CFD Simulations of 2.5 MW turbine using ANSYS CFX and OpenFOAM

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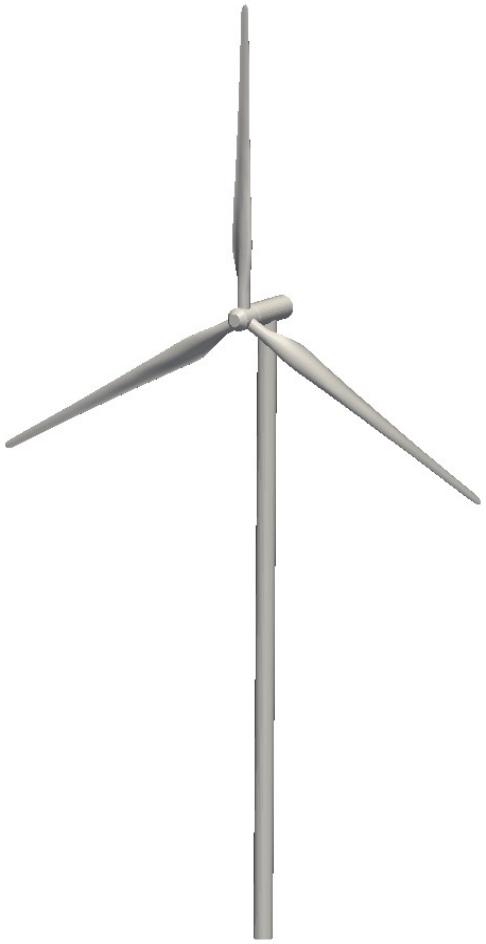
Outlook

- Complete wind turbine (incl. tower) was simulated
- Focus on comparison of ANSYS CFX and OpenFOAM
- Structured mesh generated in ANSYS ICEM CFD
- Steady-state and transient simulations

Turbine Data

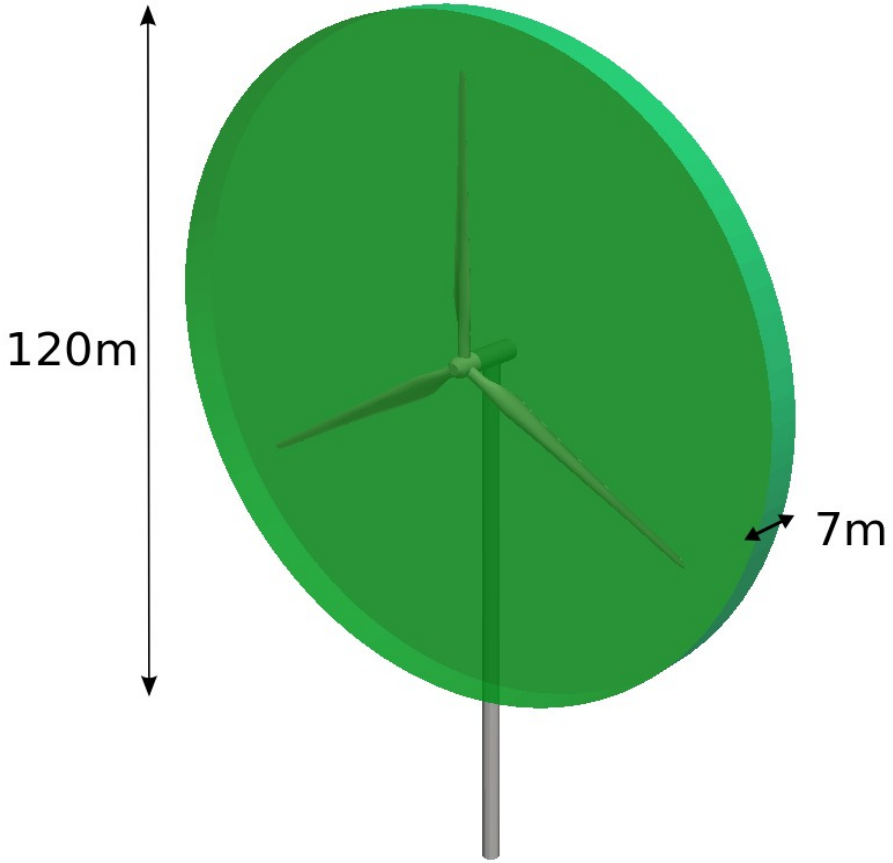
- Reference 2.5 MW wind turbine
- Designed by IWES
- Upwind configuration
- Rotor diameter: 100 m
- Hub height: 100 m
- Rated inflow velocity: 10.8 m/s
- Rated rotational speed: 13 rpm



Meshing strategy

- Two separate structured meshes (rotor and far field)
- Both simulations use the same mesh
- Total cell count: 52 million (36 + 16)
- Mesh quality verified by checkMesh
- Y+ 200

Meshing strategy



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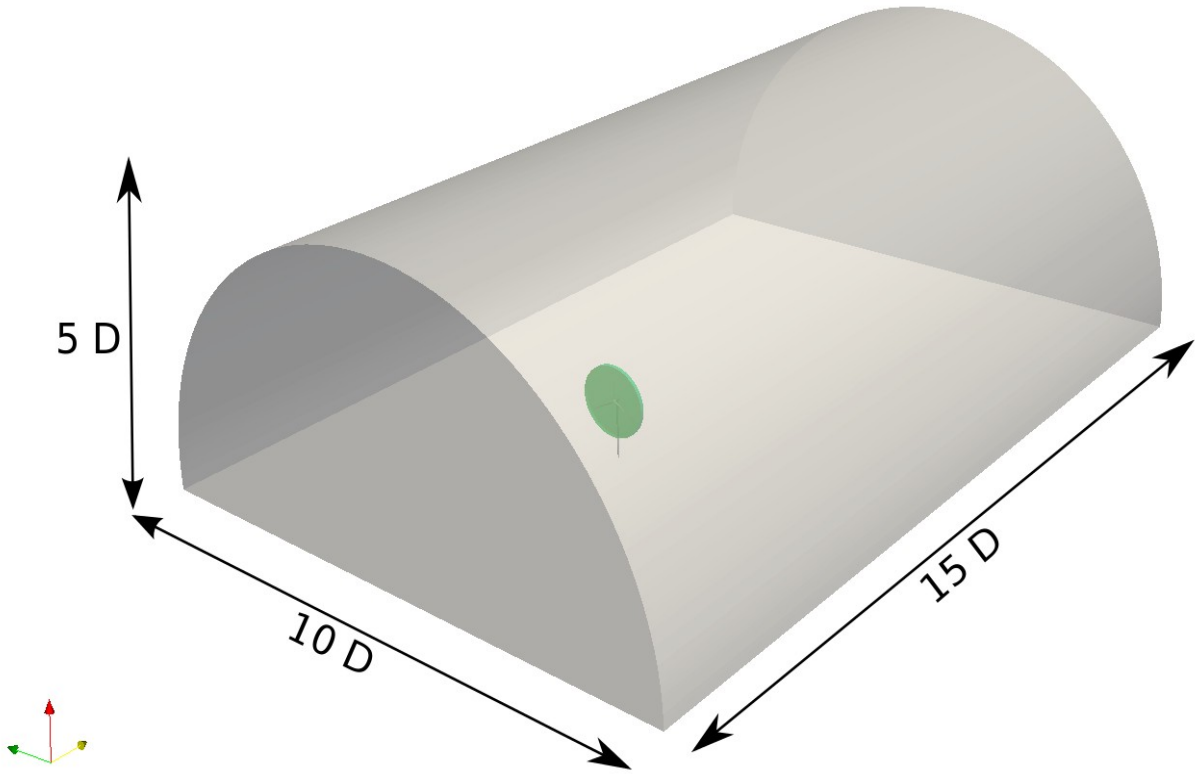
Meshing strategy



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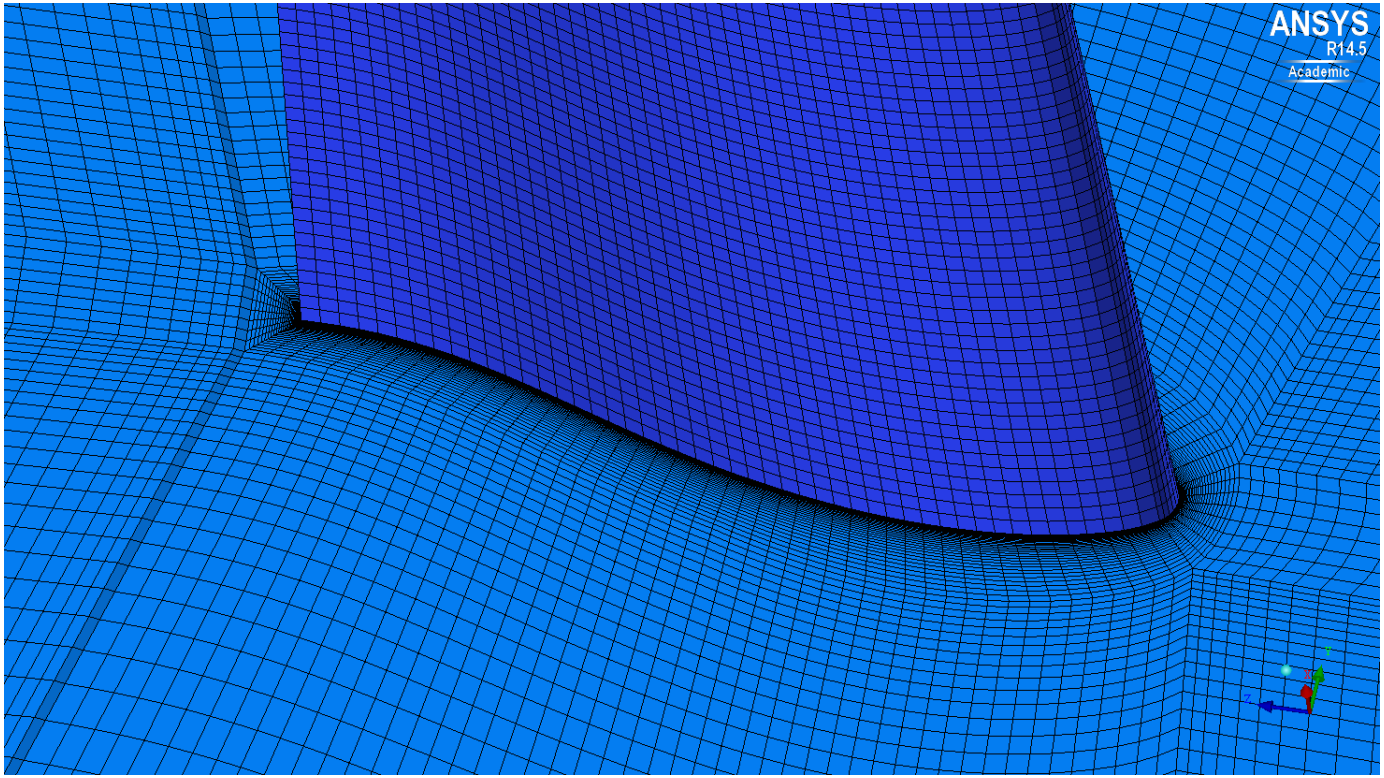
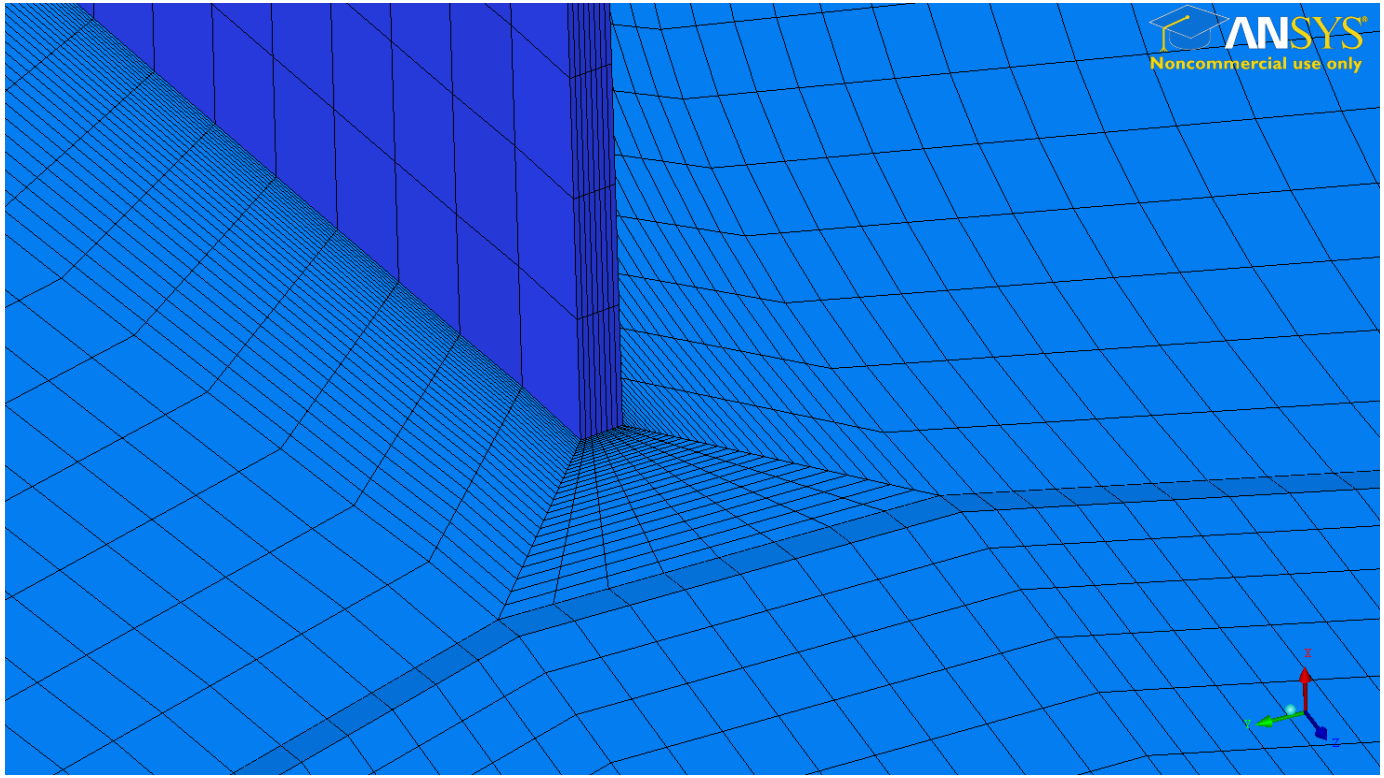
Meshing strategy



Chord length: 2m, r/R=0.5

Meshing strategy



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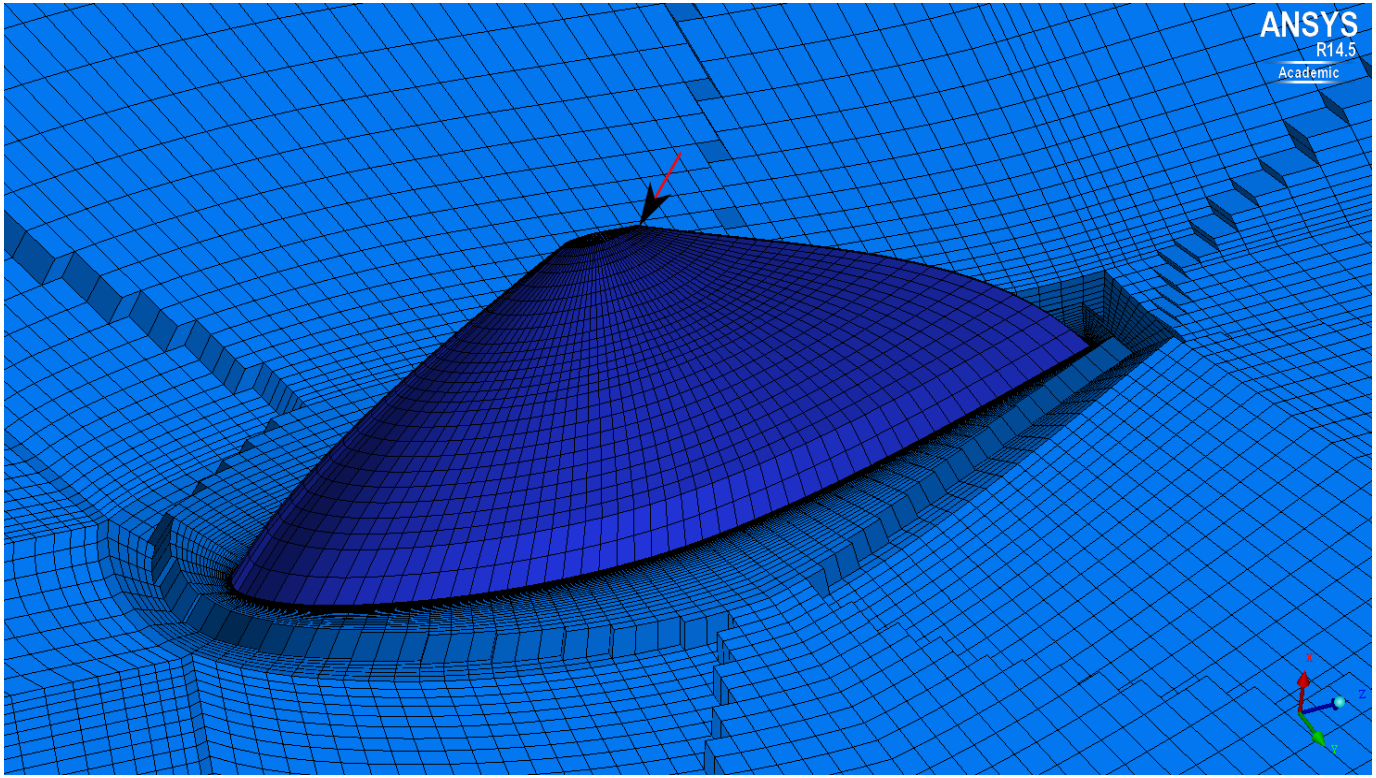
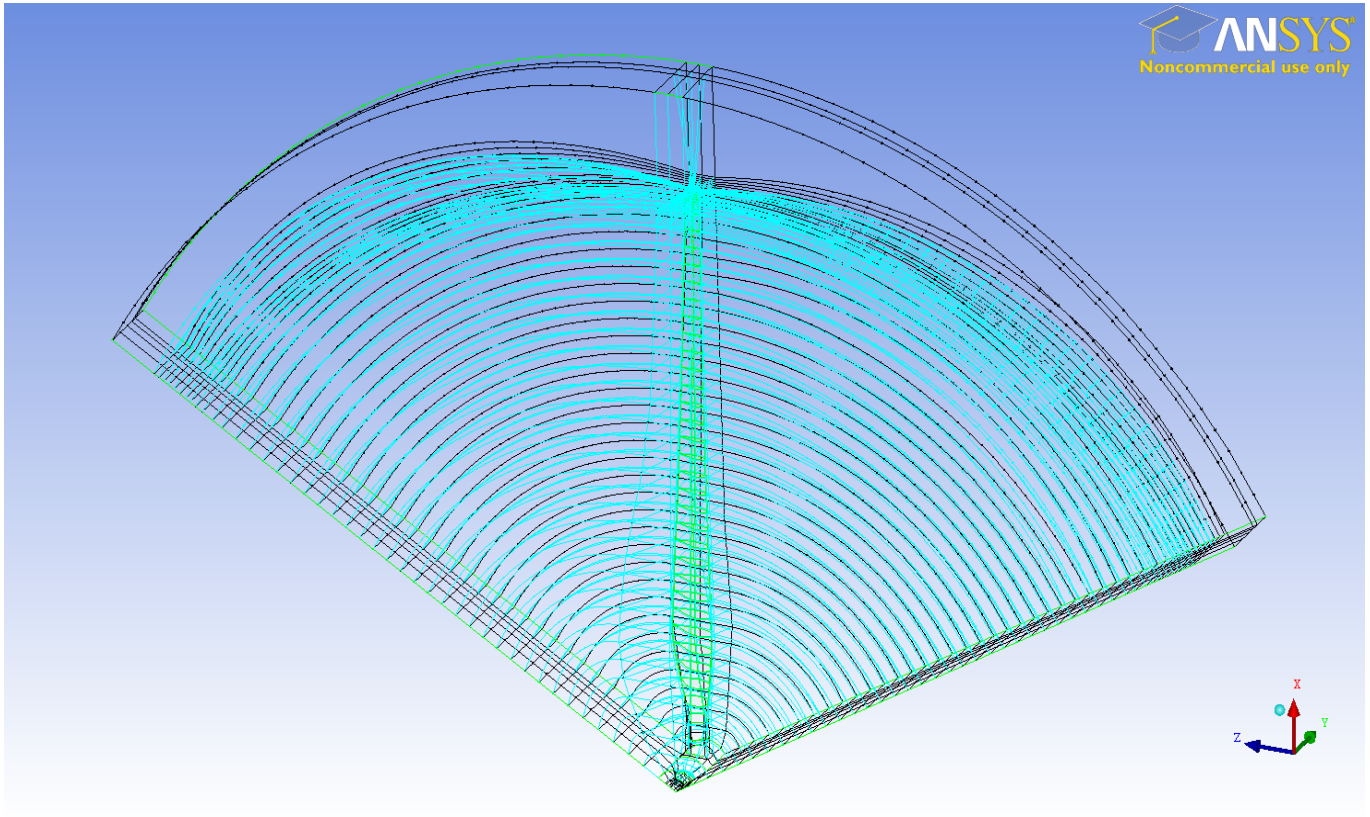
Meshing strategy



Tip chord length: 6cm

Meshing strategy



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Set-up ANSYS CFX 14.5

- Steady-state (RANS)
- Frozen-Rotor concept
- GGI interfaces
- k-Omega SST turbulence model
- Standard solver settings

Set-up OpenFOAM 2.1.1

- Steady-state (RANS)
- Mesh import using fluent3DMeshToFoam
- MRF concept
- AMI interfaces
- k-Omega SST turbulence model
- MRFSimpleFoam [I. Herraez]

Preliminary Results

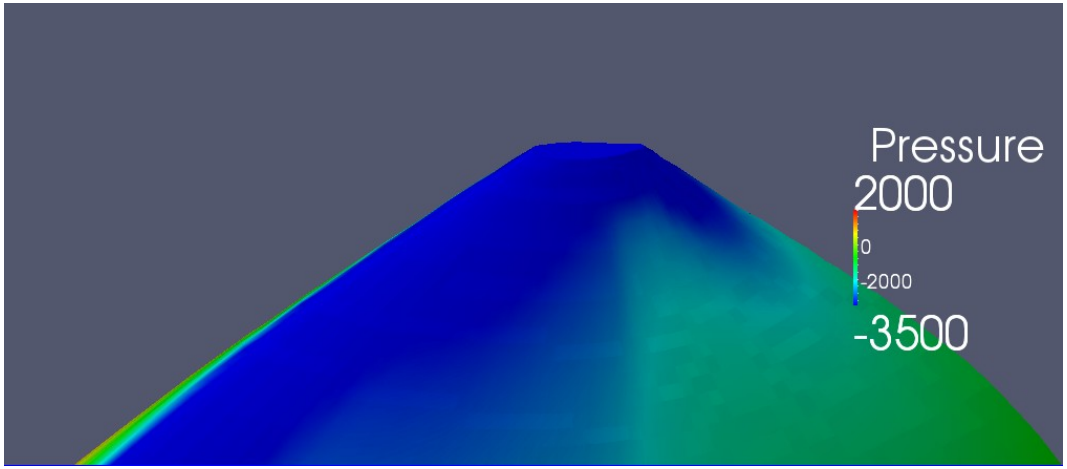
- Power output calculated based on pressure & viscous forces
- CFX-Post: torque function, OpenFOAM: turboperformance lib
- Calculated aerodynamic wind turbine power output:

  ANSYS CFX 14.5: 2.045 MW

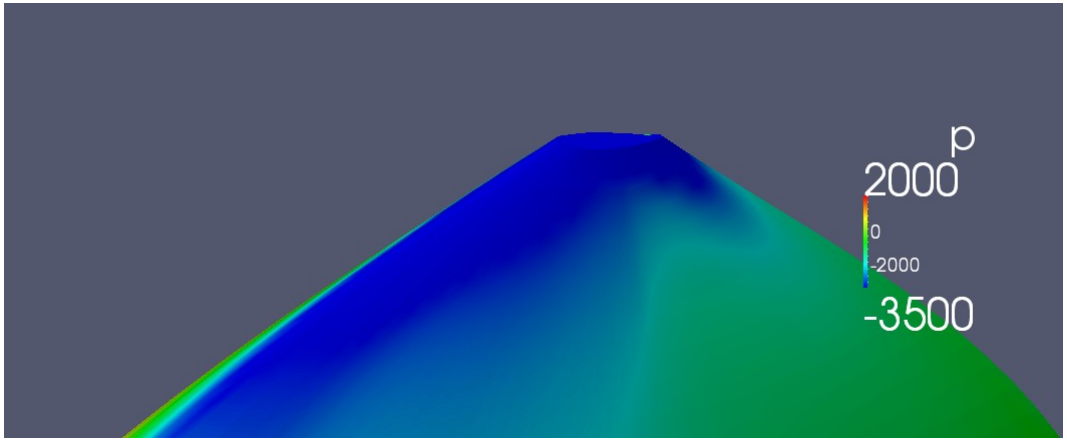
  OpenFOAM 2.1.1: 1.98 MW

Preliminary Results

ANSYS CFX



OpenFOAM



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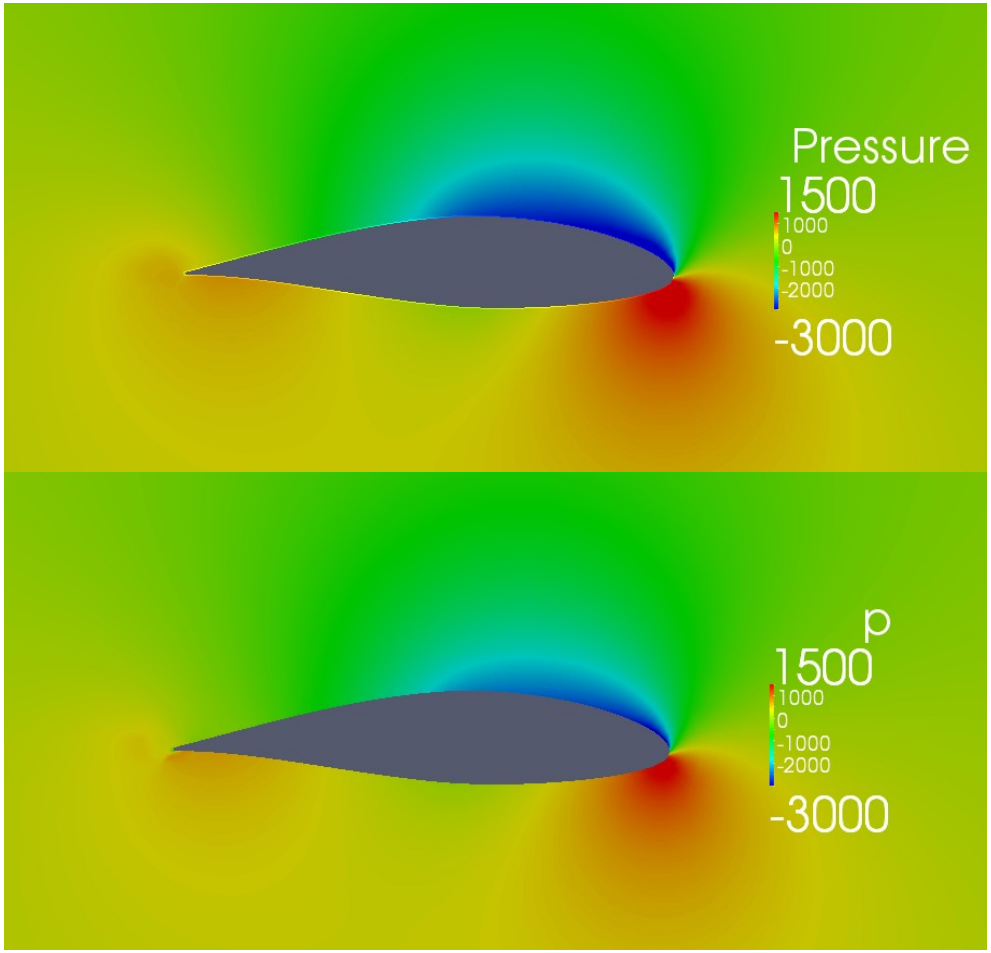
Preliminary Results

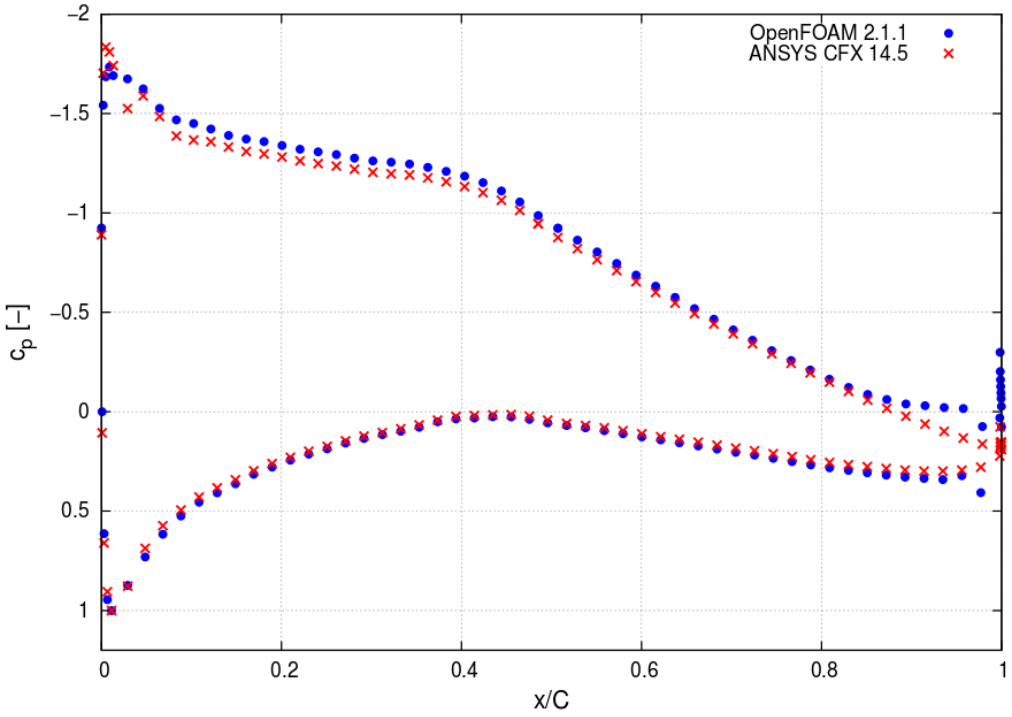
ANSYS CFX

OpenFOAM

r/R=0.9 (45m)



Preliminary Results



r/R=0.9 (45m)

Conclusion

- Structured meshes generated in ICEM can be used within OF
- Meshing approach used worked
- Similar results with both ANSYS CFX and OpenFOAM
- CFX faster (3-4x) and more stable

Thank you for your attention!

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