



# Aeromines

**Supercomputing to everyone:  
meet the growing needs of businesses**

***Romain Klein & Prof. Elie Hachem  
European HPC Summit Week 2018 Ljubljana | 29-05-18***





# ABOUT US ///



## MINES PARISTECH - CFL TEAM

The CFL research team (Computing & Fluids) is well recognized in developing finite element codes for computational mechanics with anisotropic mesh adaptation and parallel computing.



**15 years**

## Cimlib library

CimLib is a C++ fully parallel finite element library involving the use of SPMD and the MPI library standard.

**2014**

## Aeromines Platform

Since its launch, Aeromines offers consistent application functionality, optimal security, and lightning fast customer response times.

# **/// WHAT WE DO AND HOW WE CAN HELP**

- 1** HPC for Industry
- 2** Link between Researchers,  
Scientific editors & Industry
- 3** Cloud computing Platform
- 4** Solution components &  
partnerships
- 5** Features, test cases & Demo



# HPC Solutions

- ❑ Beyond the academic and scientific world
- ❑ Real Contributors to competitiveness
- ❑ Provide breakthrough insights

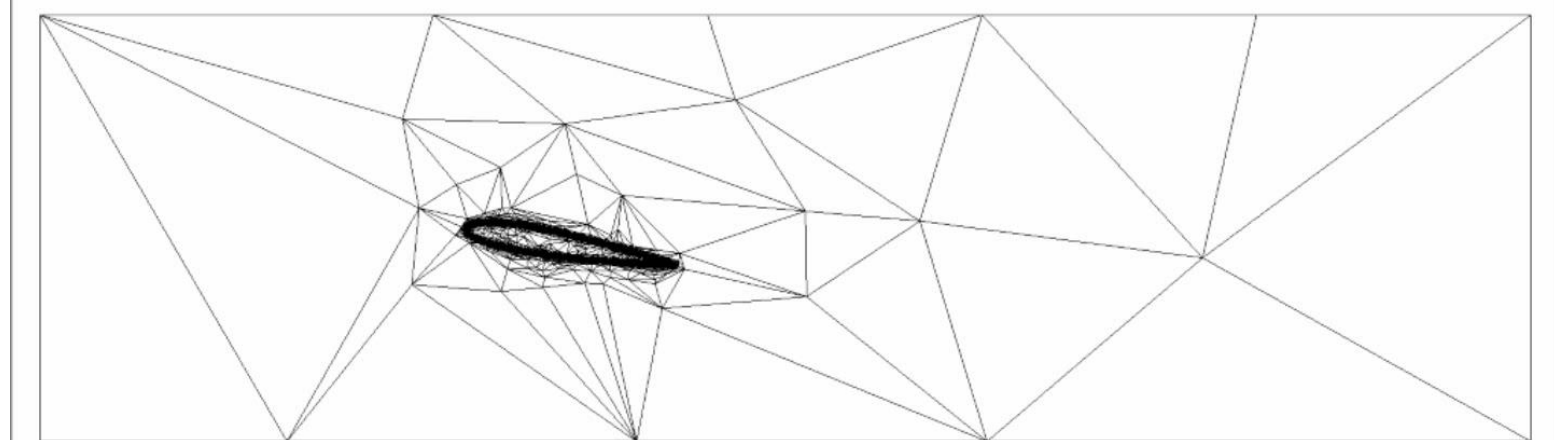
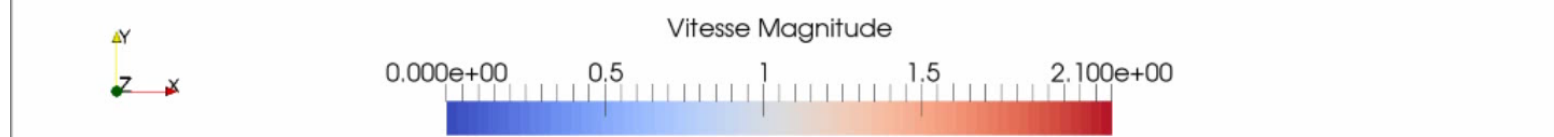
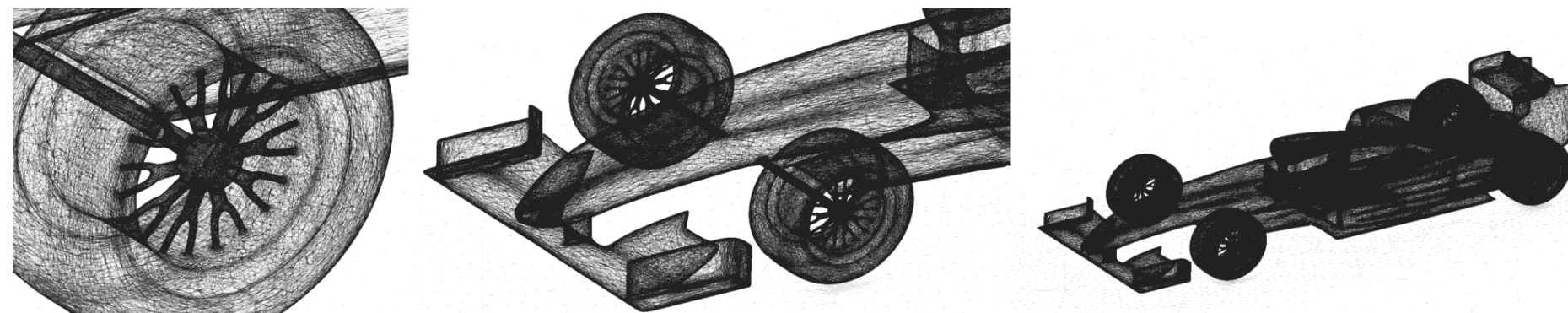
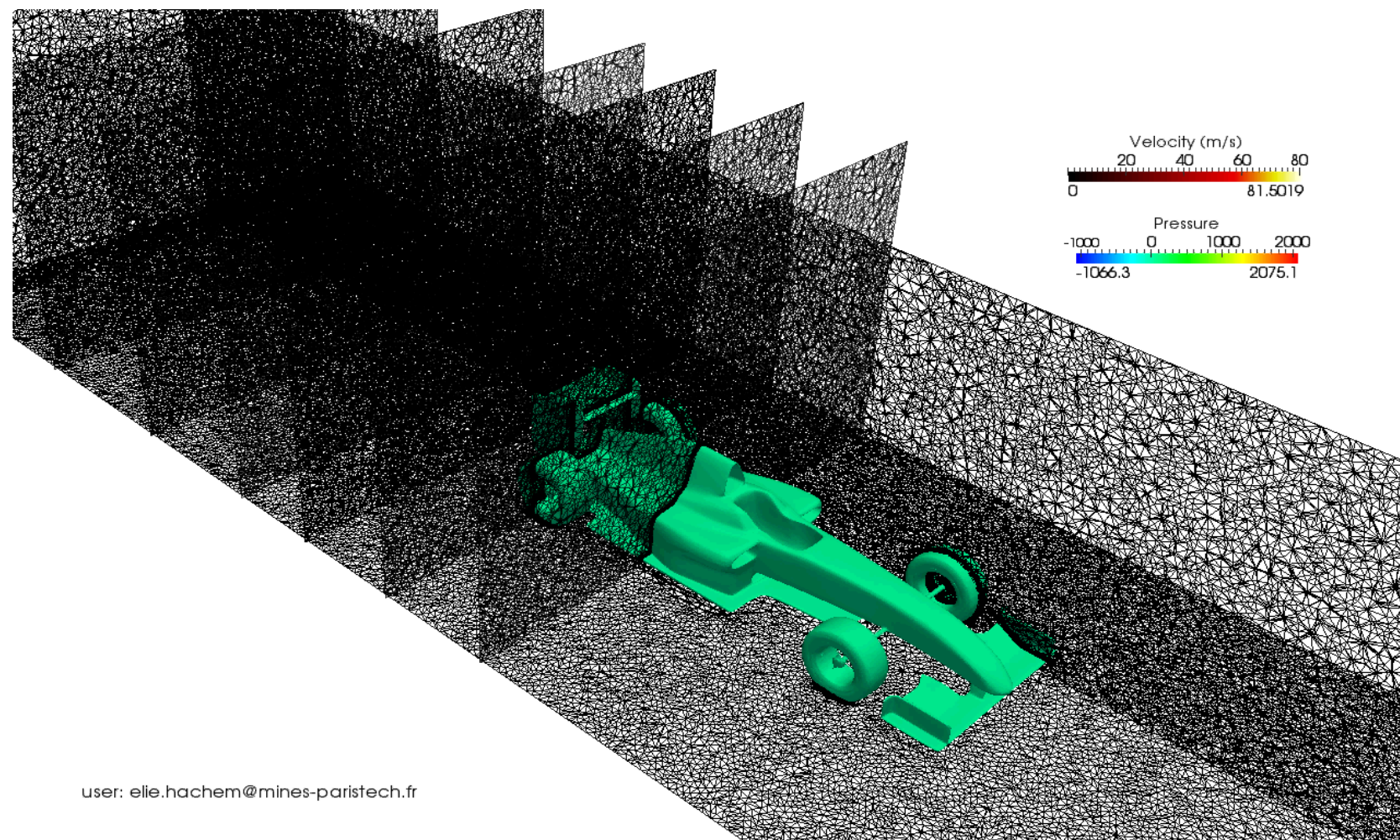
*“Boeing 787 used only 11 prototype wing designs versus 77 wing designs for the prior-generation Boeing 777”*





# Computational Mechanics

/// Innovative adaptive algorithms combined with HPC enable automated complex simulations





# HPC Impact show cases: Energy

## Computation Fluid Dynamics

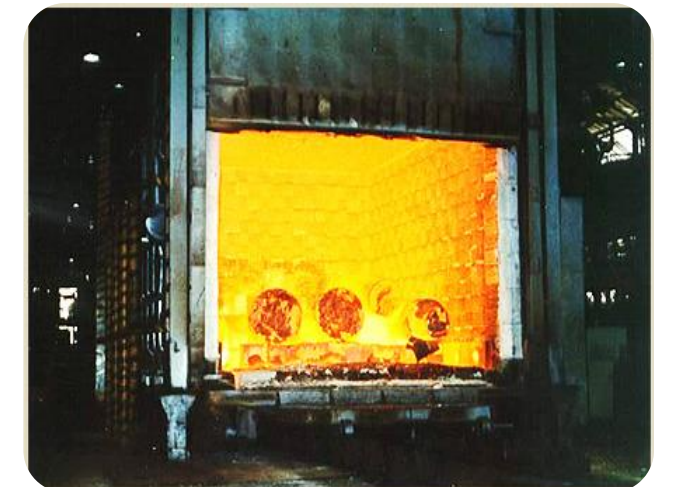
- ❑ *Parallel adaptive FE Unsteady Navier-Stokes solver*
- ❑ *Fluid-Structure Interaction*
- ❑ *Implicit LES solvers*

## Aerothermal

- ❑ *Conjugate heat transfer*
- ❑ *Forced, and natural convection*
- ❑ *Radiative heat transfer*

## Multiphase Flow

- ❑ *High density and viscosity ratio*
- ❑ *Surface tension*
- ❑ *Conservative Levelset method*

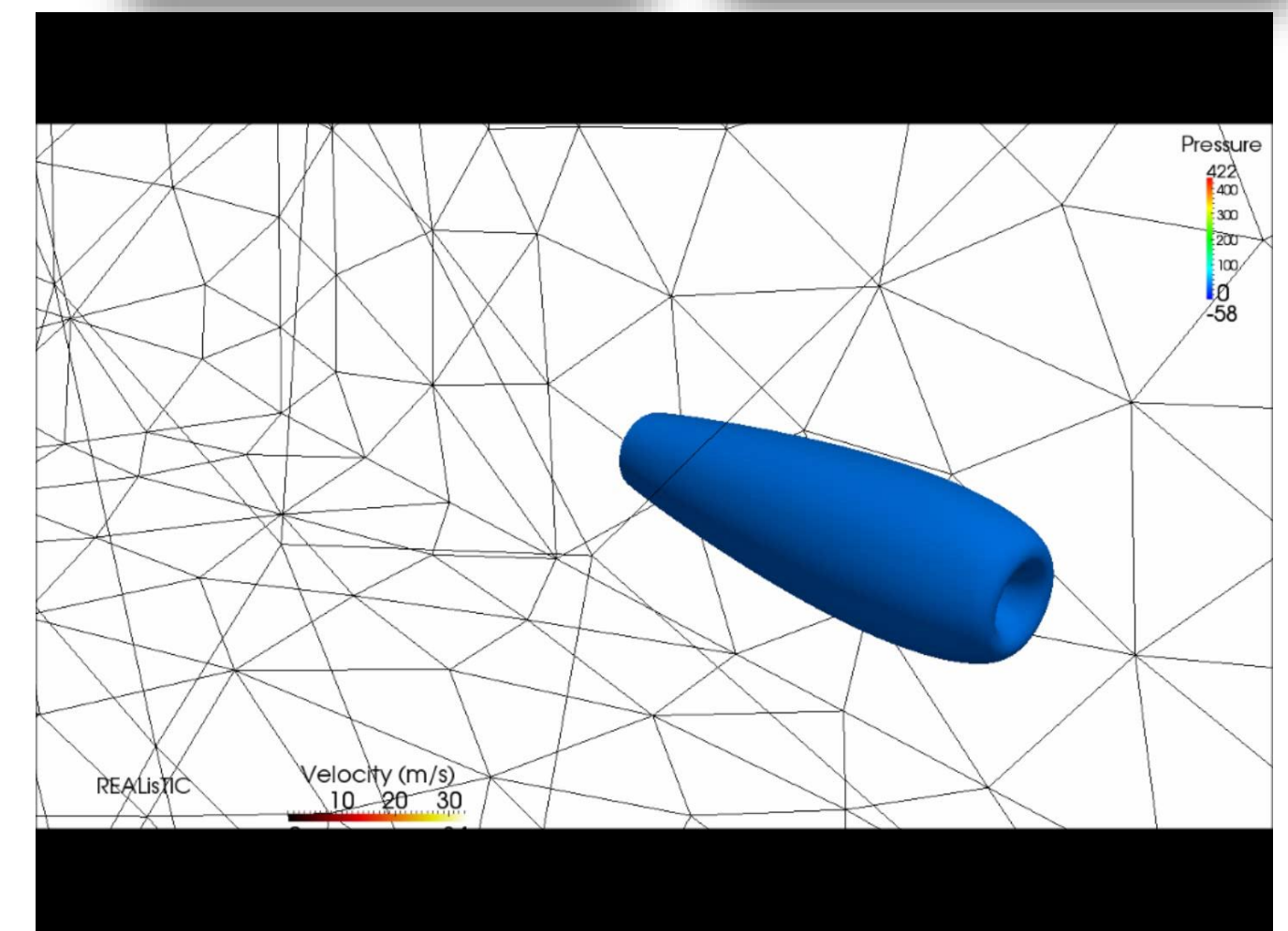
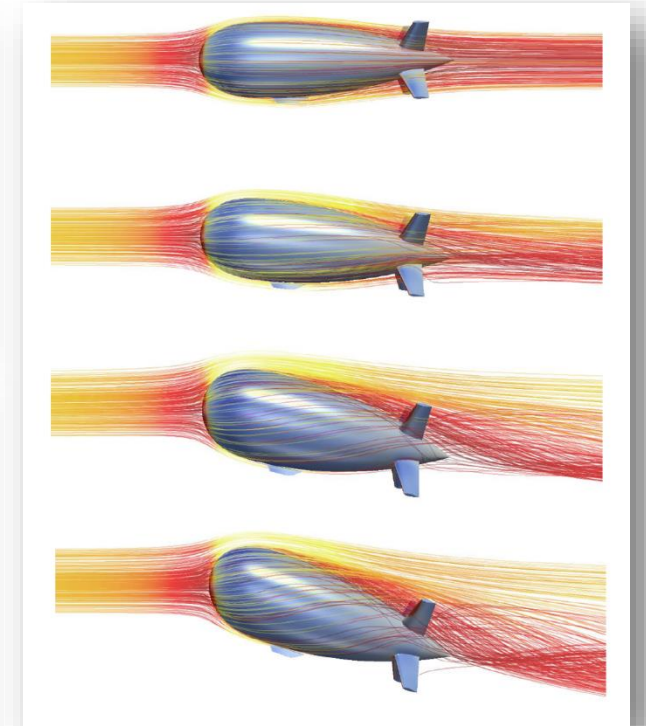
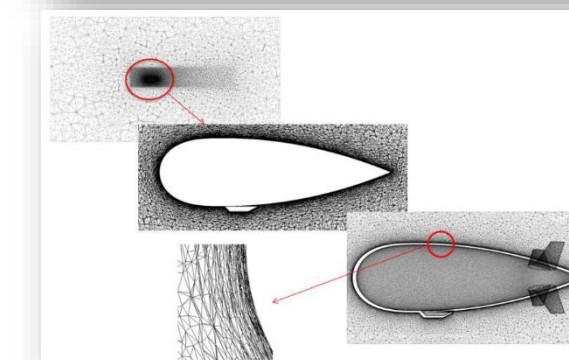
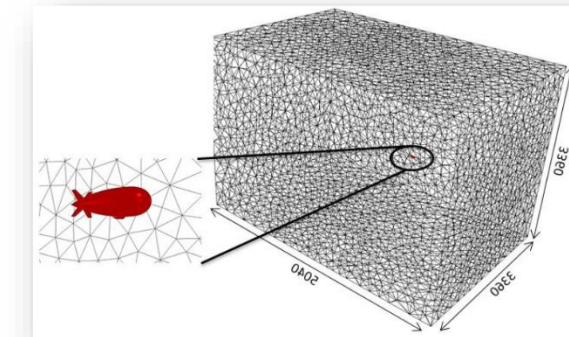
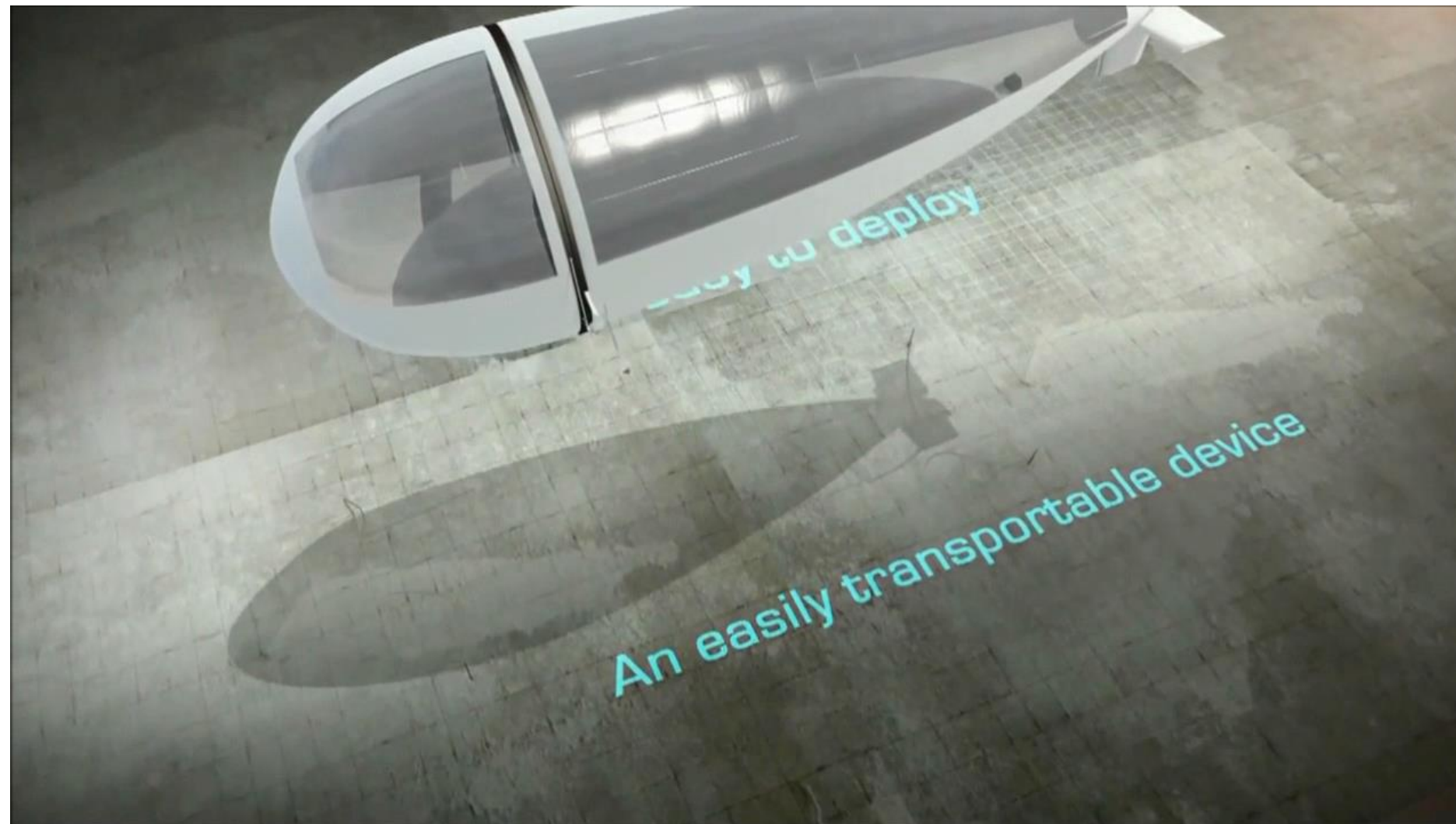




# Stratospheric airship

## Ground breaking algorithms :

- ❑ Adaptive and parameter free simulation process
- ❑ Automatic boundary layer mesh generation
- ❑ Reliable estimation using highly anisotropic meshing



CAD ➤ MESHING ➤ SETUP ➤ SOLVE ➤ POSTPROCESS



# Conception of a new drone



## Ground breaking algorithms :

- ❑ High flexibility to optimize the process such as the conception of a new civil drone
- ❑ Extensive validations with benchmarks and experiments

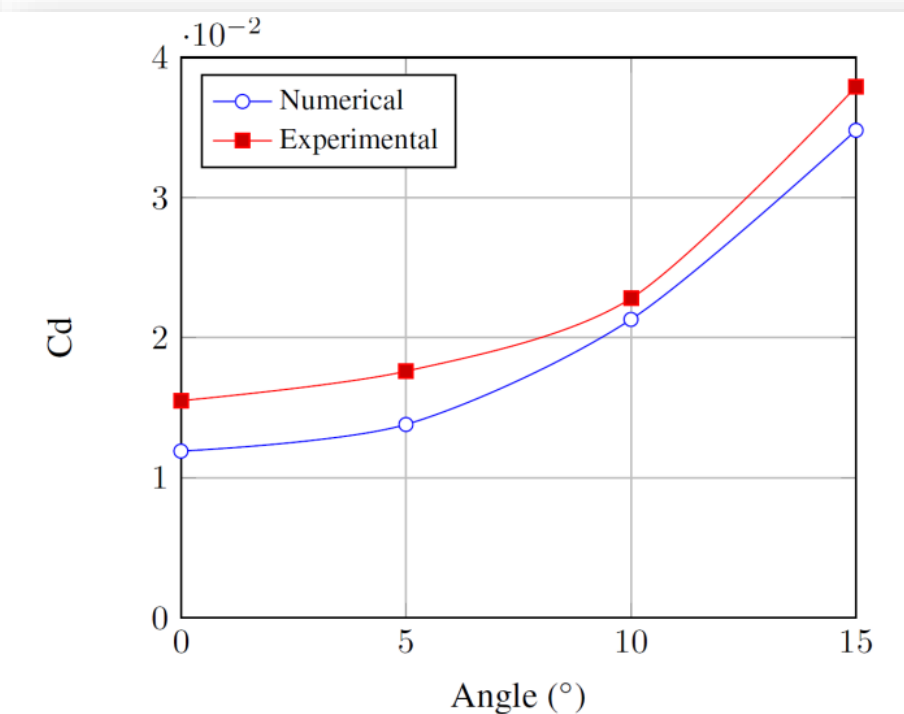
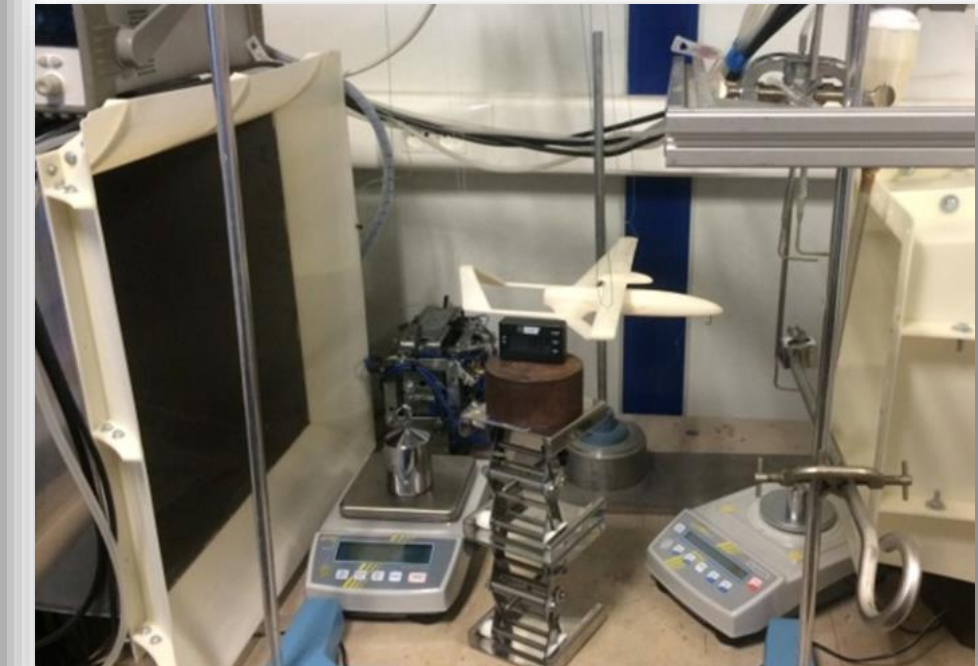
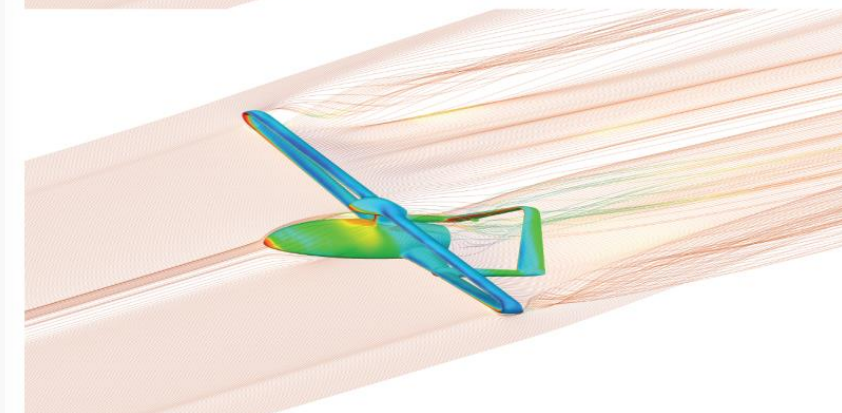
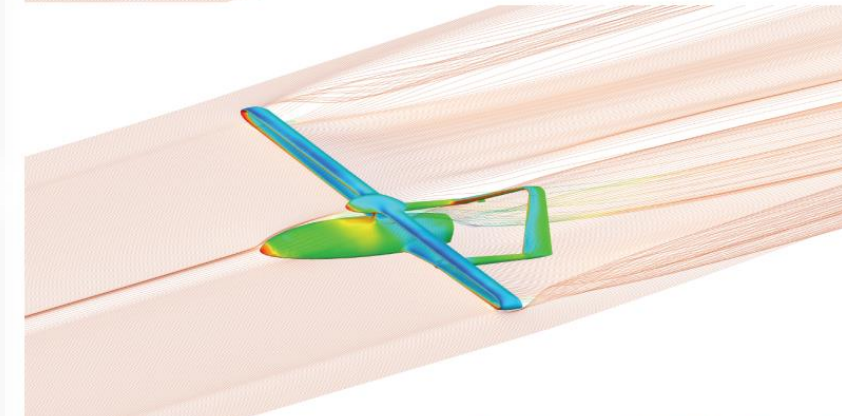
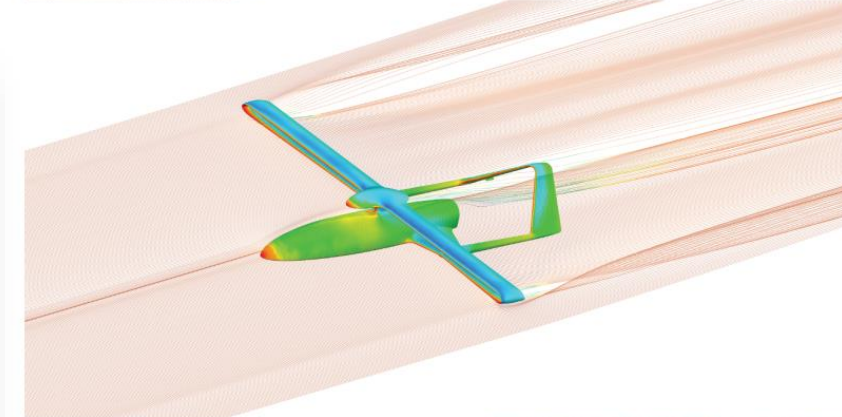
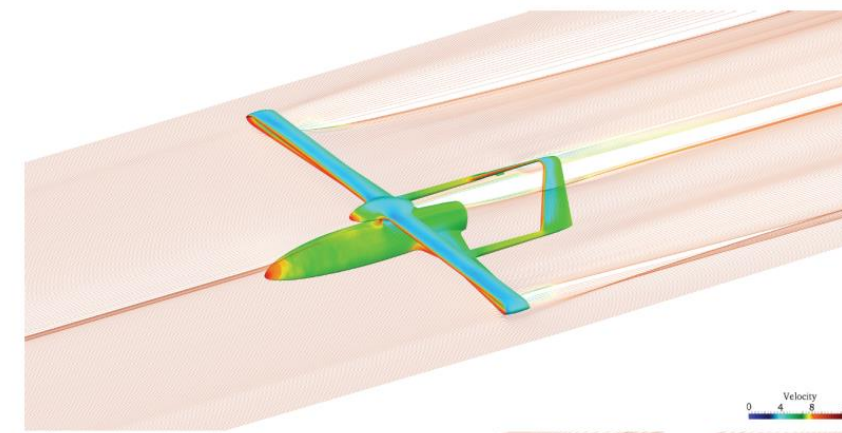
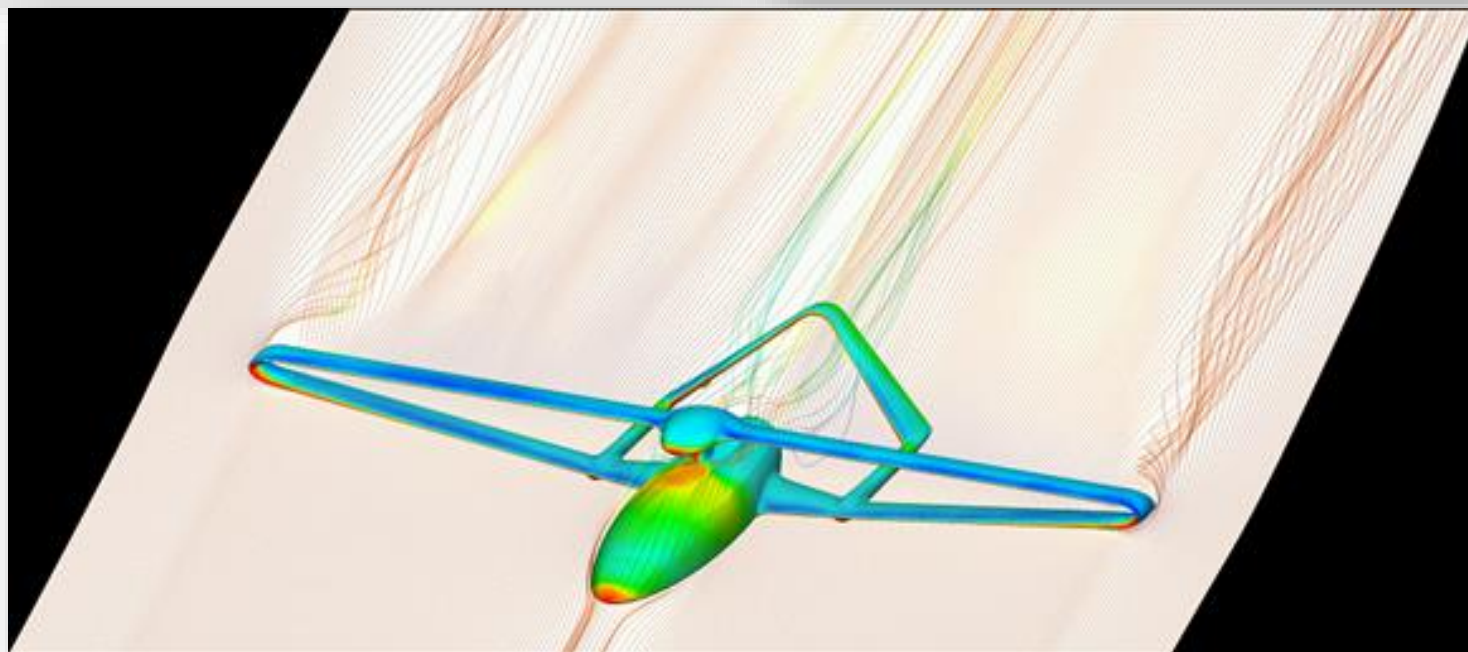
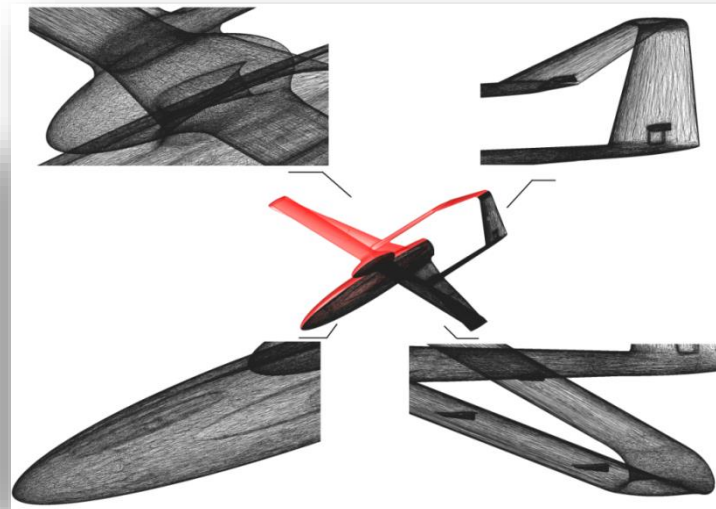
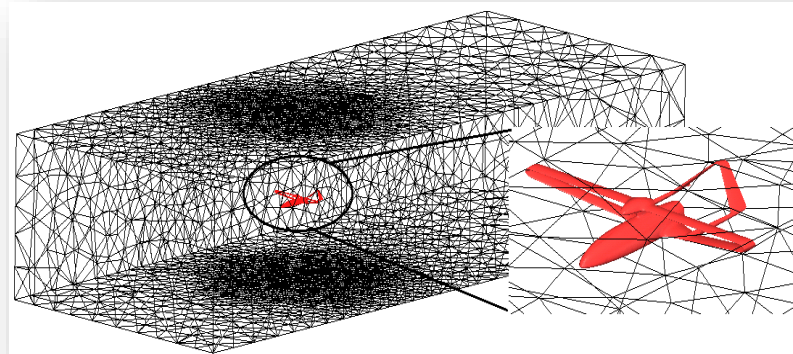


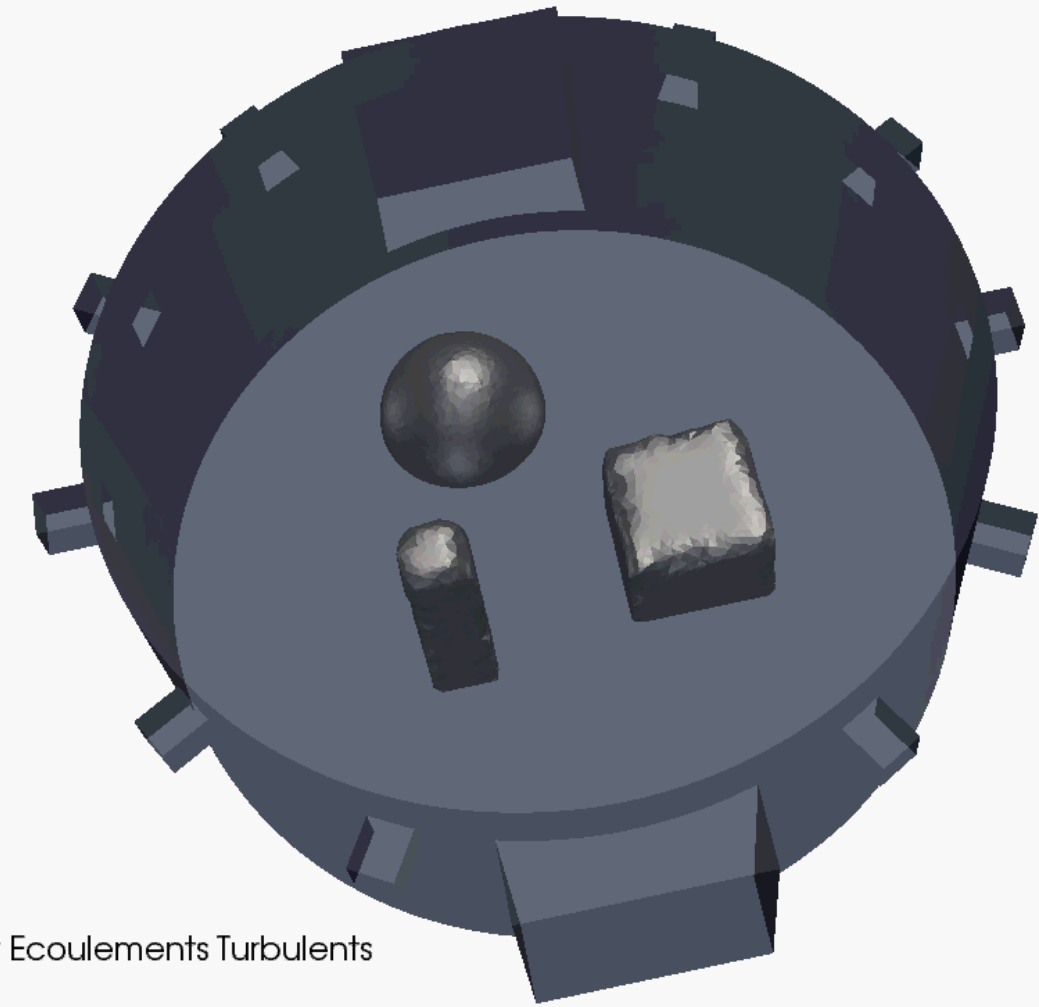
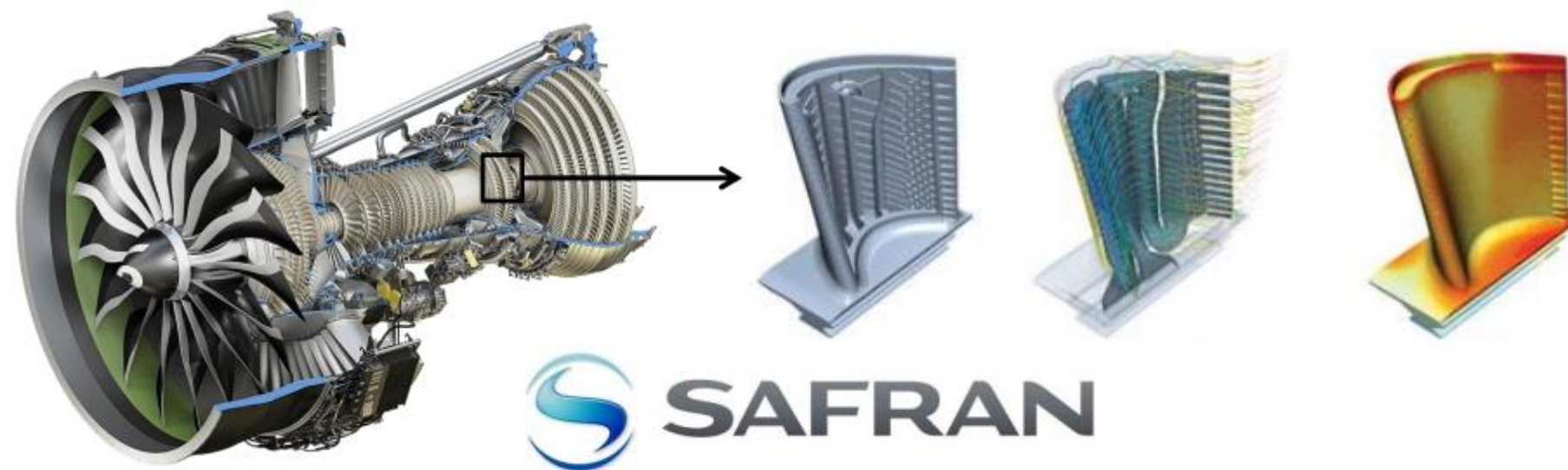
Figure 15. Comparisons for the drag of the UAV at 10m/s



# Aerothermal optimization

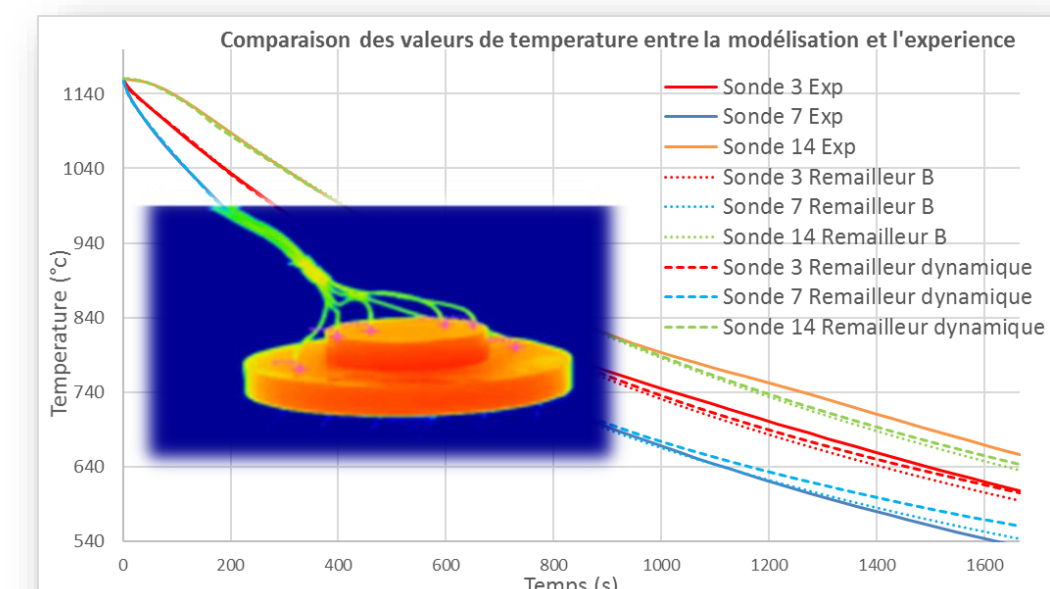
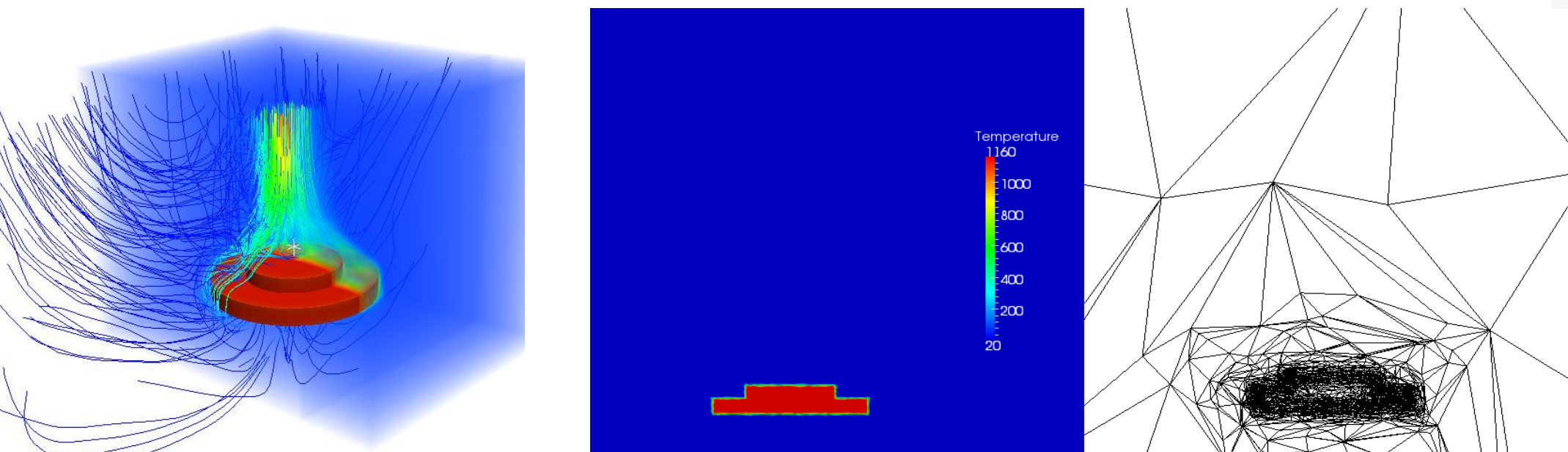
## Ground breaking algorithms :

- ❑ Conjugate heat transfer
- ❑ Challenging industrial processes
- ❑ Thermal treatment for high value parts



Transfert Thermique et Ecoulements Turbulents dans un four industriel

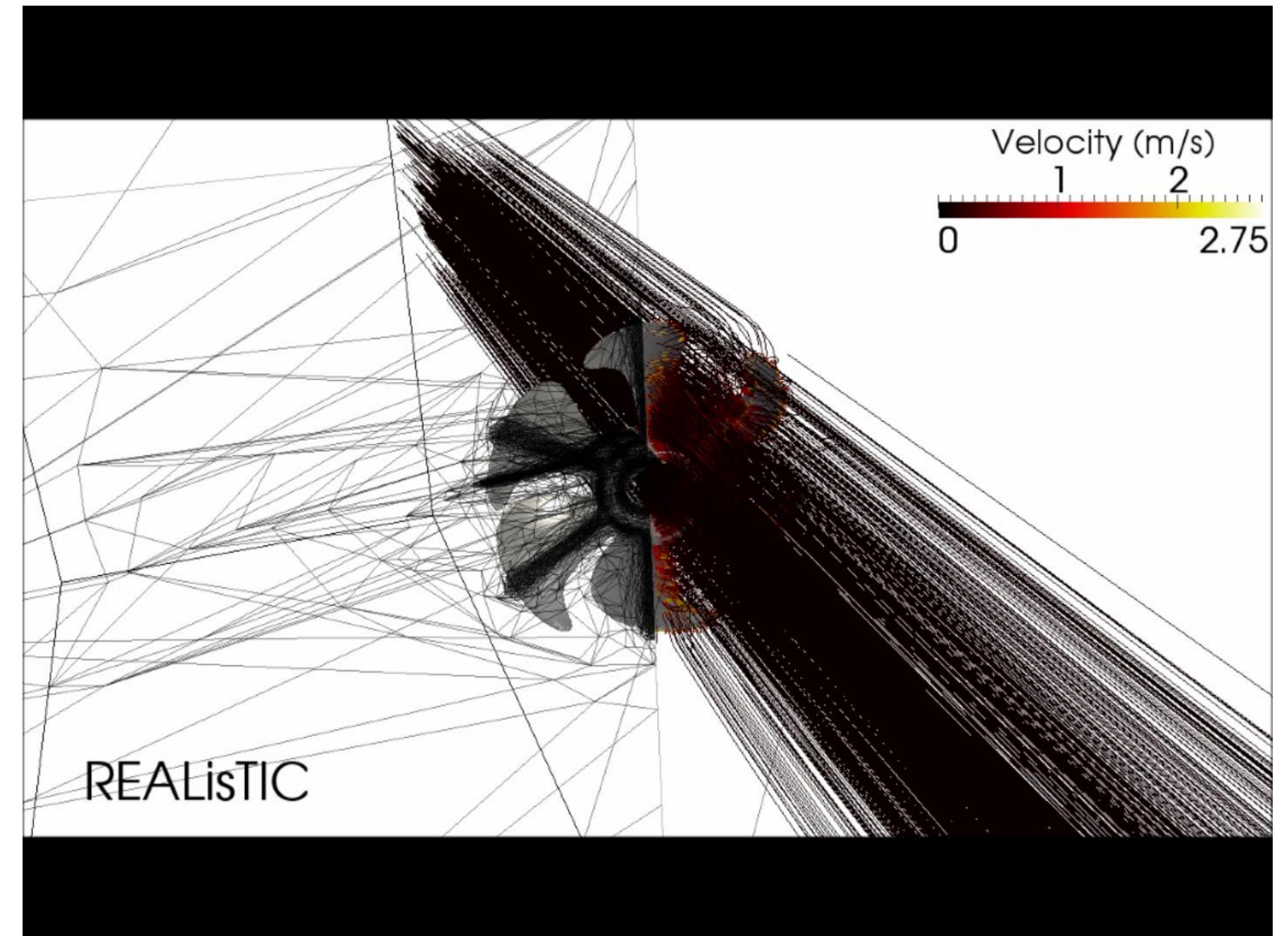
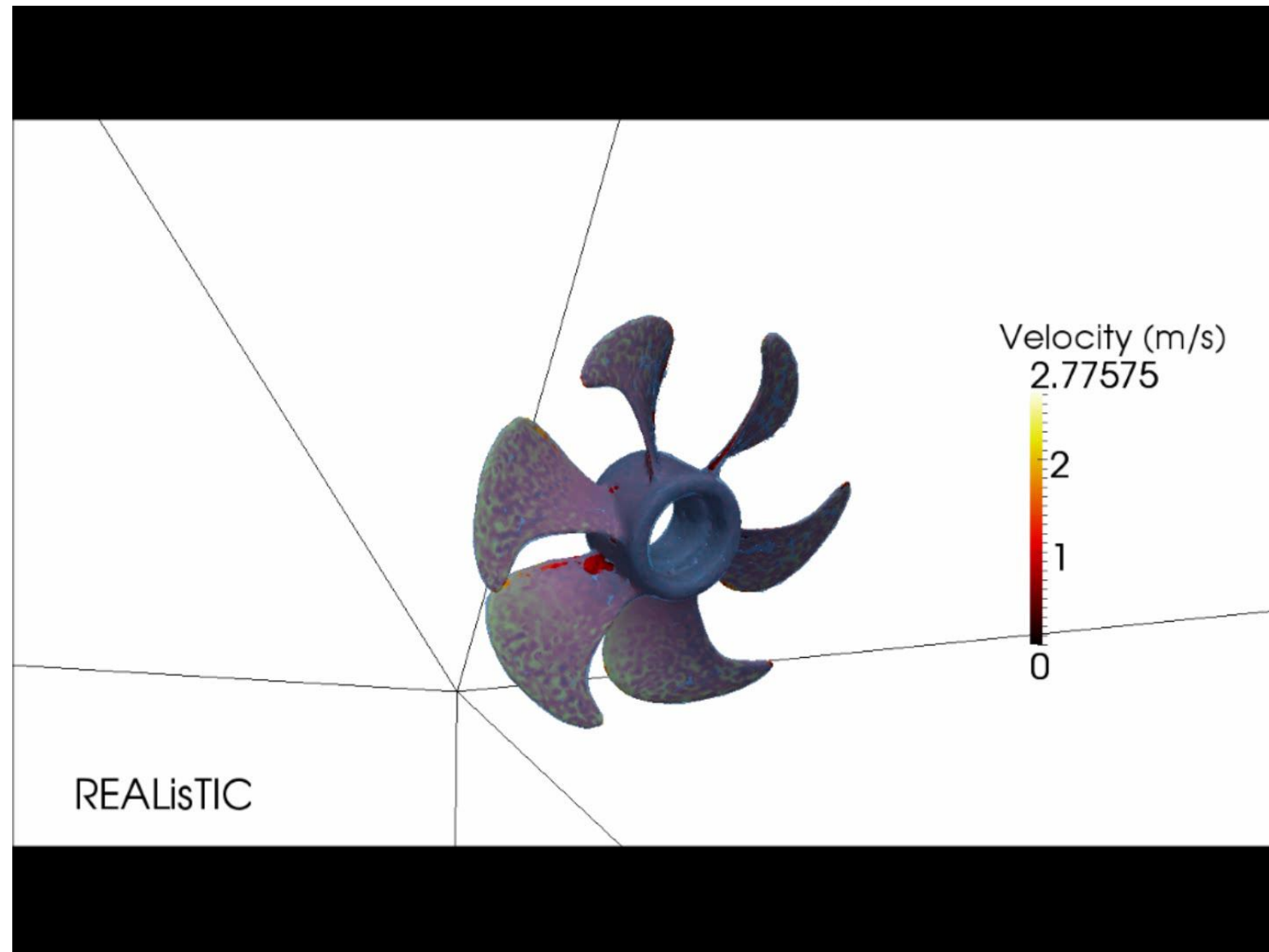
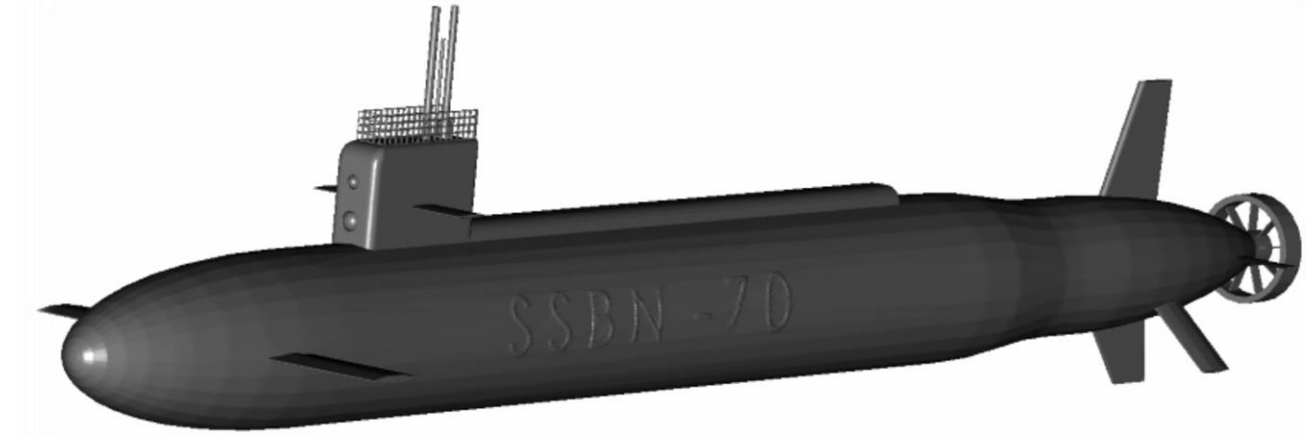
CimLib 2010





# Wind turbine simulations

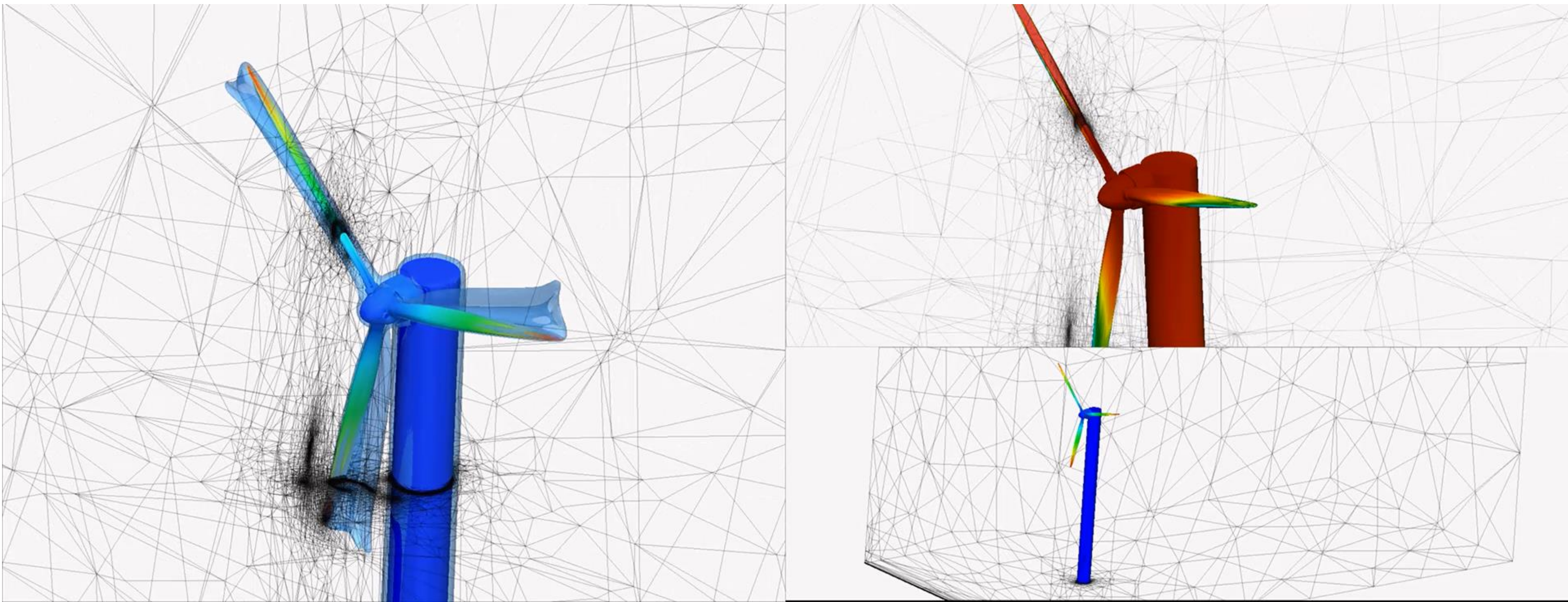
- ☐ *Complex geometries*
- ☐ *Immersed method*
- ☐ *Moving geometries*
- ☐ *Unsteady mesh adaptation*





# Wind turbine simulations

> Innovative adaptive focus on boundary layers





**When Science Meets Industry.**

**When Industry Meets Software company.**



# Changing the business model

## The benefits

- ❑ *Help enterprises take off complex simulations in the cloud*
- ❑ *Make advanced simulations accessible for subject matter experts*
- ❑ *Design environments tailored to specific requirements*
- ❑ *Offer pay-as-you-go model based on the number of cores and amount of data required for each individual simulation*
- ❑ *Avoid large investment of time, effort and technical expertise*



## New collaboration

*“A working relationship and innovation partners since 2014”*

**MINES  
PARISTECH**

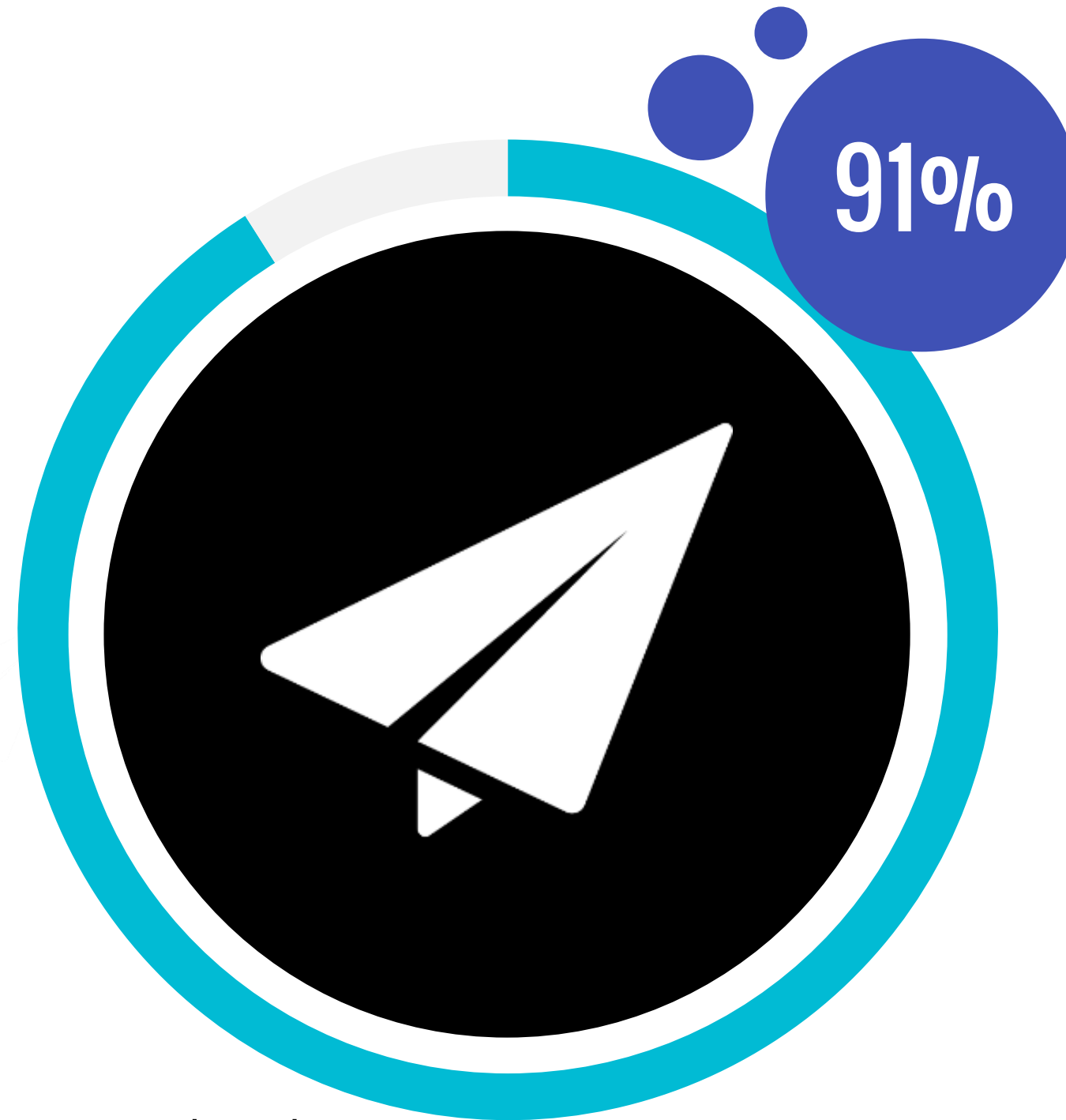
Researchers and an  
army of PhDs

**IBM Spectrum  
Computing**

Infrastructure,  
Technical  
specialists and  
Cloud experts



# Transfer Disruptive Research to Industry



## Enabling our clients:

- ❑ to set up secure clusters with customized software stacks in the cloud within one month
- ❑ to reduce simulation lead times by 91%
- ❑ to provide cost-effective HPC services.

## DETERMINE YOUR NEEDS

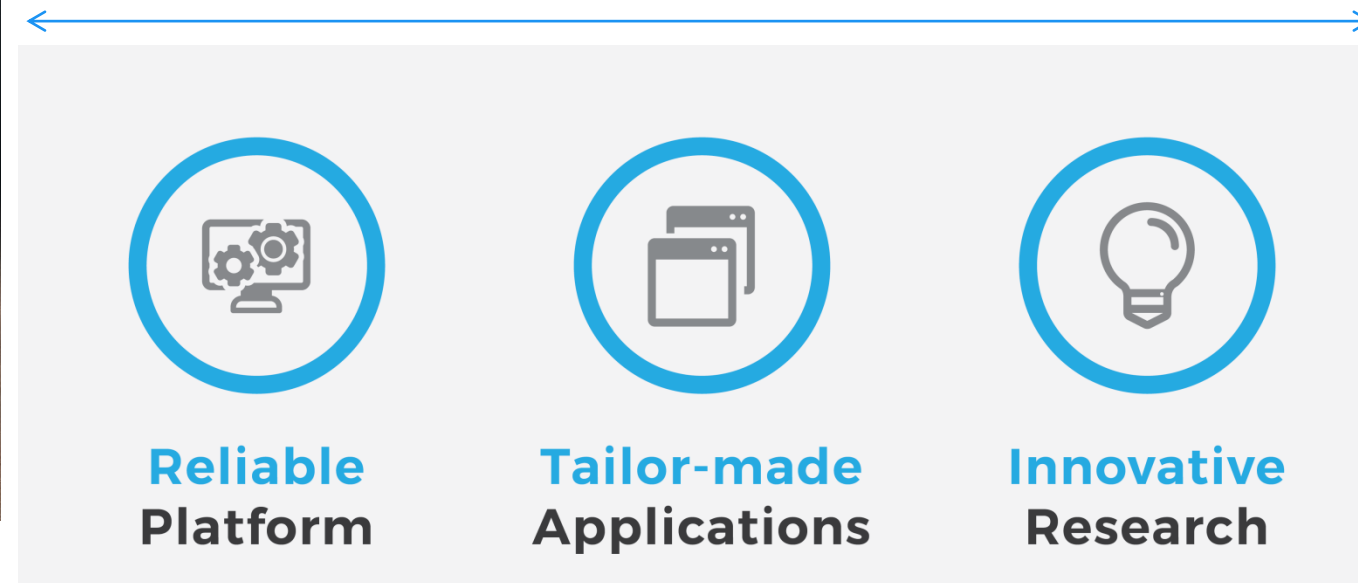
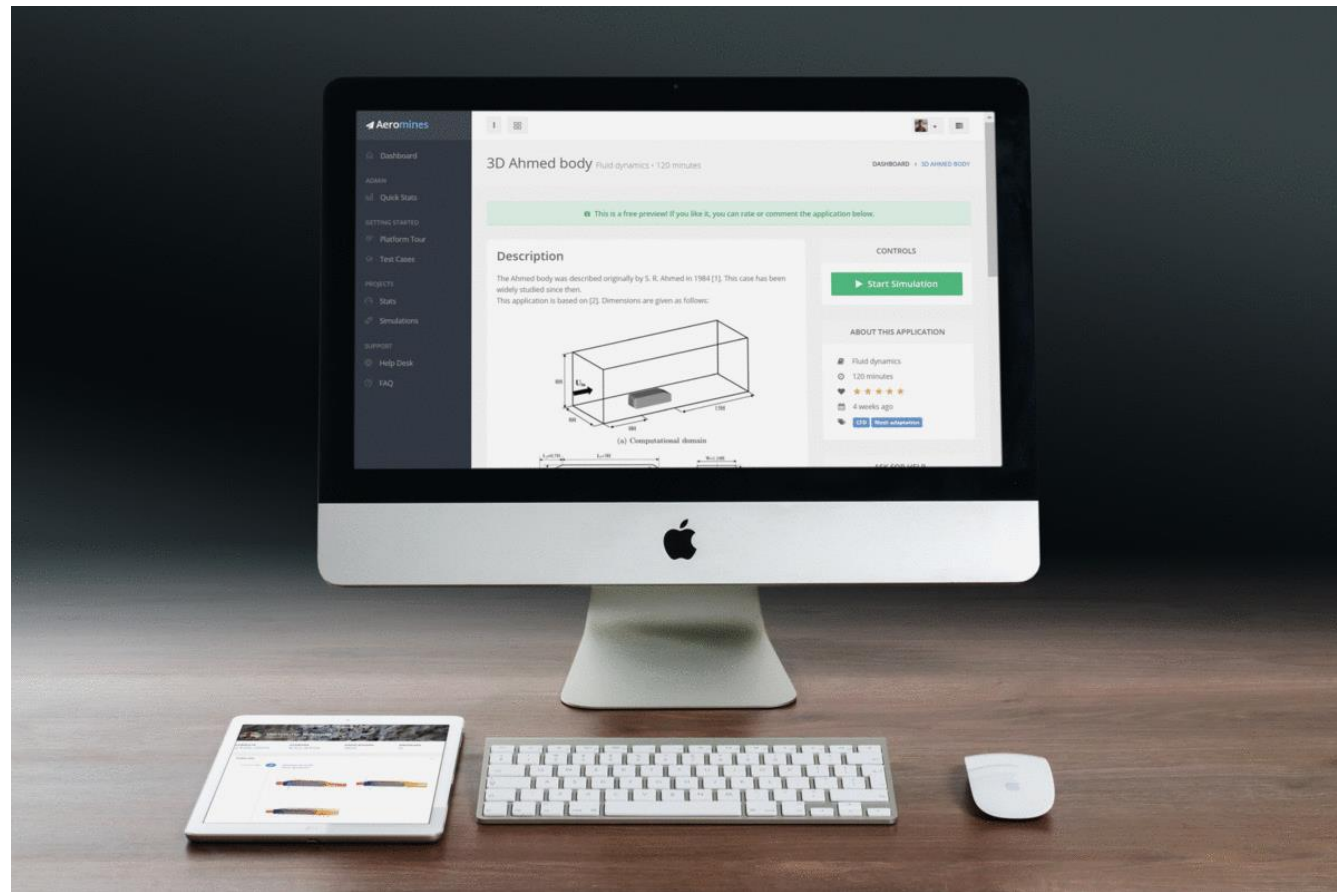
Understand a process in different conditions, or analyze the drag and lift of your aircraft or optimize the design of a prototype? We will help you to determine your requirements together.

## YOUR APP TO THE CLOUD

We will setup and quality check your application offline before making it available to your secure cloud session. You will then be able to run your application from everywhere, to modify the critical parameters and to visualize the results in real-time!



# Cloud computing Platform



## Example: Wind Farm design

- ☐ ***Dimension of your domain (Bbox)***
- ☐ ***Number of wind turbines***
- ☐ ***Position of each one***
- ☐ ***Inlet and wind velocities***
- ☐ ***and other parameters...***







# THE LIST OF PARTNERS

IBM  
Spectrum  
Computing

TERATEC  
Forum

Carri  
Systems

Mines  
Paristech

GENCI

+ European  
Collaborations



# Info

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