CFD PORTFOLIO

Lorenzo Vecchietti

My Experience with CFD

2018

Learn OpenFOAM

2019–2020

Lead of CFD activities at Dynamis PRC

2020–2021

Multiple university projects about CFD

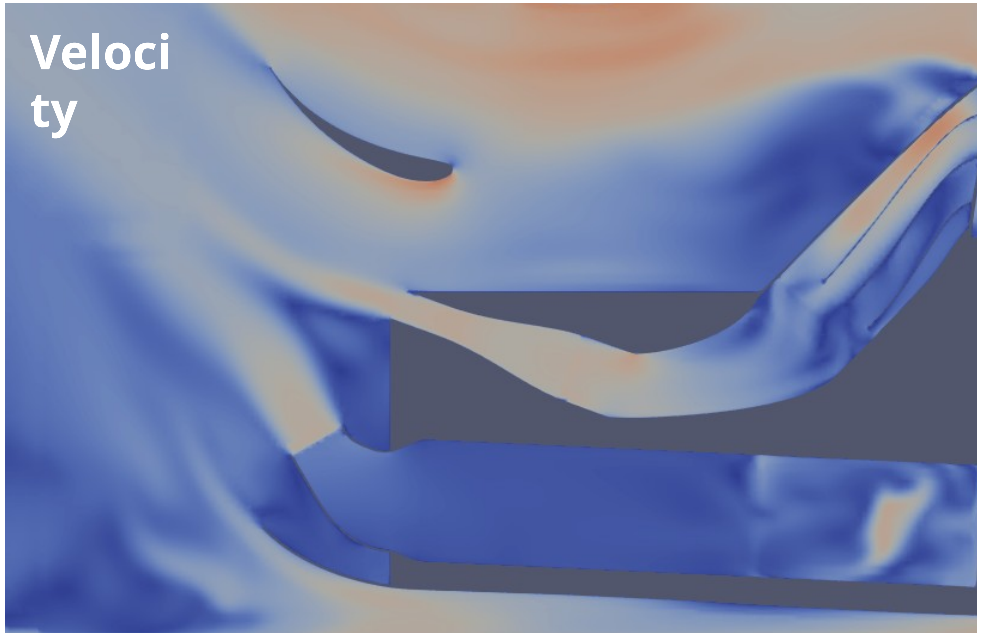
2021

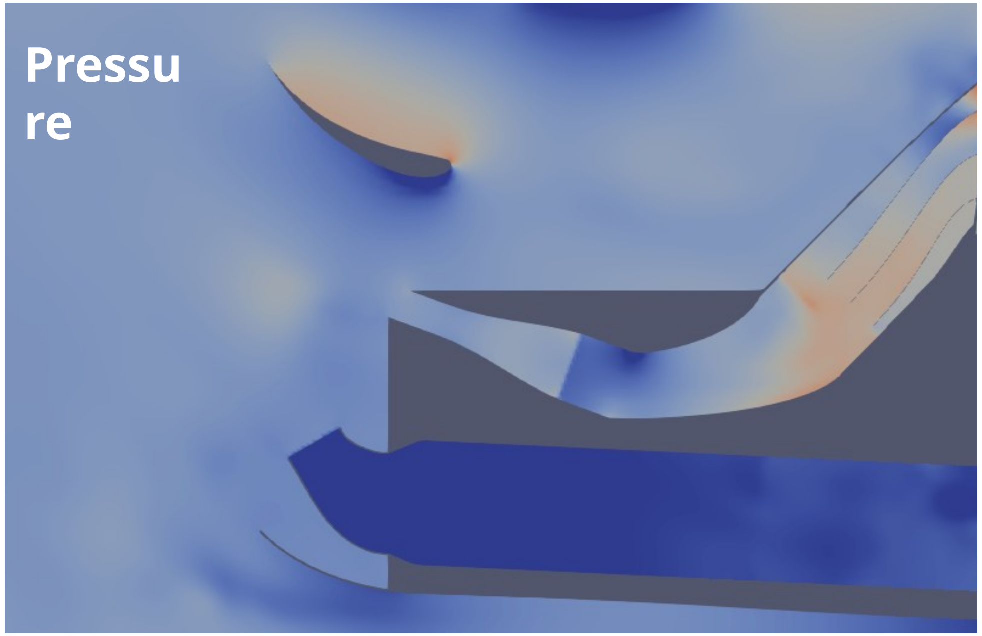
Master thesis: DNS code that employs an innovative immersed boundary method

2022

Joined Ansys Electronic Thermal Management Team (Icepak+Fluent)

CFD XP @ UNI





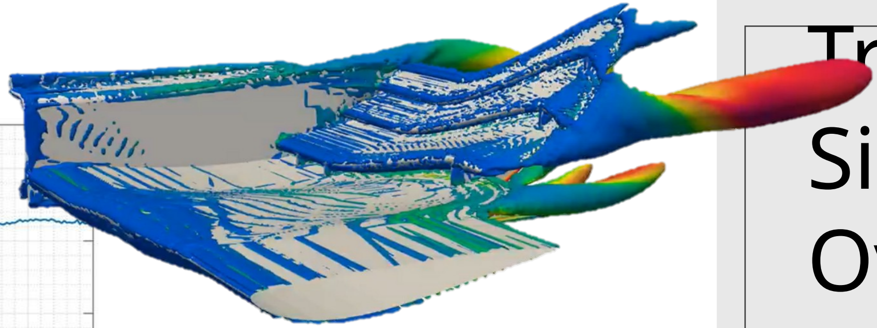
Porous media & Fan

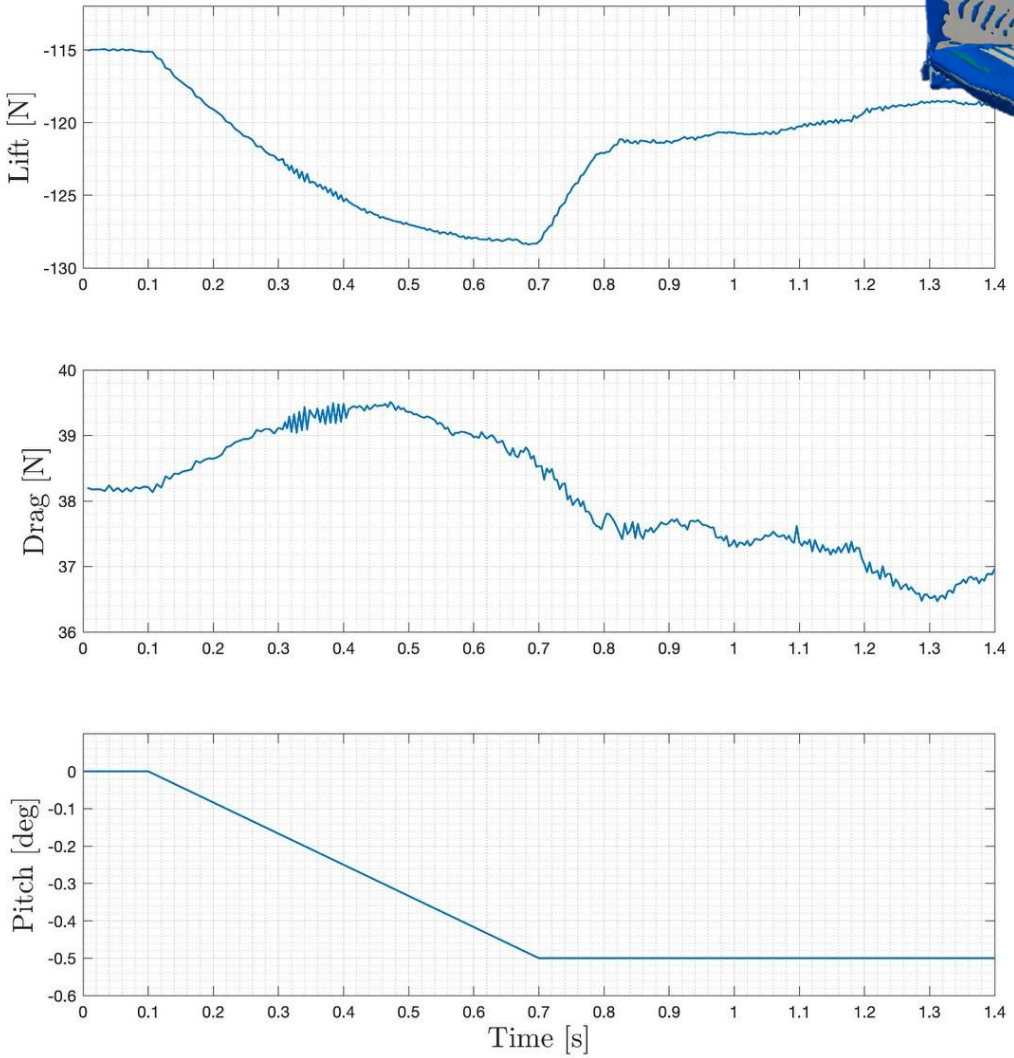
Objectives:

Obtain flow rate data on radiators and battery pack to properly size fans

Results:

The results have made it possible to correct initial estimates. In the race there were no major cooling problems





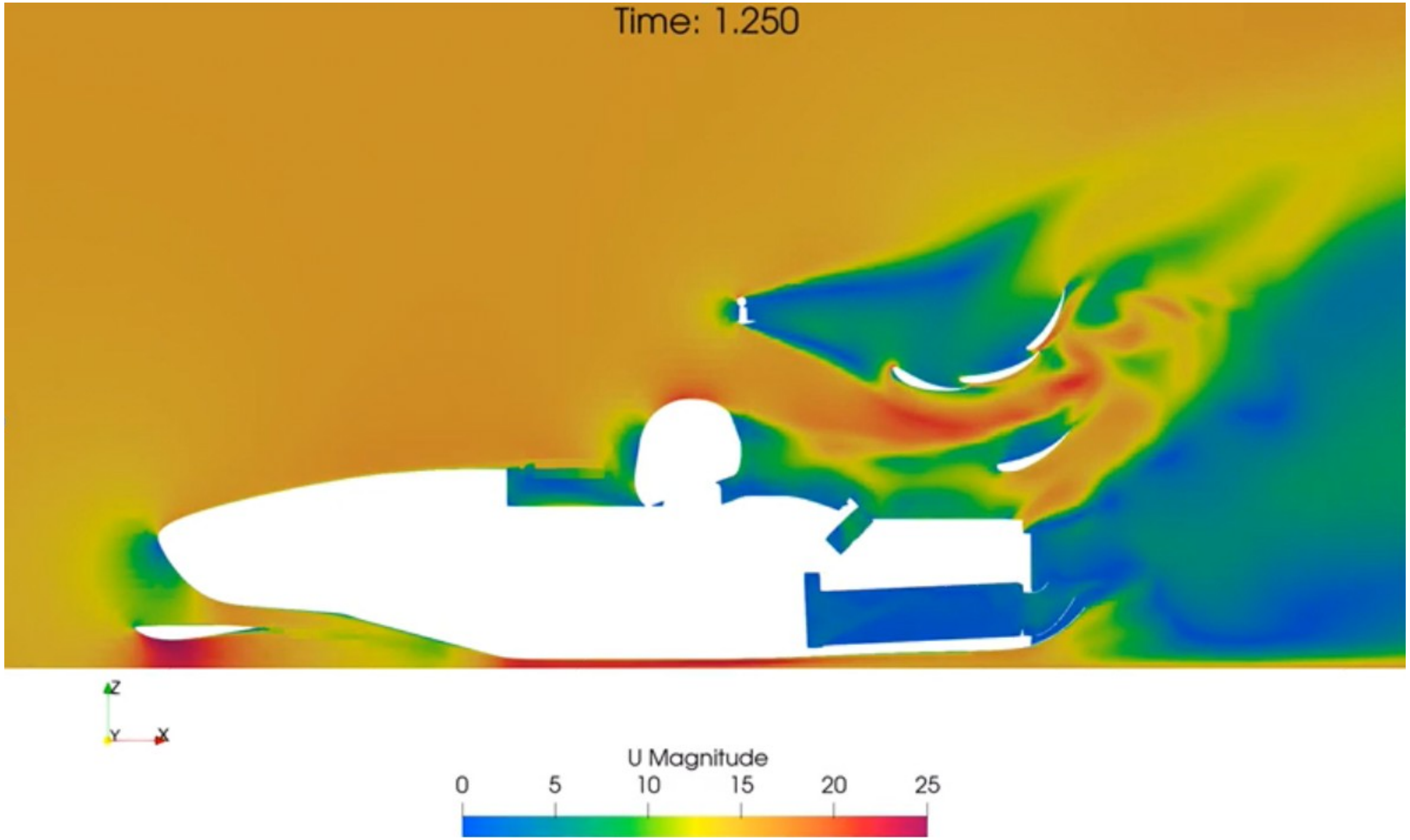
Transient Simulations – Overset meshes

Objectives:

Better understanding of aerodynamic behavior under braking

Results:

10% increase in front wing downforce.



Transient Simulations

Objectives:

Get indications of how wrong the RANS results were.

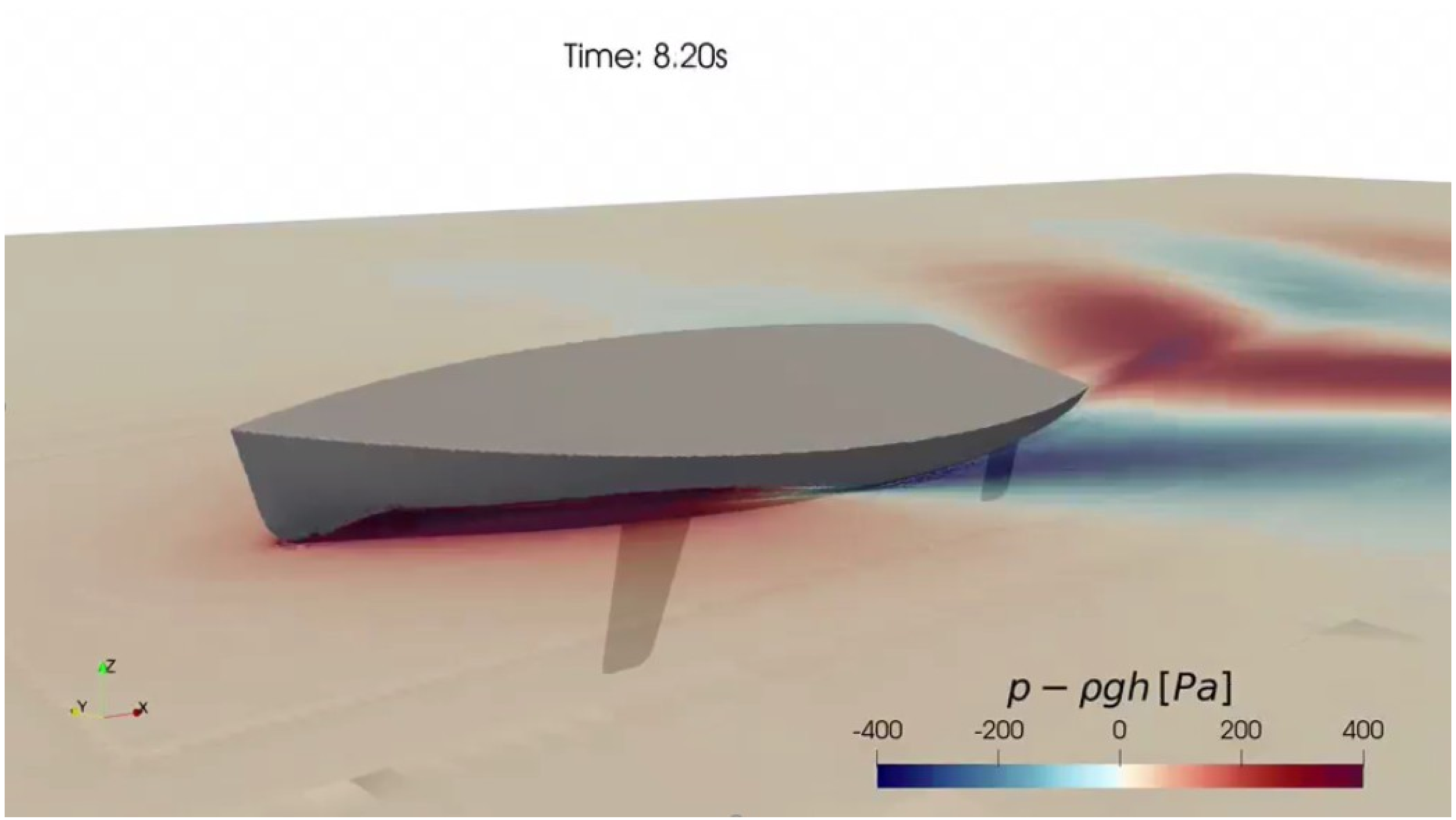
Obstacles:

Due to limited computational resources, we used the SST-k-Omega-SAS turbulent model, more accurate than a URANS but less than a LES.

Results:

Despite the SAS model, the vortical region behind the rear wing revealed an improved accuracy compared to the flow-viz results obtained on the track.

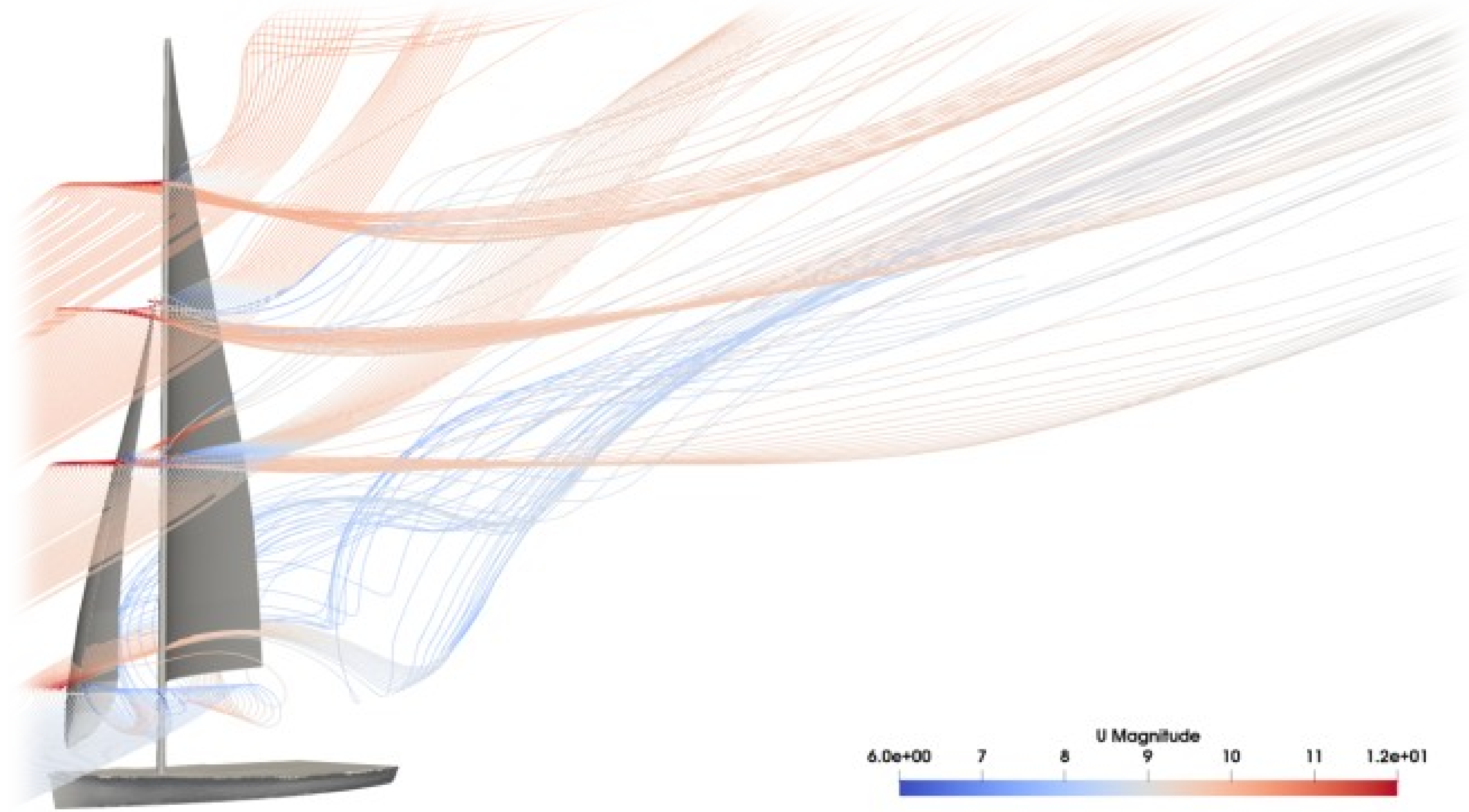
In other regions, errors with respect to RANS simulations were acceptable.



Hull Optimization (VOF simulation)

Rhinoceros was used for a parametric study of the hull. After choosing the best configuration based on simplified models, the hull was studied on OpenFOAM.

Pitch dynamics simulated while roll and yaw axes are frozen.



Search for optimal sails configuration

Genetic Algorithm:

First, the optimal inflated configuration of the sails using a genetic algorithm has been searched. Due to limited computational resources, we used 2D RANS results (obtained with SU2 on 10 different sections of the sail) and vortex-lattice method results.

Result verification:

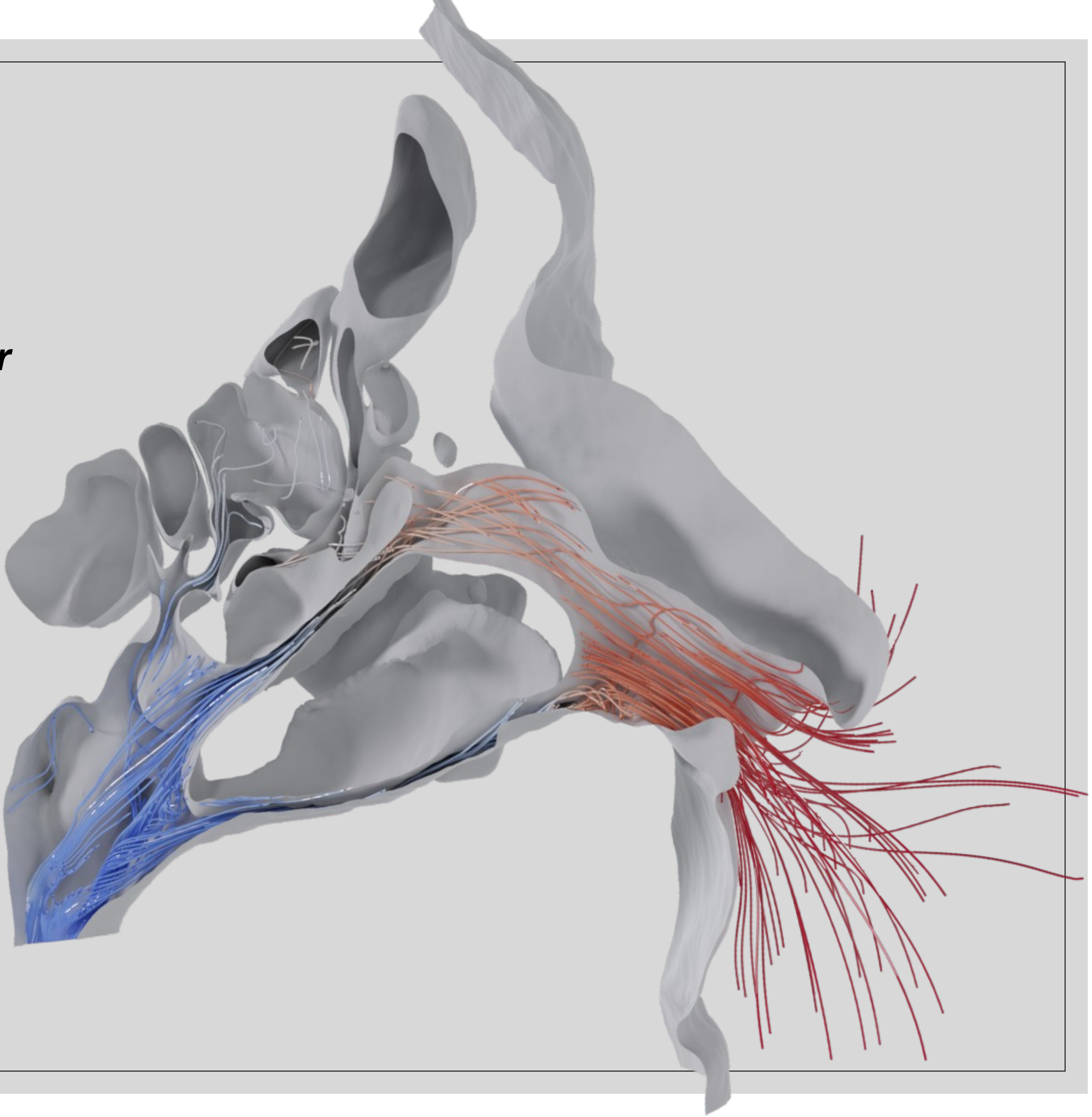
The best configuration of both codes was tested on OpenFOAM. Despite the limitations, the use of two-dimensional sections proved to be more accurate than the vortex-lattice method.

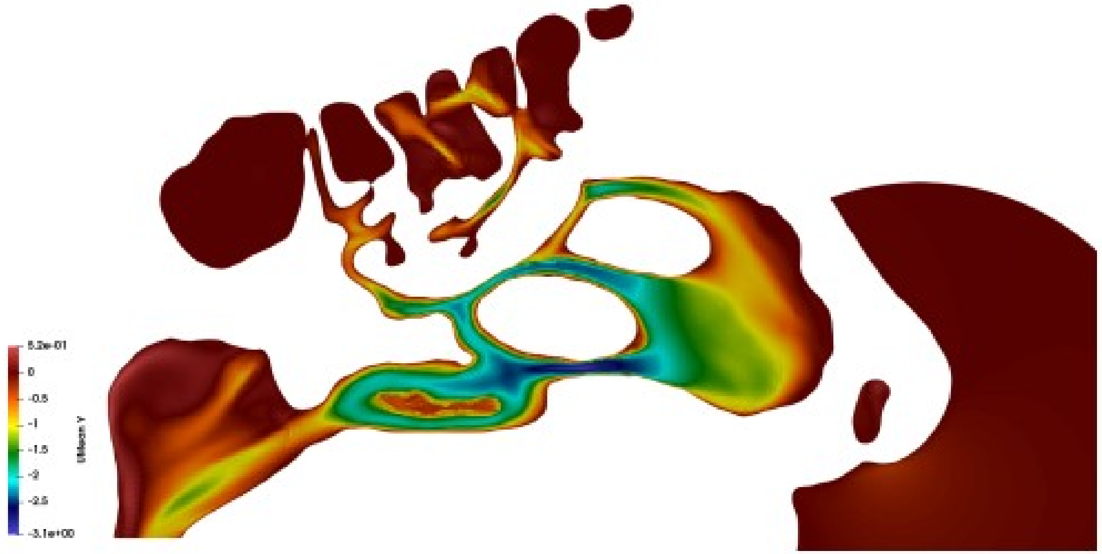
MASTER THESIS

Master Thesis

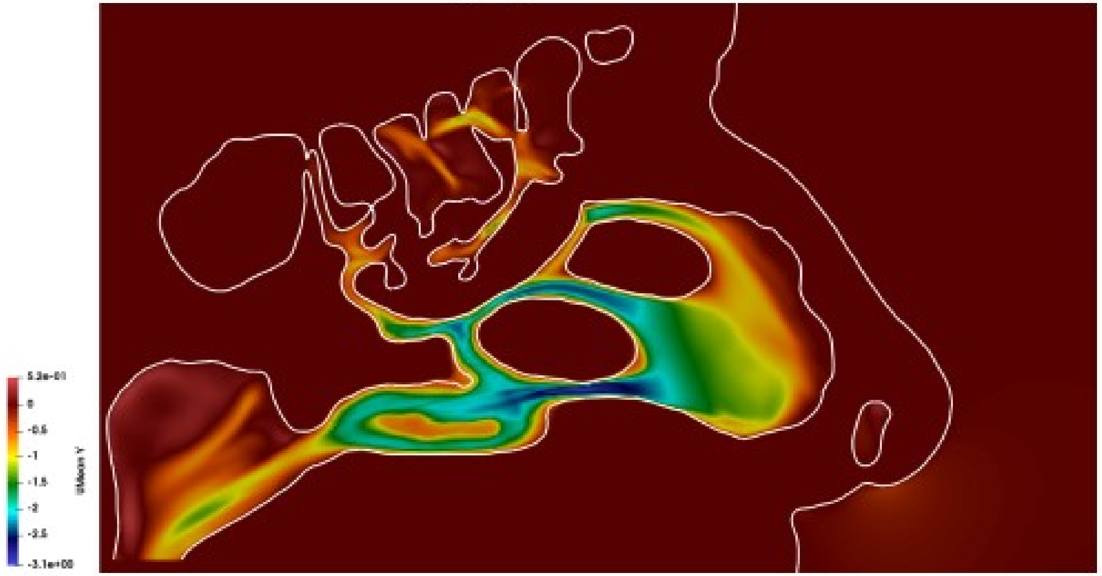
"A Direct Numerical Simulation code for the flow in the human nose"

- Second order FDM, solution trough fractional step
- Immersed Boundary Method (not yet published)
- Programmed in CPL language (developed by Paolo Luchini since 1999)





(a) OpenFOAM



(b) STLIMB

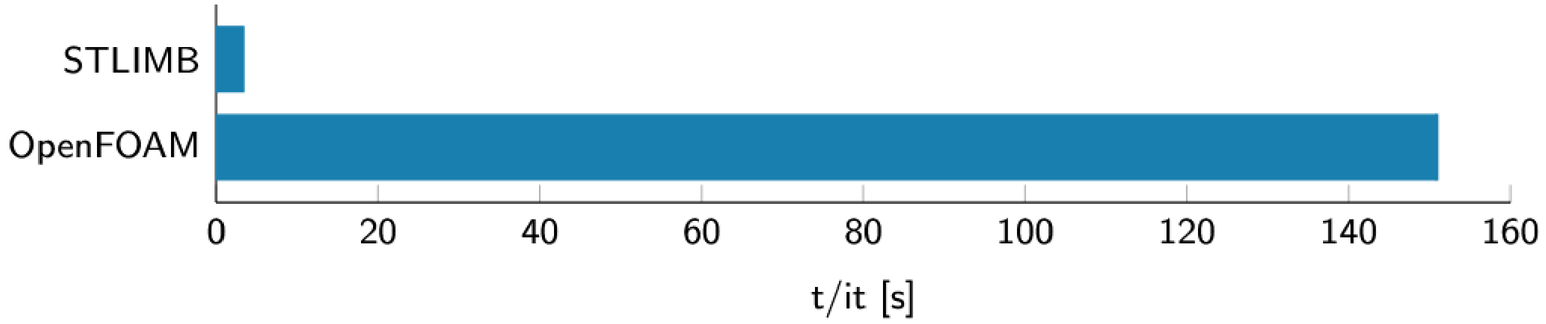
Motivation of the work

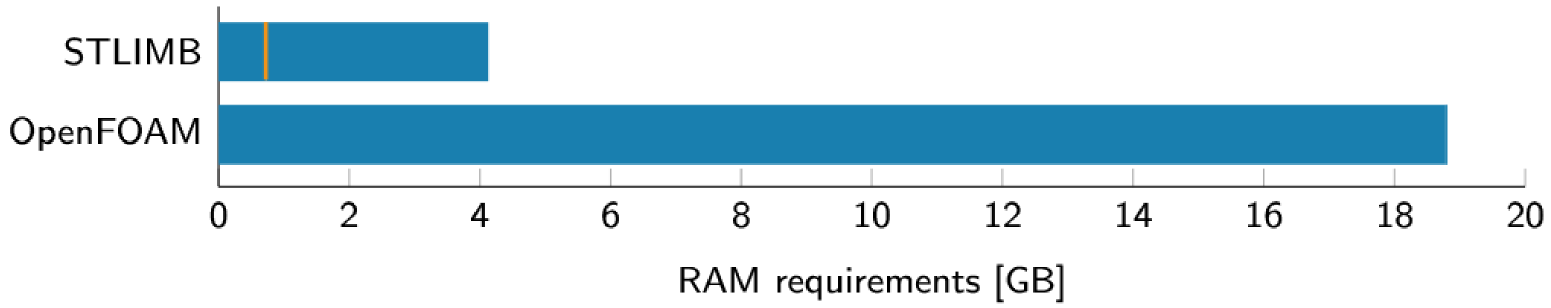
Nasal breathing disorders (NBD) are widespread

Doctors do not have functional information about the flow.

⇓

A fast CFD code is needed but you do not want to include modelling error → DNS.



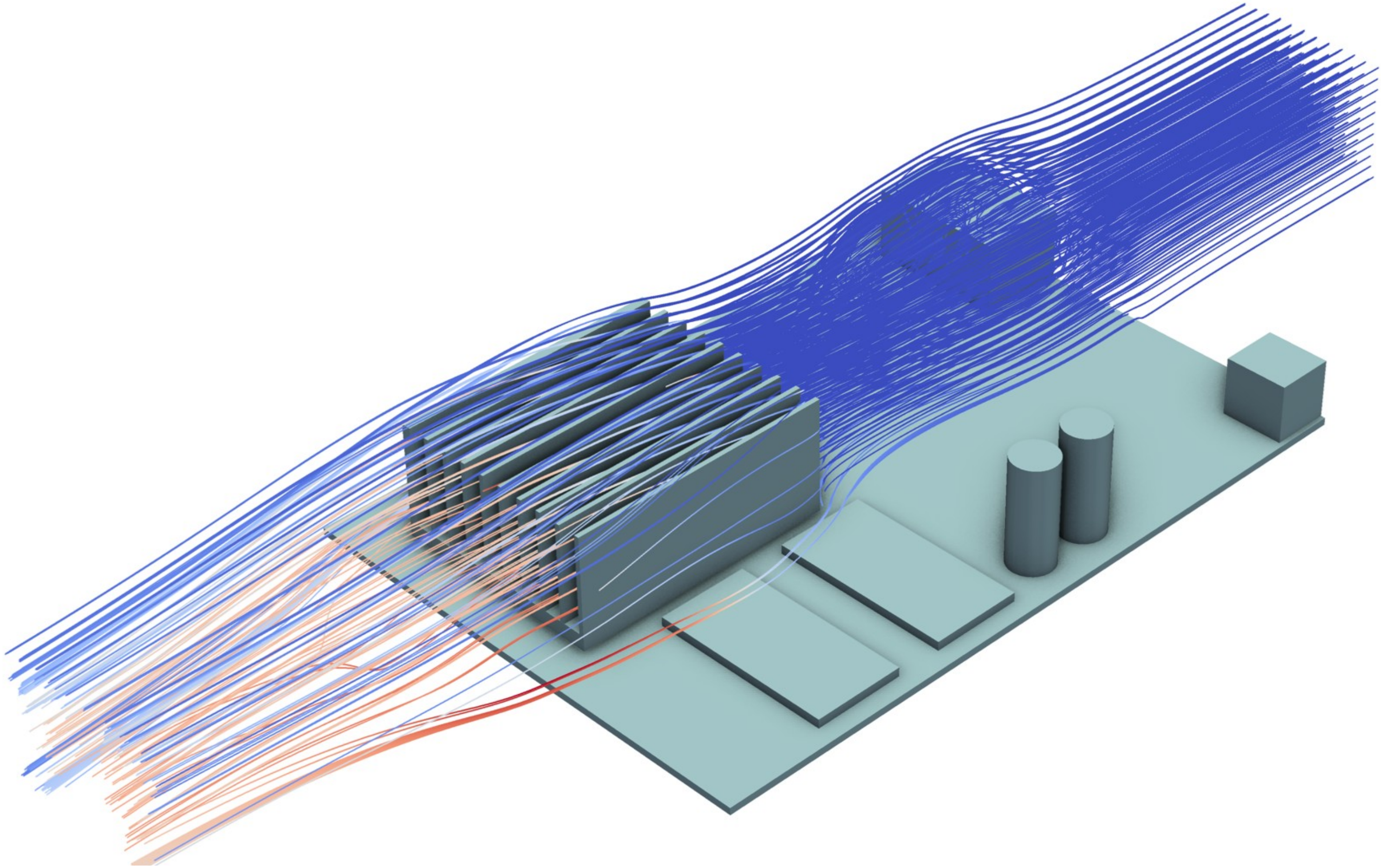


Results

A fair comparison with OpenFOAM is difficult but:

- My code turns out to be 44.8 times faster than OpenFOAM on the same machine
- RAM used is only 23% of that used by OpenFOAM.

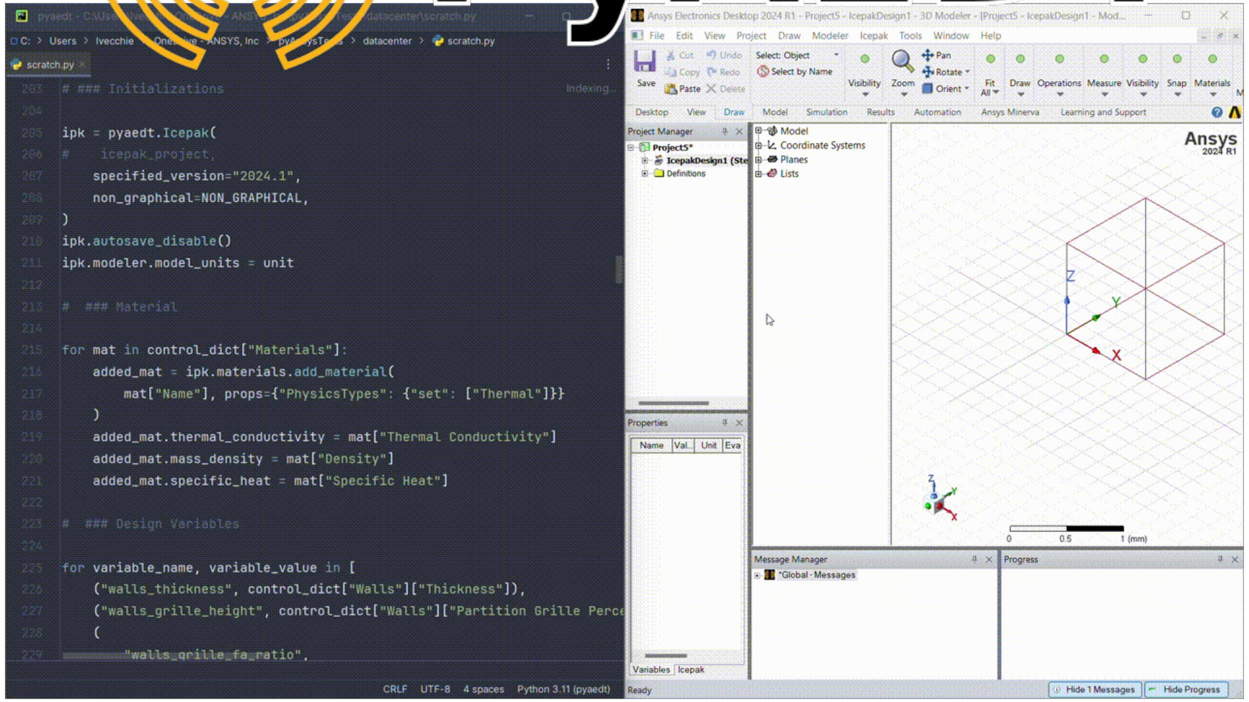
MOVING TO ETM



Presales activities

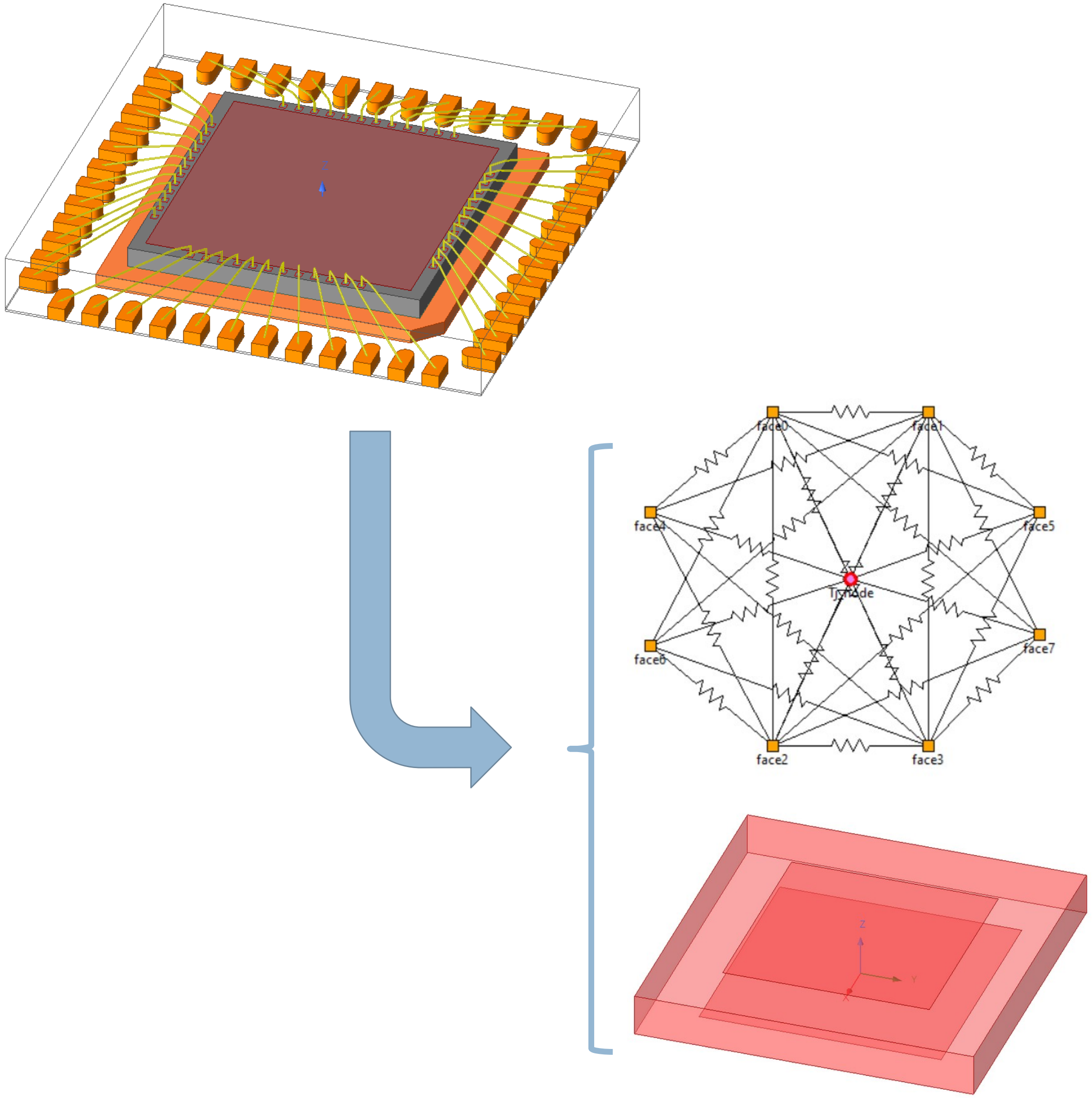
- Support semiconductor companies in EMEA
- Wide range of applications:
  - Power electronics (multiphisycs coupling)
  - 3DIC components (die characterization, powermaps, …)
  - Reliability simulations
  - Reflow simulation
  - Miscellaneous (datacenter HVAC; induction heating)
- AI tiger team

PyAEDT



Automation

- APIs developer to automate Icepak
- “Firefighter” for a multi-million $ project
- Customization to overcome software limitations



R&D

- ROM for high fidelity components
- Customized workflow that will generate 150k this year
- “one man show”: UI, Business Logic to interact with simulation & geometry processing, DLL to extract ROM