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TSW24 projects presentations

Prediction of Aerodynamics Fields around an Airfoil using Machine Learning

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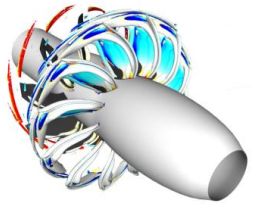
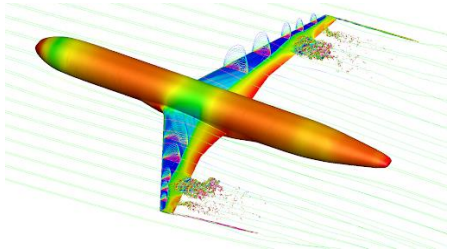
ML & Optimization theme leader
@Cenaero

Context

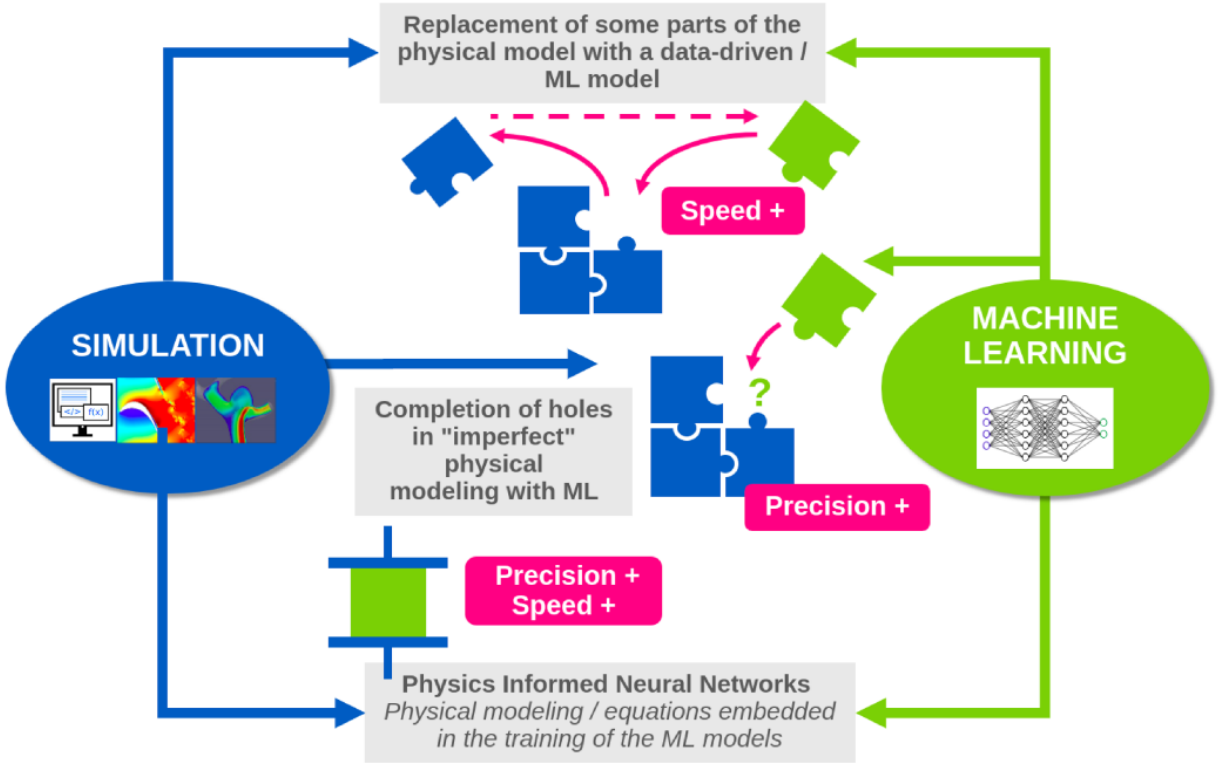
- Aerospace industry faces enormous challenges in ensuring that it is both environmentally friendly and economically viable

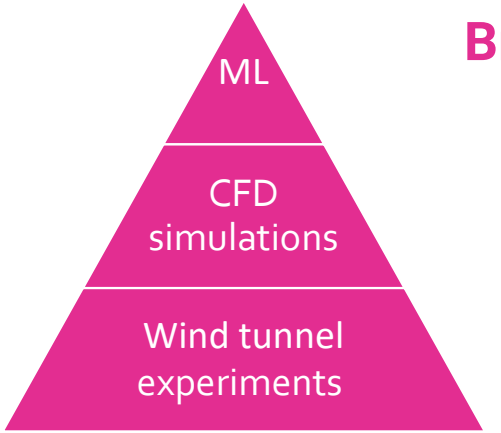




- Great importance to be able to analyze the physical fields

- Widely and smartly explore innovative and better designs by combining ML and optimization algorithms



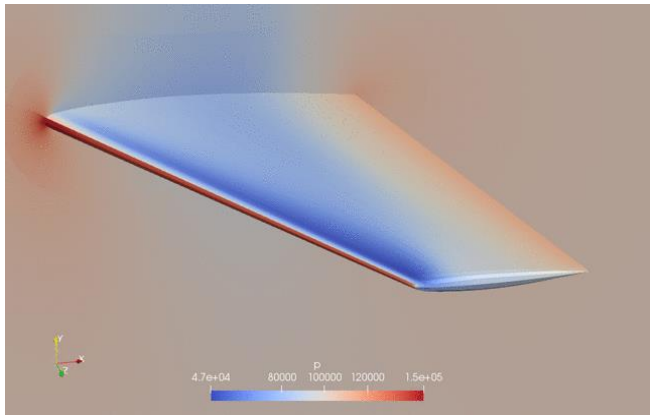


Bridging Physics and Machine Learning

Objectives of the Project

Prediction of aerodynamics fields around an airfoil

- Development of ML models to predict the physical fields of interest (pressures/velocities)
- Comparison of different ML models (Fourier Neural Operator, Graph NN, CNN, …) in a common comparison framework
- *[Optional]* Investigation of the enrichment of the model

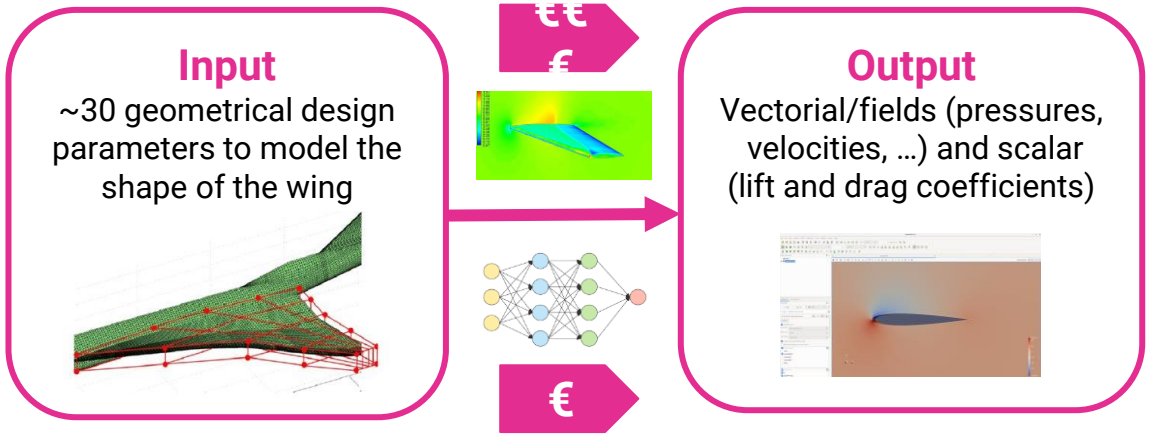


The Onera M6 wing is a classic CFD validation case for external flows.

Data

Open dataset of CFD simulations generated and provided by Cenaero prior to the workshop

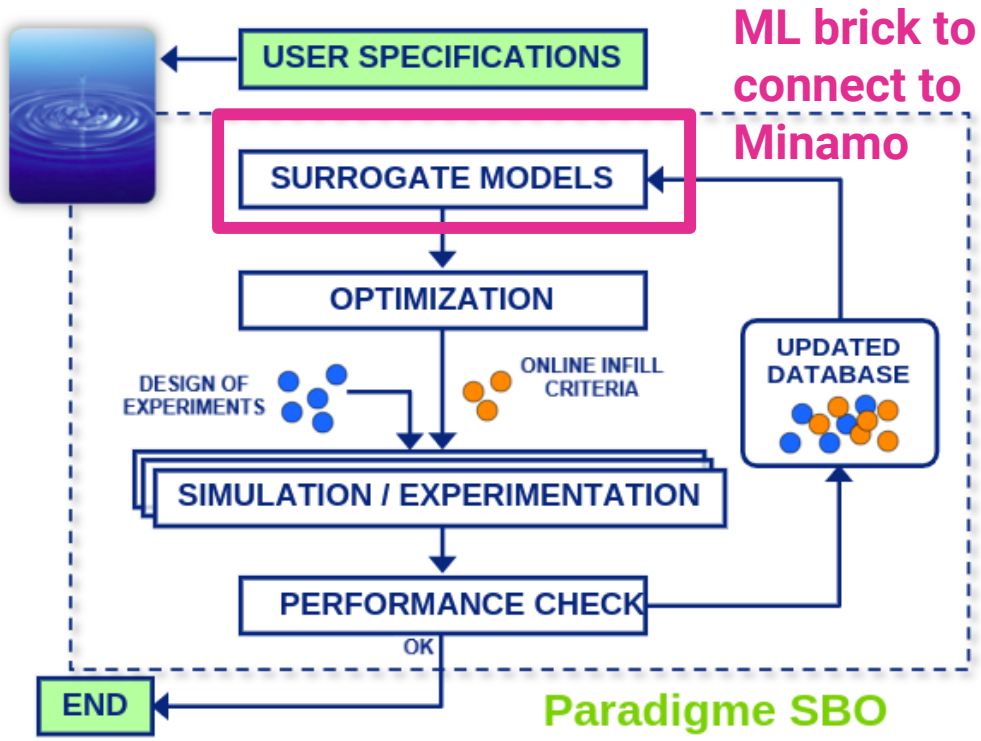
ML-based approaches allow to exploit the abundant and intrinsic physical information and to obtain complete flow field information



Expected Outcomes of the Project

Linked to the GD 1 *"Hybrid Modelling Methods towards an Augmented Engineering"*

- How machine learning can accelerate numerical simulations (CFD, FEM, ...), making them faster and more accessible to take better decisions to optimize products and processes
- Brick for prediction of physical field with high accuracy but an affordable computational cost
- The ambition (most probably after the workshop) is to combine the ML-based aerodynamic field prediction with the Cenaero's optimization strategy to optimize the shape of the wing
- Extend the developed methodology to other design processes involving expensive numerical simulations



Team & Skills Needed

Potential team members (to be confirmed in a few minutes 😉)

- Lionel Salesses – Cenaero
- Rajan F. Coelho – Cenaero
- Caroline Sainvitu – Cenaero
- Florent De Geeter – ULiège
- Yann Claes – ULiège
- ...

Skills

- Proficiency in Python
- Deep Learning Framework (e.g., PyTorch)
- Previous experience with ML/DL models for field prediction is a +

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Thank you all for your attention!

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