ESTECO
USERS' MEETING
NORTH AMERICA

um
2023

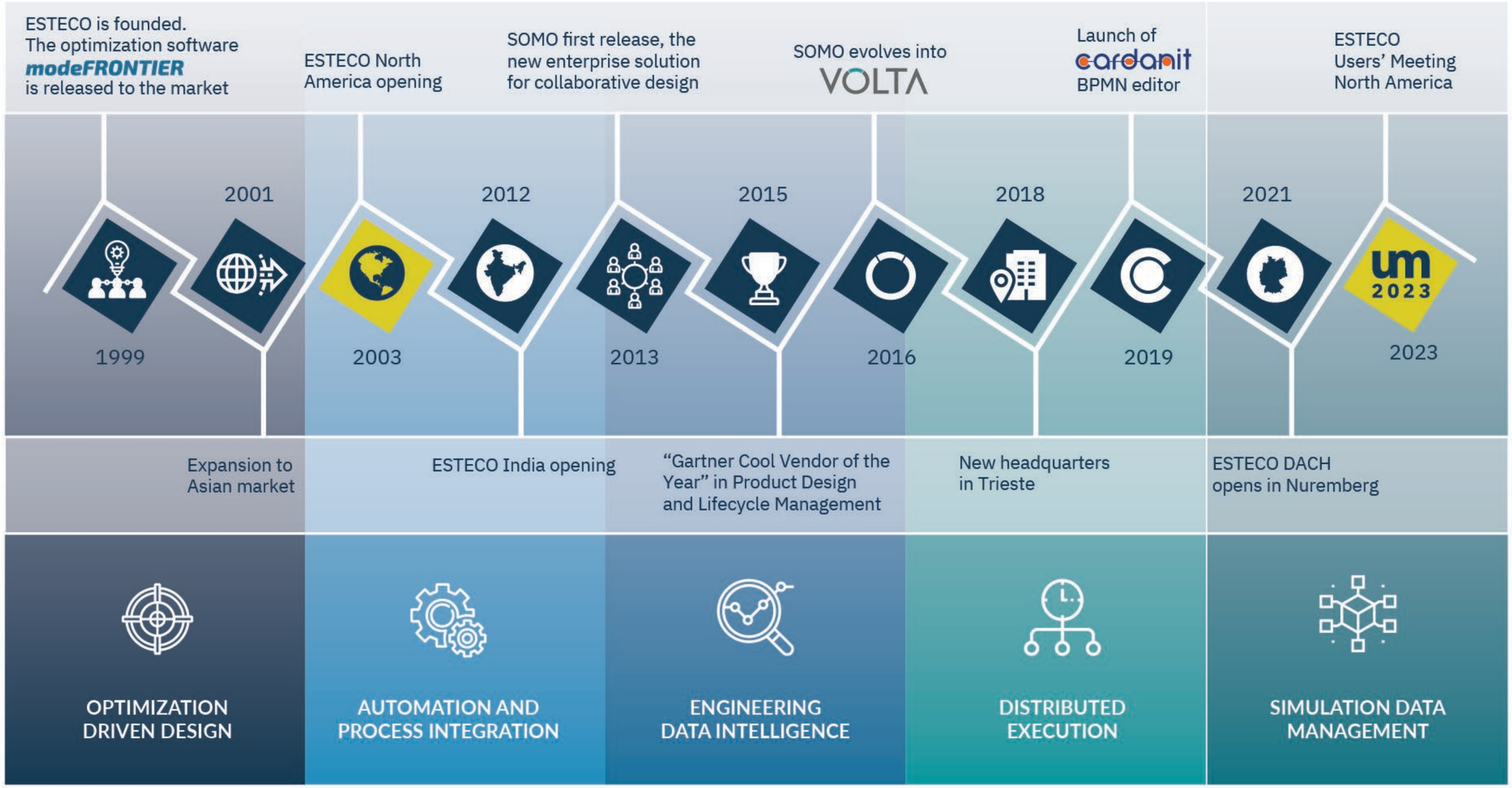
# 20 Years of innovation in North America: a review of an ongoing journey

Carlo Poloni
President

ESTECO is an independent software company, highly specialized in numerical optimization and simulation process and data management.

# 20+ years of innovation

ESTECO was founded after a successful EU project code-named “FRONTIER”



# ES.TEC.O. srl

The ideal partner for making CAE tools and IT infrastructure PROFITABLE in your company

# *Our mission is to help companies push the envelope in product design*

*Nowadays everybody points to cost cutting and reduction of time-to-market as the only means to stay competitive.*

*However, we at ESTECO believe that having* **the best product** *is still something that companies should strive for.*

# Company History

| | |
|---|---|
| 1984 | Structural analysis |
| 1992 | Acoustics/Dynamics, CFD |
| 1995 | Multi-Body structural optimisation |
| 1997 | Process simulation |

ENGIN SOFT

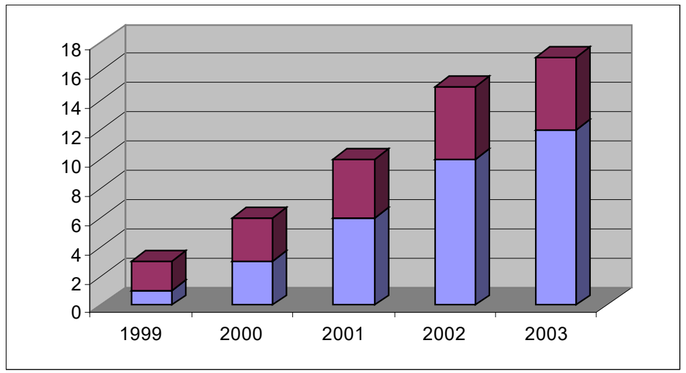
| | |
|---|---|
| 1999 | ES.TEC.O is founded |
| 2000 | FRONTIER 2.0 is released |
| 2001 | FRONTIER 2.4 is a world-wide recognised engineering tool |
| 2002 | Version 2.5.1 is released |
| 2003 | Version 3.0 is released |

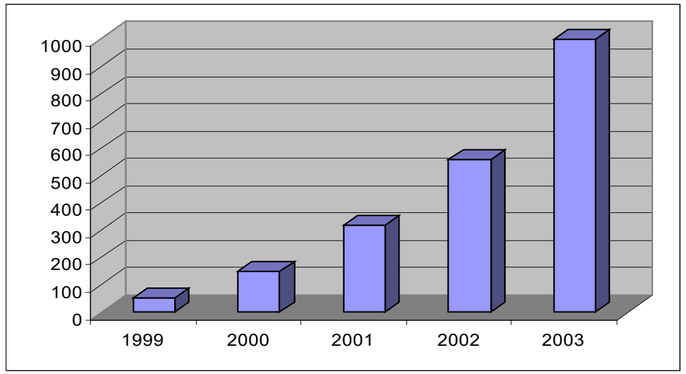
ESTECO
Achieving Perfection

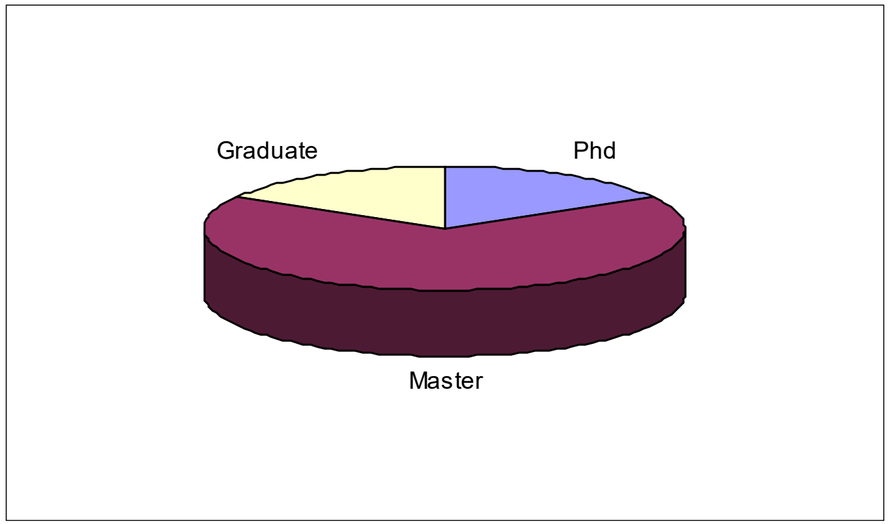
| | |
|---|---|
| 1998 | FRONTIER v1.0 issued |
| 1996 | FRONTIER EU project start |
| 1995 | First Multi-Objective opt. With British Aerospace |
| 1993 | Laminar CFD optimisation |

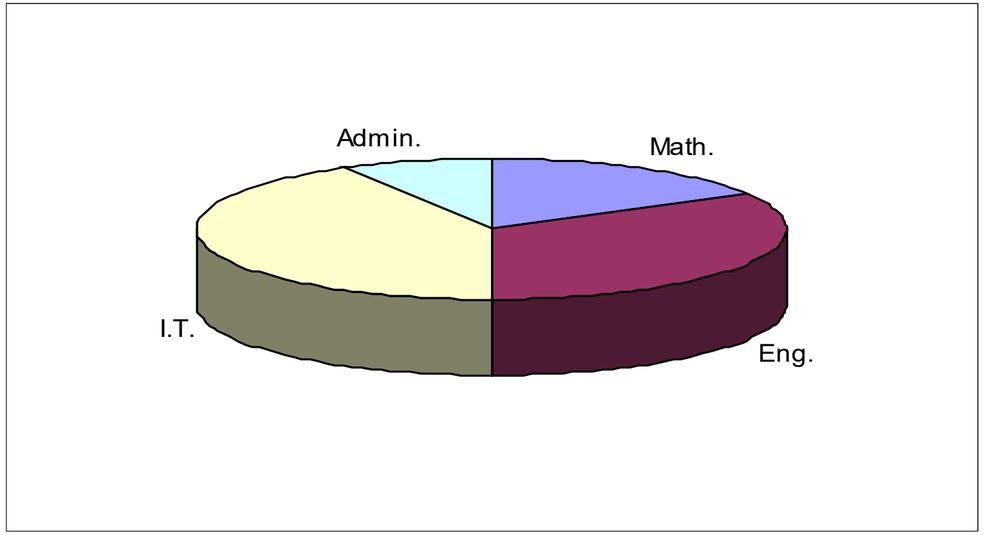
FRONTIER

# Business data and personnel



# modeFRONTIER around the world


* Office to be founded in 2003-Q4

# ES.TEC.O. Products

**modeFRONTIER**: *Software Environment for Multi-objective Design Optimization*

**ProcInt**: *Graphic Environment for Process Integration and Design Evaluation*

**SP4WEB**: *Framework for Browser-Based Access to Design Evaluation and Multi-Objective Optimization*

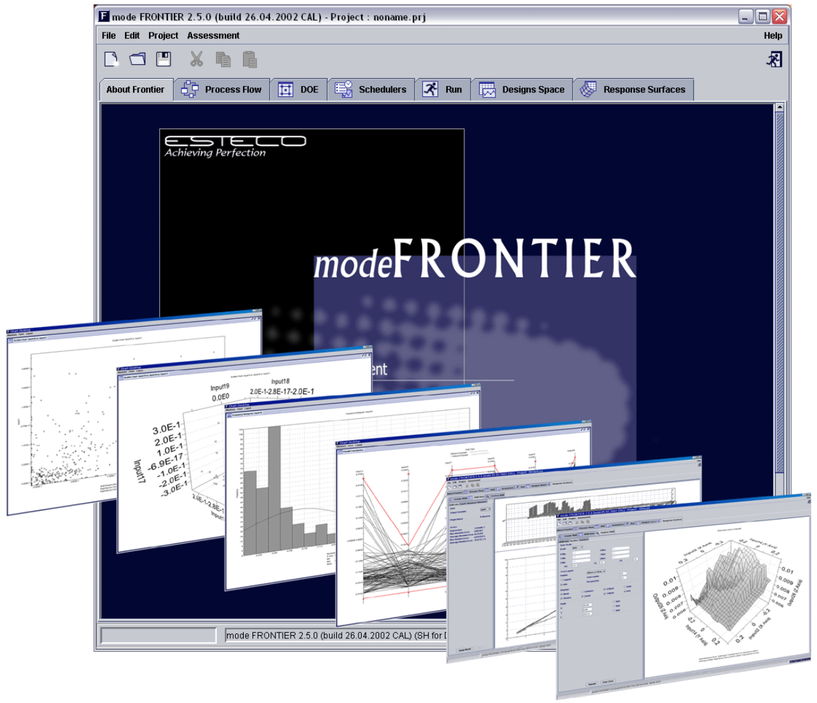
# ES.TEC.O. Products

**modeFRONTIER**

*A Software Environment for Multi-objective and Collaborative Design Optimization*

Features:

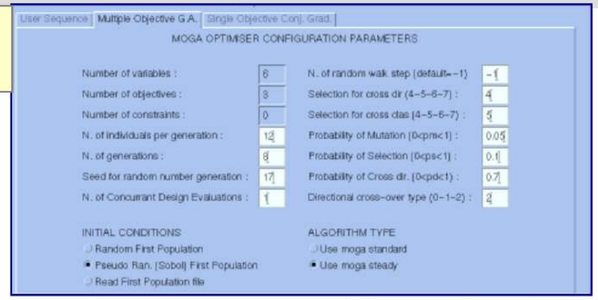
- Browser based technology (JAVA, RMI, XML)
- Capability of Handling any Computing services
- Optimization Algorithms
- Work-Flow environment for developers
- Decision Support Tools



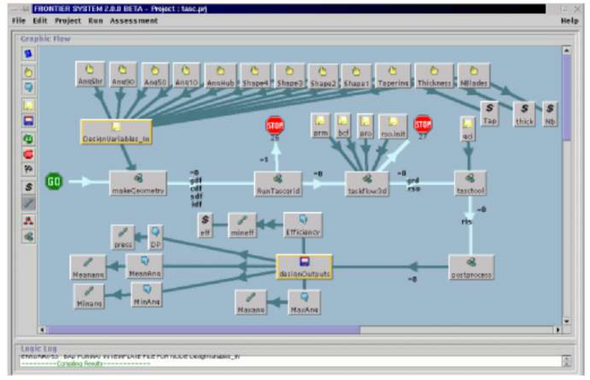
# Development History

- 1999 – FRONTIER 1.0 issued
- 2000 – FRONTIER 2.0 is released
- 2001 – FRONTIER 2.4 is released
- 2002 – modeFRONTIER 2.5.1
- 2002 – modeFRONTIER 3 under development
- 2003 – modeFRONTIER 3.0 under beta testing
- **TODAY: modeFRONTIER version 3 officially is released**

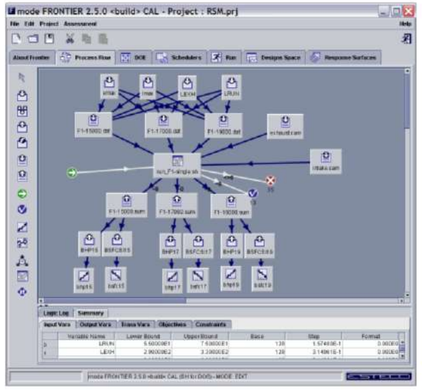
v. 1.0

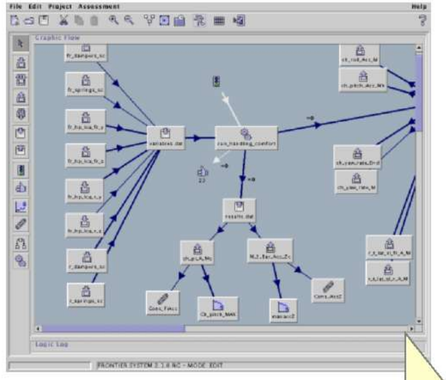



v. 2.0



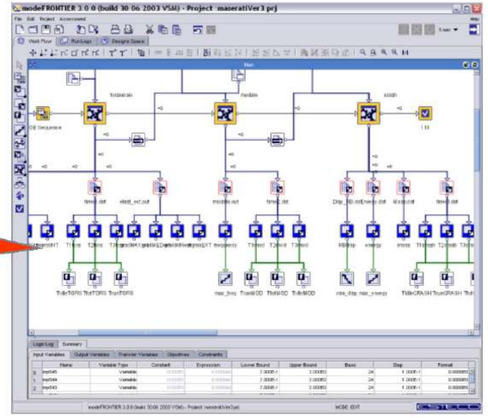
v. 2.5





v. 2.3

v. 3.0



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# modeFRONTIER

*A Multi-Objective Optimization & Design Environment*

***modeFRONTIER:*** A Software Environment for Multi-objective and Collaborative Design Optimization

## Design of Experiments

**User** Doe
**Random** Sequence
**Sobol** Sequence
**Full Factorial**
**Cubic-Face-Centred**
**Taguchi** Orthogonal Array
**Box-Benken**
**Montecarlo** Perturbations
**Reduced Factorial**
**Latin Square**
**D-Optimal**
**Cross Validation**

## Multi Criteria Decision Making

**Design** relationships
**Attribute** relationships
**Utility** Functions
**Linear Search** of Utility Function
**Genetic Algorithm Search** of Utility Function
**Hurwicz** MADM
**Savage** MADM

## Optimization Algorithms

**DOE Sequence –** Used for design space exploration
**MOGA** - Multi Objective Genetic Algorithm
**BFGS** - Modified Quasi-Newton single-objective optimizer (with constraints)
**SIMPLEX** - Single-objective derivative free optimizer (with constraints)
**SA -** Simulated Annealing
**DES -** Derandomized evolution strategy for continuous variables, single objective optimization by prof. dr. T. Back.
**MMES -** Multi-membered evolution strategy for continuous and discrete variables singe and multi-objective optimization by prof. dr. T. Back.
**FMOGA** - enables RSM aid to speed up convergence
**FSIMPLEX –** Simplex with Fast Convergence capabilities
**MOSA** – Multi-ObjectiveSimulated Annealing algorithm
**MACK** – algorithm that optimizes the RSM reliability
**NLPQLP –** Classic SQP algorithm by prof. Dr. K. Schittkowski

## Response Surface Modeling

**K-Nearest** - Local multi-linear interpolator (fast, applicable to low number of variables, low-medium accuracy).

**SVD** - Polynomial and exponential interpolation (fast, medium accuracy).

**Kriging** - Non-linear interpolator (more accurate for non linear problems).

**Neural Network** - The algorithm is based on traditional feed forward approach

**Gaussian Processes** - Stochastic Bayesian Algorithm

**User-Defined Parametric RSM** - The RSM is defined as an algebraic function of the input variables with unknown parameters

## Post-processing capabilities

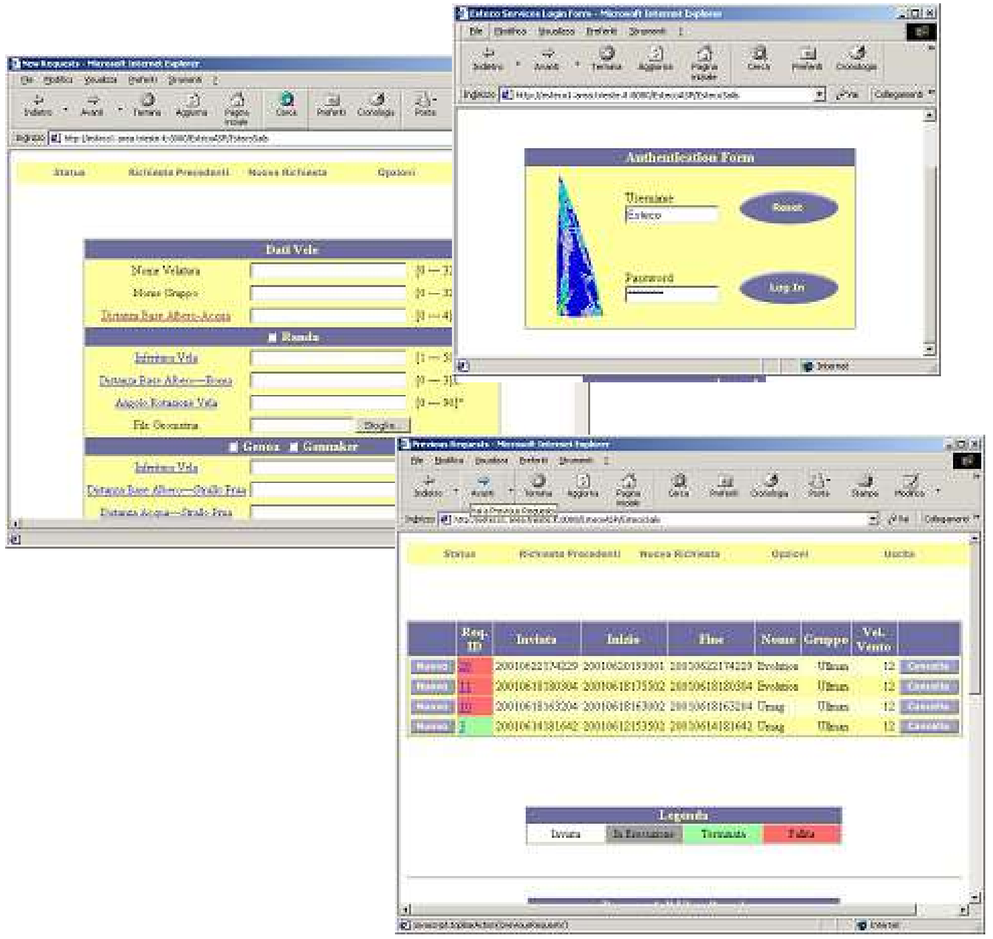
**History** Plots
**2D and 3d scatter** Plots
**Parallel Coordinates** plots for multi-dimension analysis
**Statistical Distribution** plots (for robust design and sensitivity analysis)
**Importance Factor** analysis based on Student parameter
**Correlation Chart**
**Broken Design Chart**

## *Multi-Objective Robust Design Optimization (MORDO) capability! (new version 3)*

SP4web

## SP4WEB - Service Provider for WEB

*A framework for Web-based engineering computation*



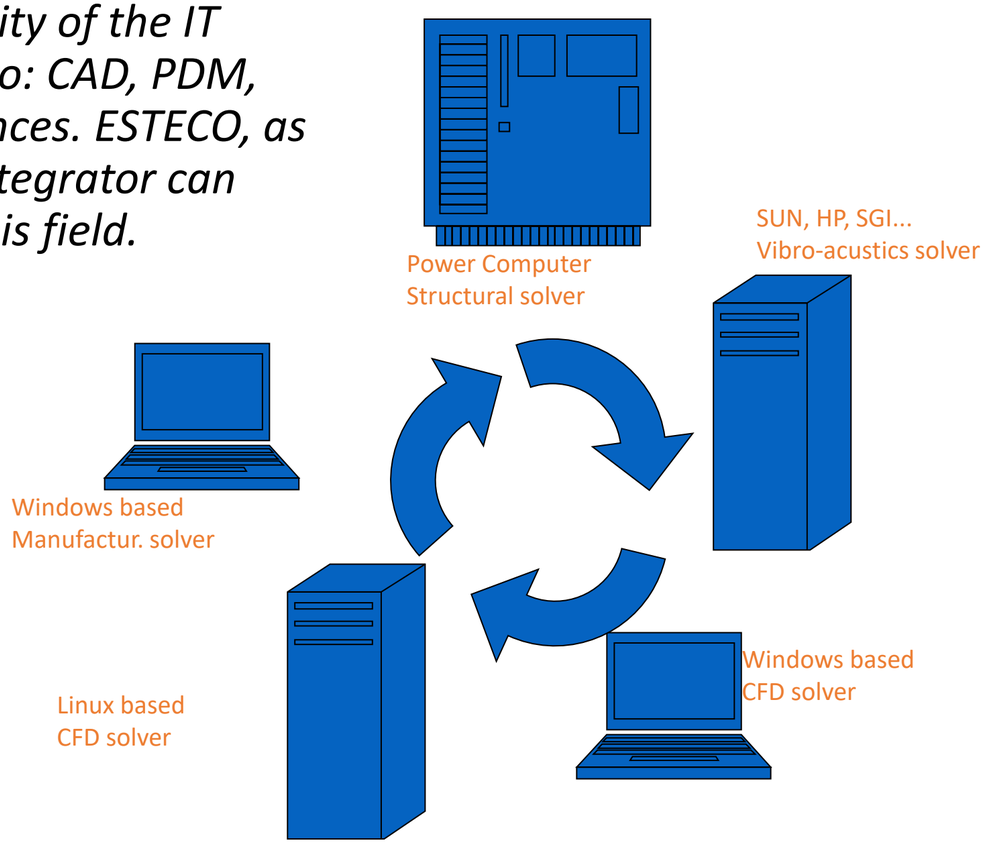

Features:

CAE services feasible through intranet or internet served by an Application Service Provider capable of:

- Accounting and access control
- Automatic report creation
- Interaction with any queuing system

## IT infrastructure design for CAE application

*CAE application requires a specialized IT competence that must look at cost, performance and usability of the IT infrastructure with consideration related to: CAD, PDM, Simulation software, Hardware performances. ESTECO, as an Engineering Software developer and integrator can provide the most qualified consulting in this field.*



# Find Us

ESTECO operative offices are located at Trieste **AREA Science Park** where Research become High Tech business

AREA SciencePark

# Pioneering time

First shape optimization with Genetic Algorithm and Navier-Stokes solver (1993)

Multiobjective optimization of airfoils (transonic/subsonic shapes) (1994)

First engineering tool to adopt Java language for portability (1995)

Adoption of Artificial Neural Networks for performance prediction (1998)

# Industrialization


Introduction of the Parallel Coordinate Chart for decision support in engineering design (1999)

Self Organizing Maps to analyze high dimensional datasets (2006)

Polynomial Chaos for uncertainty quantification (2008)

# Refinement


First to introduce MORDO and Reverse-MORDO (multi-objective robust design optimization) (2006 to 2008, 2006 with Montecarlo sampling, from 2008 with Polynomial Chaos)

Service Oriented Architecture for distributed computing (SOMO which became VOLTA) (2010 started, commercial v1 in 2013)

# Looking forward

Adoption of the BPMN standard for process modeling and execution of engineering simulations (2020)

First to adopt container architecture (2022)

# Our people

**our staff is our strength**

**150+**

**professionals**

**95%**

**with a university degree**

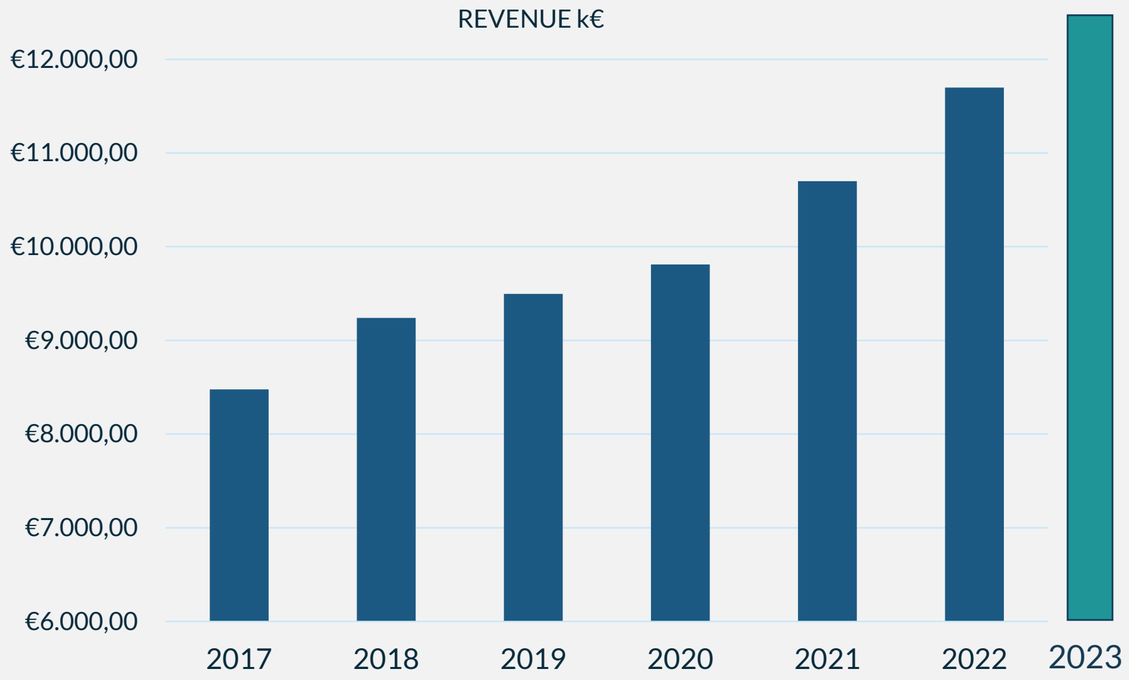
**17%**

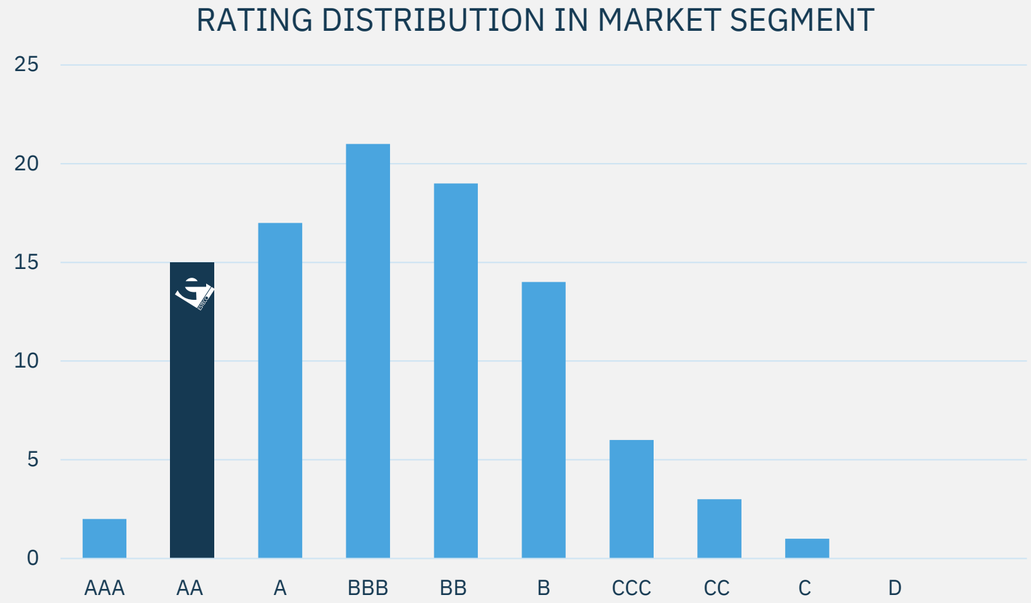
**with a PhD**

# Our stable growth

## (data related to ESTECO HQ Italy only)

| | Revenue [k€] | Default probability | Confidence | Rating |
|---|---|---|---|---|
| 2018 | 9241 | 0,11% | 100% | AA |
| 2019 | 9496 | 0,13% | 100% | AA |
| 2020 | 9879 | 0,11% | 100% | AA |
| 2021 | 10700 | 0,10% | 100% | AA |
| 2022 | 11700 | 0,10% | 100% | AA |



# Our values

**INNOVATIVE**

Our development is at the forefront of technology

**FLEXIBLE**

We respond quickly to customers' demand

**RELIABLE**

Continuous development and on-time delivery

**INDEPENDENT**

We integrate with any software

We provide **modularity**, **standardization** and **interoperability** within the engineering design process.

# ESTECO Technologies

Simulation Process and Data Management

Simulation Process Integration and Automation

Design Optimization

Business Process Management

HPC and Cloud

Robust Design and Reliability

Response Surface Models

Simulation Data Analytics

# Our products

modeFRONTIER

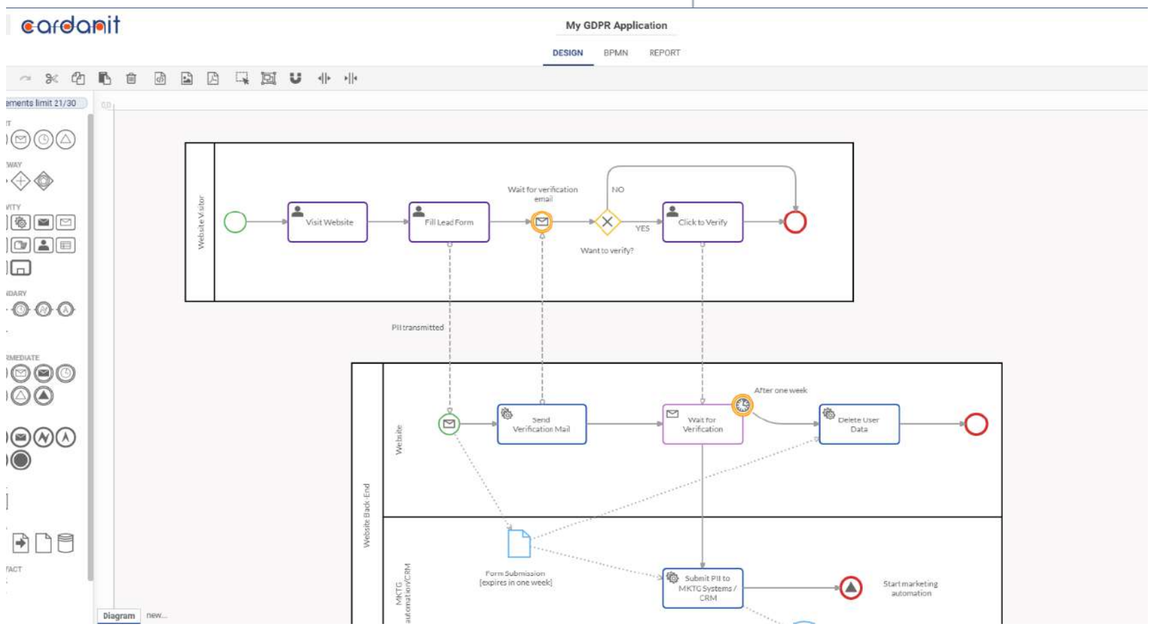
The leading software solution for simulation process automation and design optimization

VOLTA

The innovative enterprise platform for Simulation Process and Data Management (SPDM) and design optimization

# Our SaaS application

Born as a research project, Cardanit is the next generation collaborative tool for designing business processes.



# Our customers and industries

Embraer
General Atomics
Leonardo
Lockheed Martin
Raytheon
Ford
Honda
Stellantis
Toyota
Volvo Cars Corporation
Mahindra
TAFE
Volvo Trucks
ABB
Bajaj
BASF
Cummins
FAW
Whirlpool
Sony

Automotive and Ground Transportation

Aerospace

Architecture, Engineering and Construction

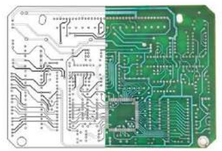
Manufacturing and Industrial Equipment

Marine

Energy

Healthcare

Consumer Goods



Electronics

# Less intuitive applications / customers

Optimization of sport equipment dynamic response

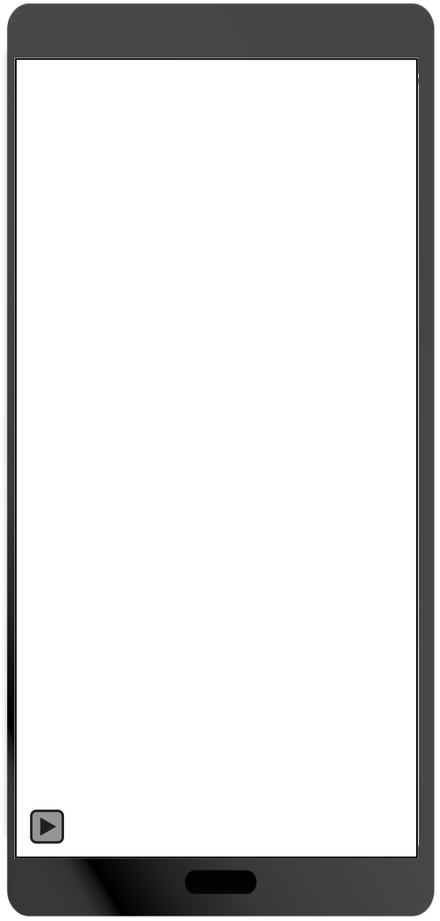
Robust design / analysis of assets in the supply chain (refrigeration systems, transit, storage, etc.)

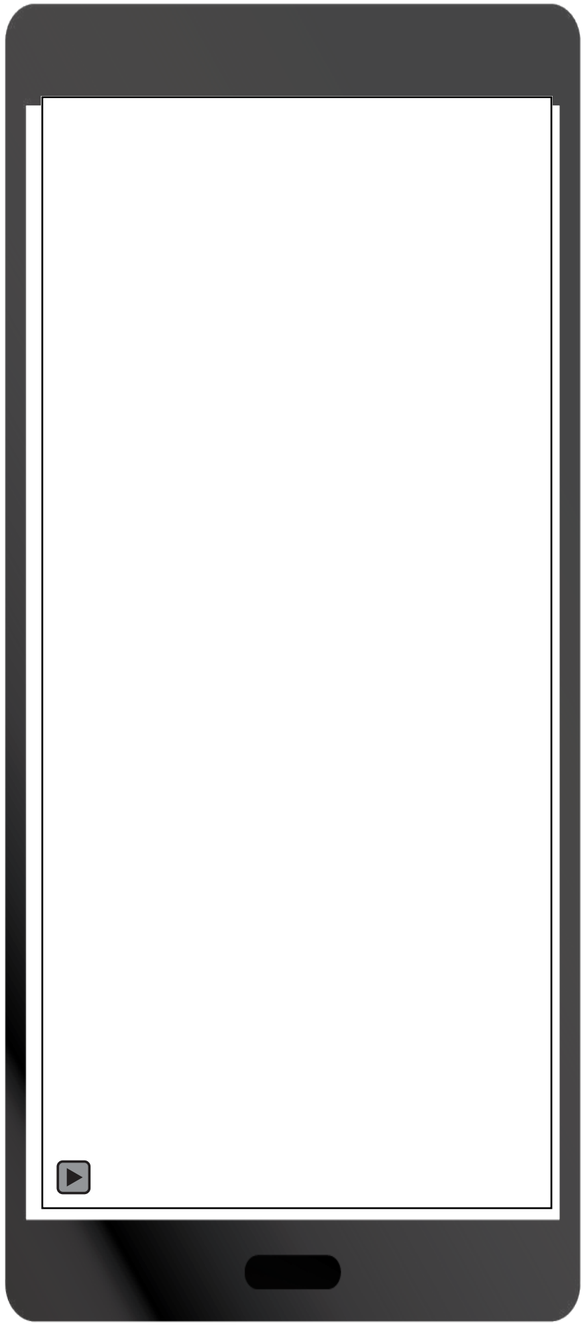
Social and Health services planning  in Bruxelles City

Port multi-modal transportation modelling and optimization

Port Network Authority
of the Eastern Adriatic Sea
Ports of Trieste and Monfalcone

# Our adventures





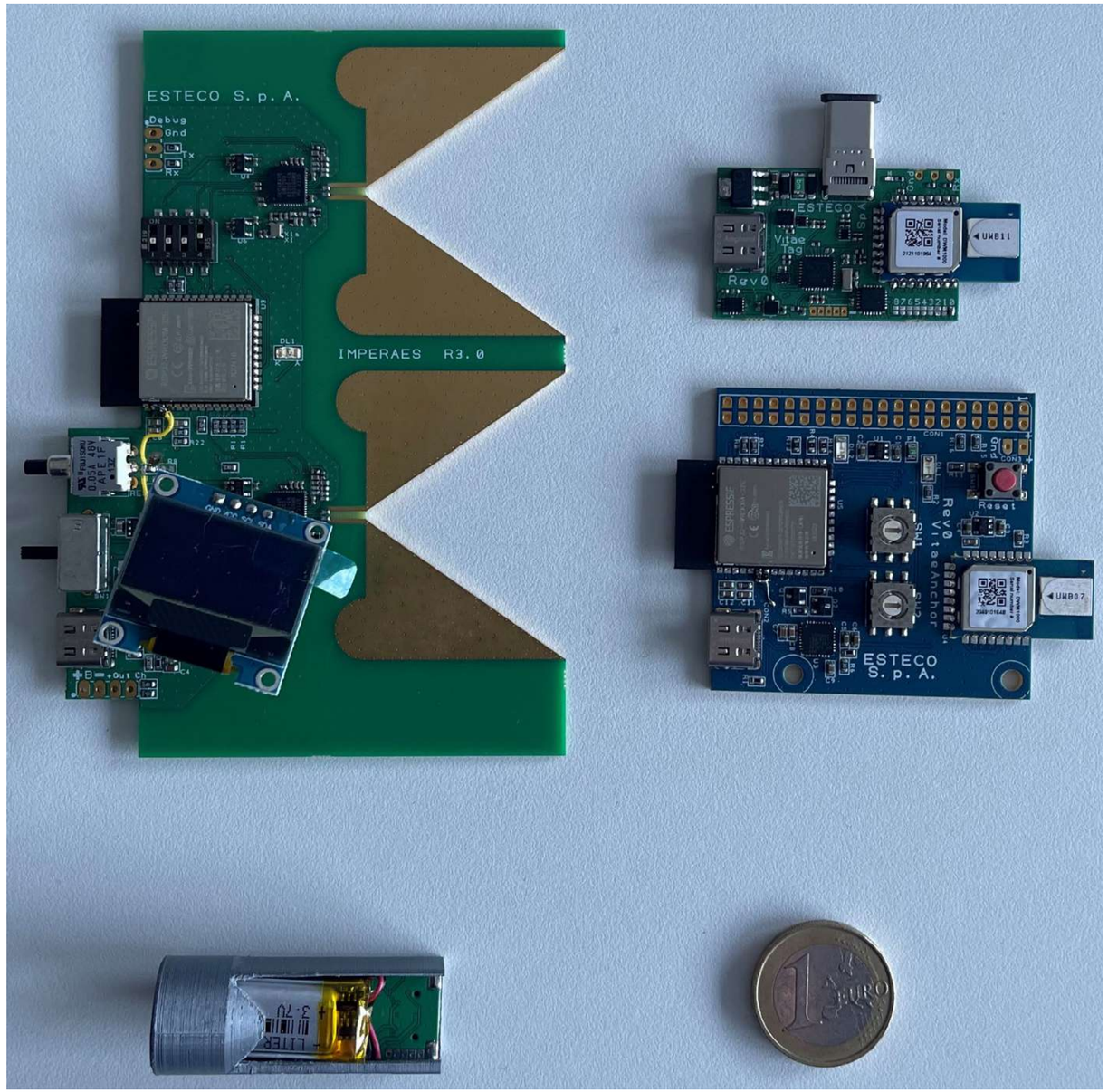
- Machine Learning
- Social login
- Progressive web apps
- Cloud

# Our adventures

HW prototypes

(es. Indoor localization, UWB based, proprietary algorithms and hardware)

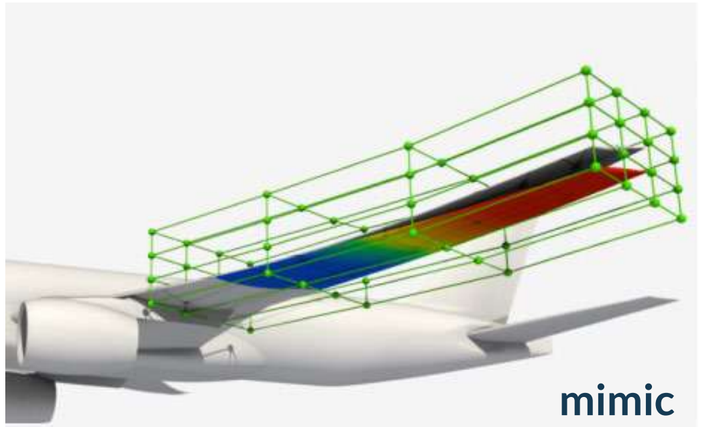
- IoT
- Machine Learning

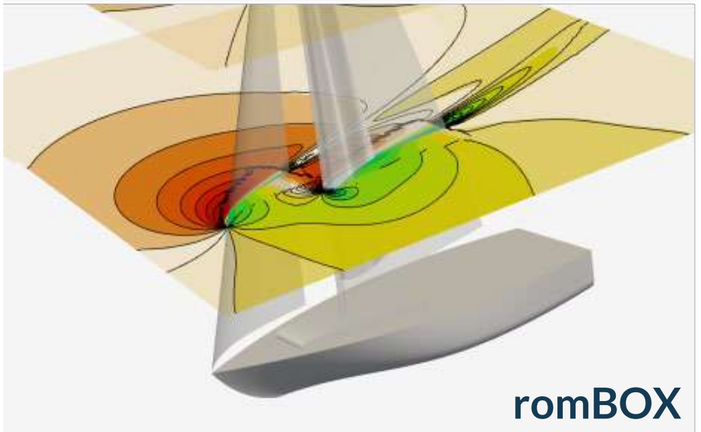


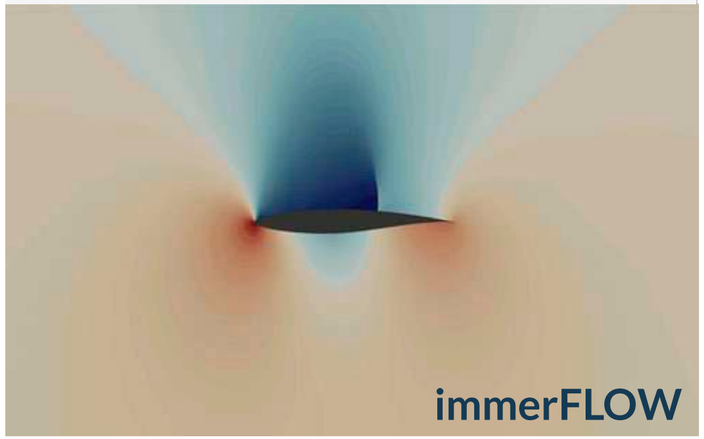
# Our adventures

OPTIMAD
numerical creativity

- Geometry morphing
- Reduced Order Models
- Immerse Boundary CFD



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# Thank you!

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