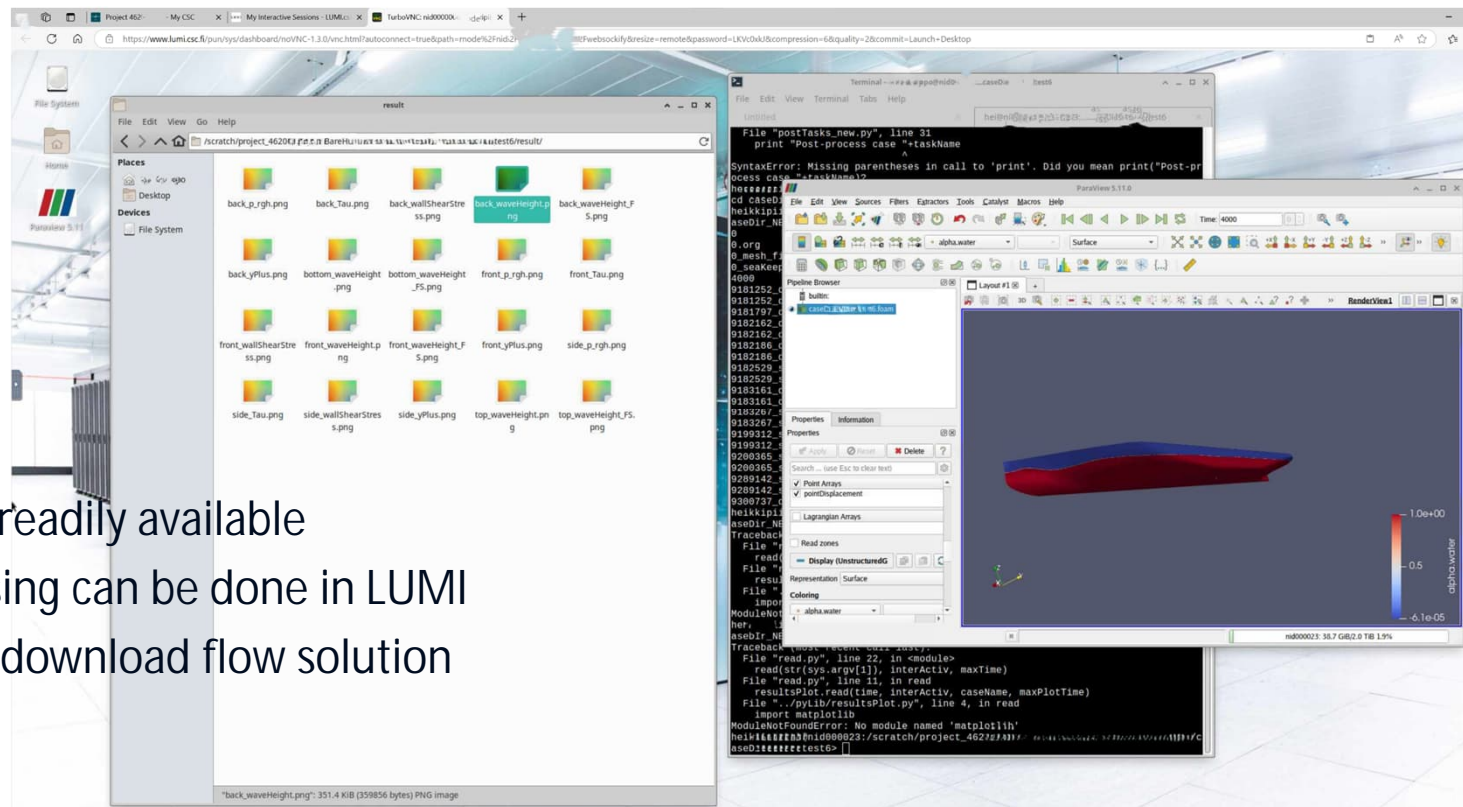


6 / Setup batch run

- PuTTY provides a command window to LUMI
- Batch runs are put to queue system using SLURM
- For debugging process, a separate queue is available

```
lumi.cs.cfi - PuTTY
login as: *****
Authenticating with public key "rsa-key-..."
Passphrase for key "rsa-key-...":
Wrong passphrase
Passphrase for key "rsa-key-20...":
First login: Mon Jan 27 13:09:14 2025 from xx.xx.xx.xx
*****
  LUMI
*****
The Supercomputer of the North
*****
-----
[User guide and support
| https://docs.lumi-supercomputer.eu
| https://lumi-supercomputer.eu/user-support
+-----
Announcements-----
+ IMPORTANT: Check the post-maintenance updates on
| https://lumi-supercomputer.github.io/update-202409/
+-----
NOTE: The default version of both the Cray PE and LUMI stack
| is now 24.03 and this is also the only version of the Cray PE
| officially supported on the current system. We recommend
| moving to 24.03 when possible. Base libraries for 24.03 and
| 23.12 are already on the system and much user-installable
| software for 24.03 is already available also.
+-----
Unfortunately, due to the late decision to move directly to
| ROCm 6.0 rather than the originally planned 5.7, we are not
| able to keep our promise of fully supporting 23.09 also. We
| did test many of the build recipes and tried to fix problems
| when possible, but a recompile of GPU software may be needed.
+-----
Expect longer answer times as usual to very technical tickets
| as there is still a lot of development work to do.
+-----
You can use the lumi-workspaces command (without loading an
| additional module) to check your quota and allocations on
| LUMI. Also check 'module help lumi-tools' for more info.
+-----
Notes-----
| Make sure one of the following modules is loaded to have the
| full LUMI experience:
| - CrayEnv: the Cray software stack enriched with some
|   additional tools not installed by default in the OS
| - LUMI: the extensible LUMI software stack that you can use
|   as a basis for additional software installs with EasyBuild
|   and other tools.
| - spack: If you are an experienced Spack user and know how it
|   works, Spack is offered as-is. We do not do development or
|   bug fixing in Spack but do offer a configuration compatible
|   with the Cray PE.
+-----
Did you know?
*****
Switching versions of the Cray Programming Environment should be possible by
| loading the cpe module for the version. However, it is a fragile process and
| often produces error messages. One clean way to do it, is in the CrayEnv
| environment: Clean the environment using 'module purge', load the cpe/yy.mm
| module of your choice, and then load the prgenv module of your choice in its
| default version. You have to use different module load statements though
| for the cpe and PrgEnv module as the cpe module only takes full effect at the
| post module load command. E.g., to load the 23.09 version of PrgEnv-cray:
$ ml CrayEnv
$ module purge
$ module load cpe/23.09
$ module load PrgEnv-cray
*****@lumi04:~$
```


7 / LUMI Interactive Session / Postprocessing



- Paraview is readily available
- Postprocessing can be done in LUMI
- No need to download flow solution

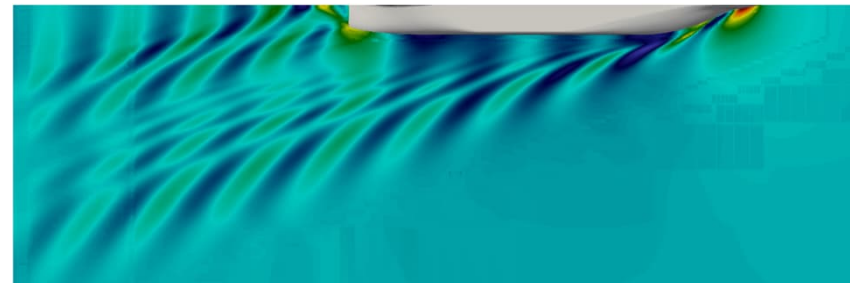
8 / Postprocessing

- Frictional Resistance + Dynamic Pressure Resistance = Total Resistance
- Wake field at propeller disk
- If Actuator Disks are used, then Propeller Power
- Dynamic pressure distribution on hull surface
- Wave system
- Selected streamlines



9 / Summary

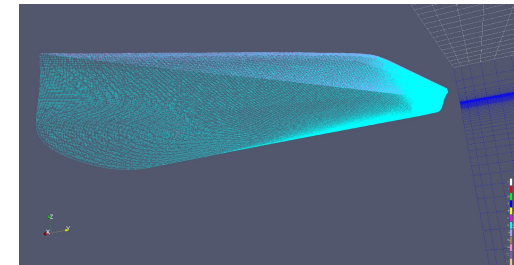
- Hull geometry -> LUMI with FileZilla
- Run SnappyHexmesh with PyFoam scripts
- Debugging is available in a separate queue
- Setup an OpenFoam batch job
- Postprocess in LUMI Interactive Session
- Download only postprocessed results with FileZilla
- Enjoy the results



10 / OpenFoam with LUMI / Conclusions

PROS

- OpenFoam and Paraview are readily available
- Mesh generation, batch jobs and postprocessing are ready to be used
- No software licenses are needed -> No license costs
- LUMI computing power available on demand
- LUMI maintenance is done by CSC
- Helpful LUMI user support is provided by CSC
- CSC is a non-profit organisation with reliable and skillful reputation



CONS

- Learning to use OpenFoam takes quite some time



THANK YOU !

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