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NORTH AMERICA

um
2023

Switching from simulation-driven to data-driven design by exploiting the synergy of VOLTA and romBOX

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OPTIMAD

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About OPTIMAD

Simulation-Driven vs Data-Driven

Syngergy between romBOX & VOLTA

What is romBOX
Ensuring scalability and maintainability through VOLTA

Conclusions

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ABOUT OPTIMAD

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People and competencies

Strong scientific background

- computational geometry
- numerical methods, scientific computing
- data science (reduced order models, ML, AI)

Industrial proficiency

- computational fluid dynamics
- its integration in product development.

28 employees

52% hold a PhD

31 average age

7 countries

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Our products

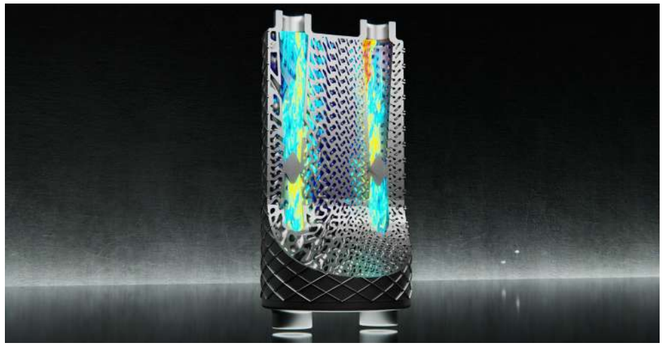
Enabling the digital transformation of product development cycles and design processes

mimic

shape parameterization, mesh manipulation & morphing

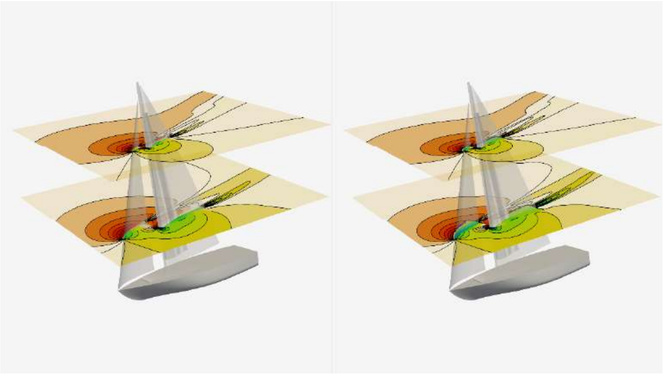
immerFLOW

high-productivity CFD solver



romBOX

reduced order models & machine learning for simulation data exploitation



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Simulation-driven vs Data-driven

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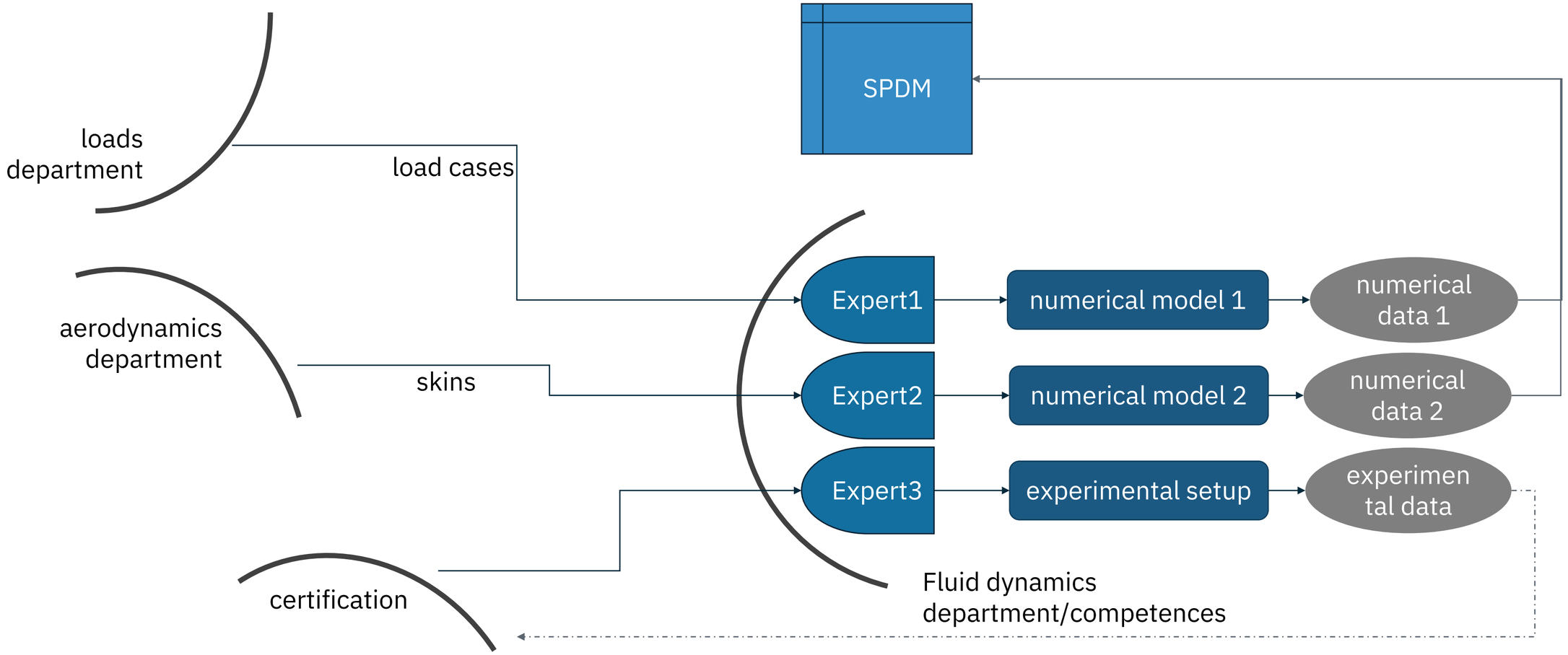
Simulation-driven design

State-of-the-art



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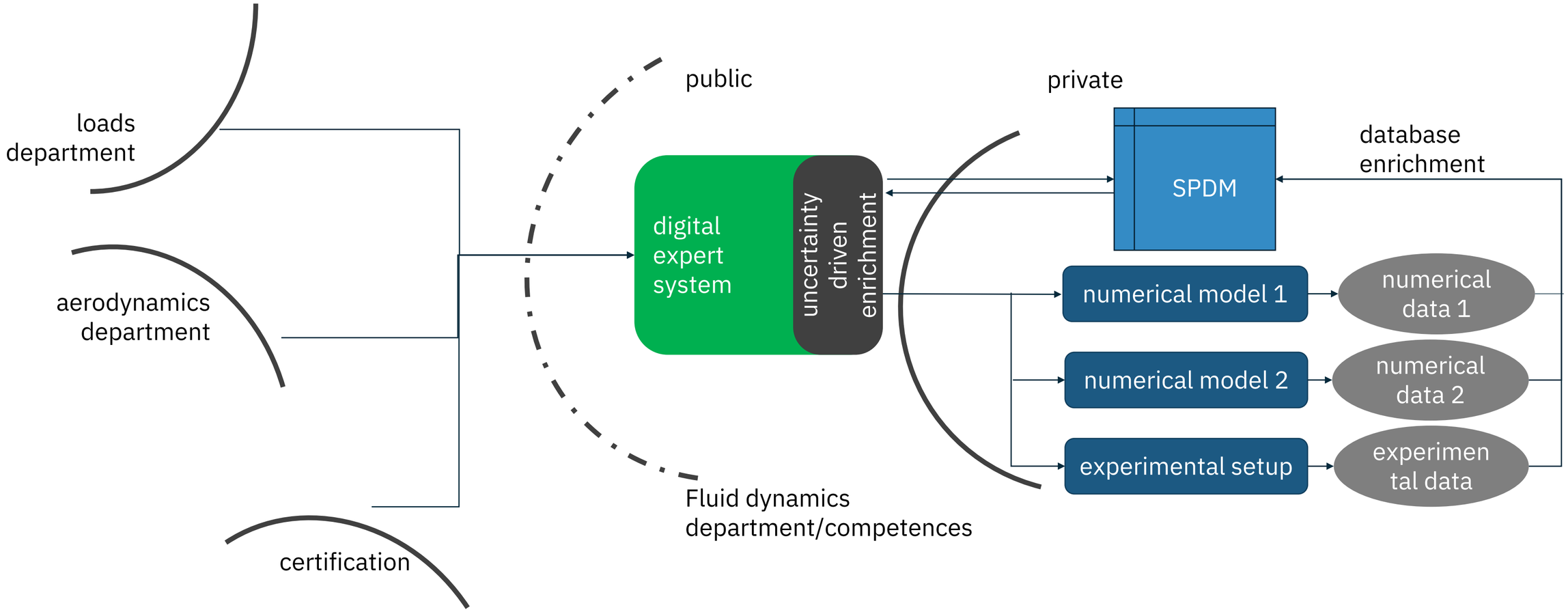
Data-driven design

Our vision – levaraging consolidated technology



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Data lifecycle

Simulation Driven

- created to accomplish a **task**
- used for the duration of a **task**

Data Driven

- created to accomplish a **task**
- intensively exploited during the **product lifecycle**

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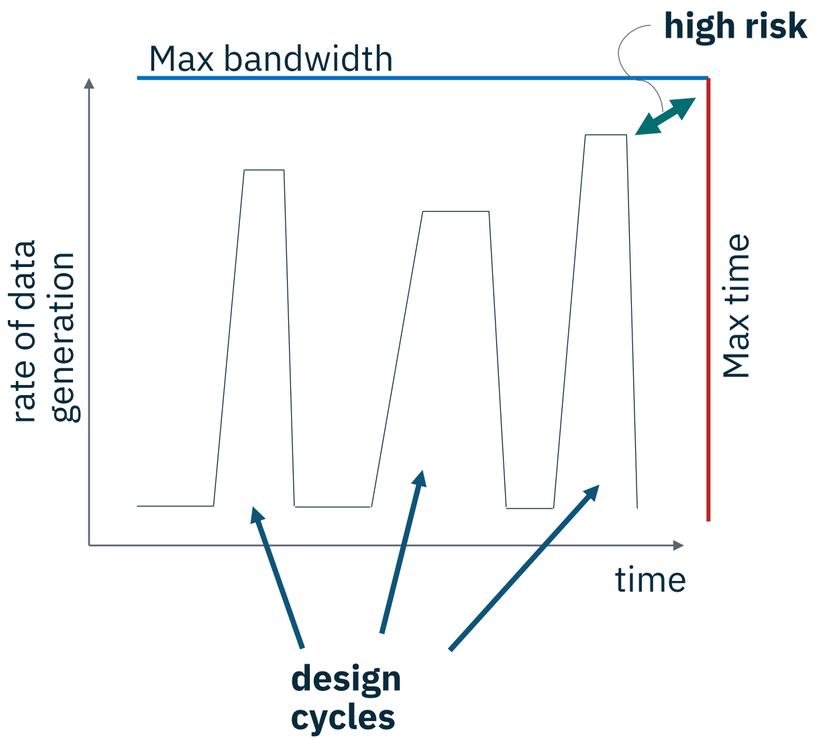
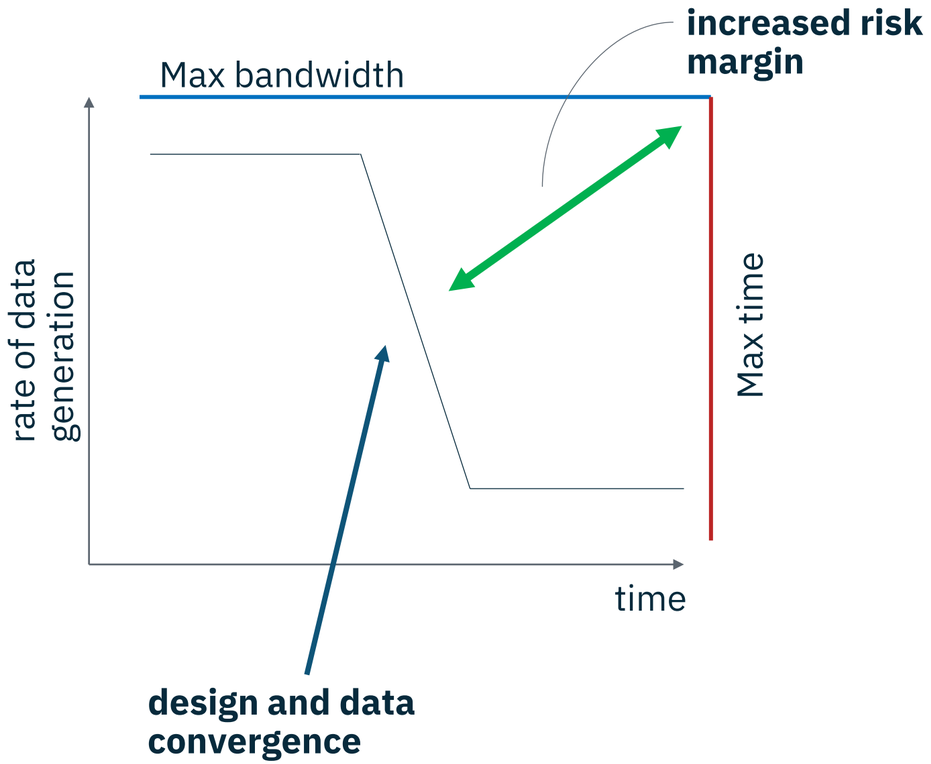
Usage of resources

Simulation Driven



Data Driven



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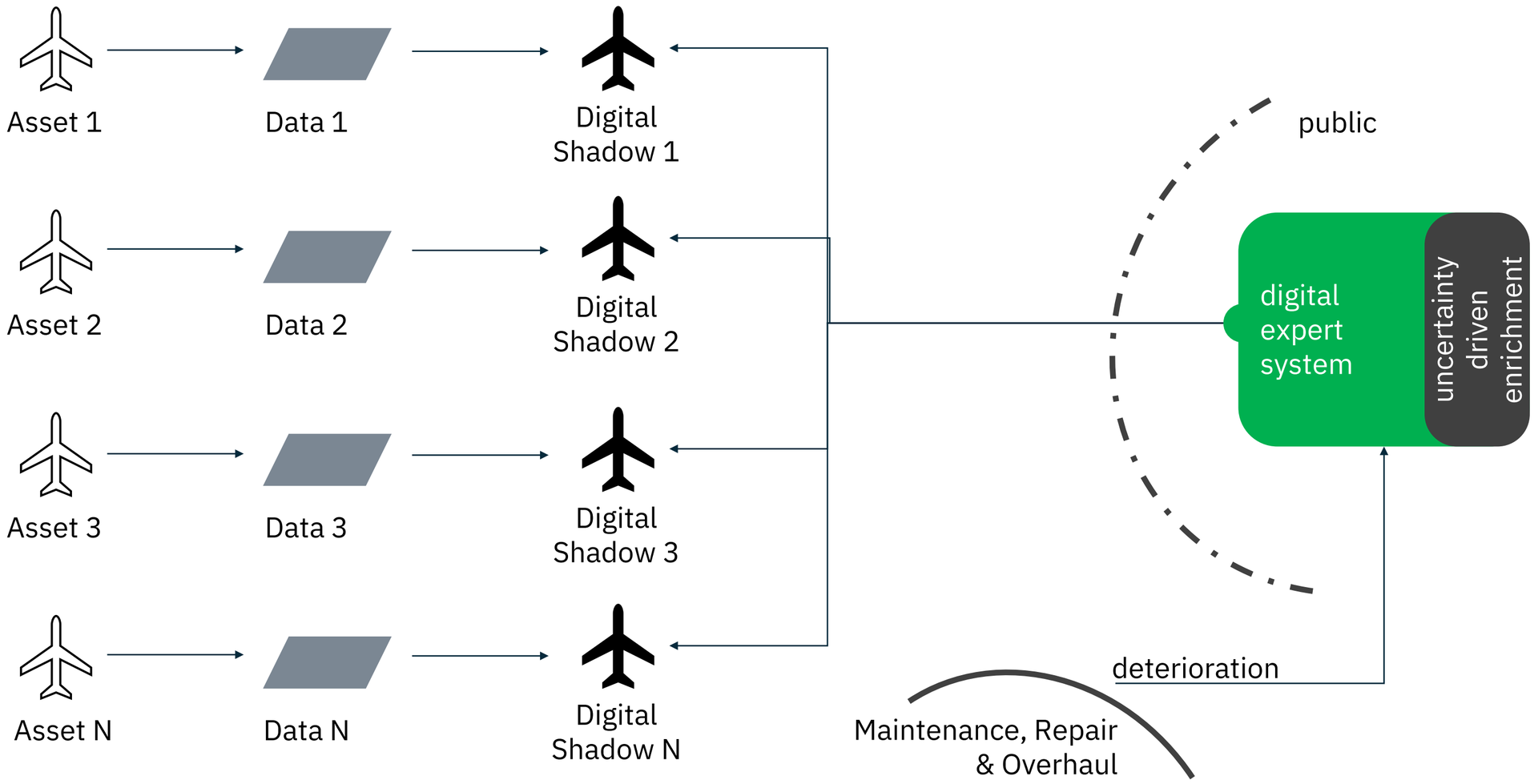
Beyond design

Towards digital shadows and twins



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Syngergy between romBOX & VOLTA

What is romBOX?

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a reduced order modelling & machine learning toolbox

Data-driven models

- Reduced Order Models
- ML, AI
- Multi-fidelity
- Data morphing

Physics-driven models

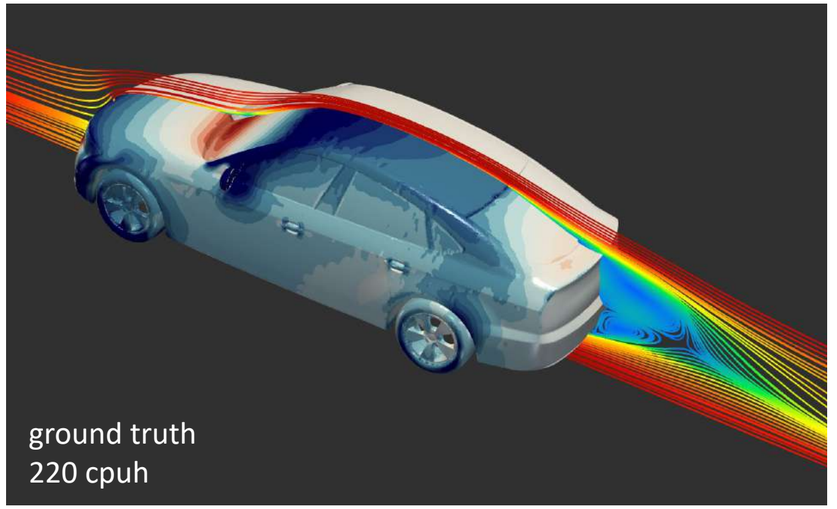
- by coupling solver

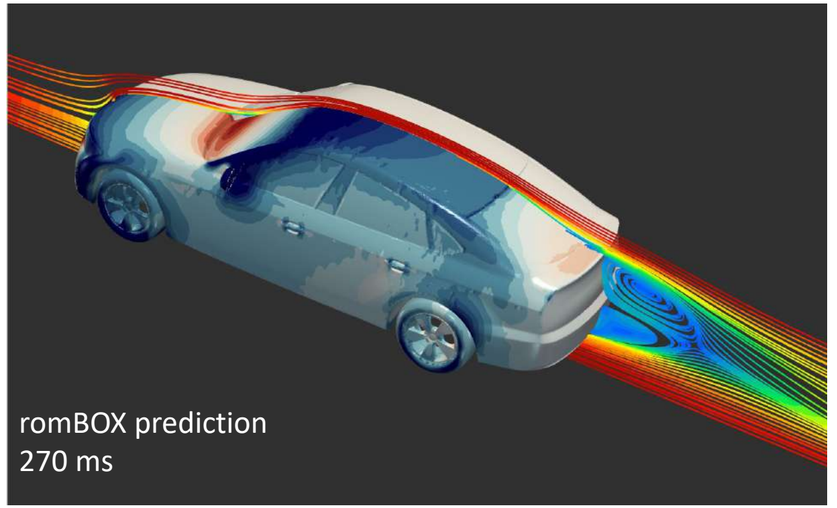
Geometry handling

- User-given parameterization
- Empiric parametrization
- Autoencoders

Any data

- Surface data
- Volume data
- QoI
- Sensitivities





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Example: real-time aerodynamic predictions

Setup

Geomtery

- DrivAer baseline
- Mimic
- 8 design parameters

Aerodynamic evalutation

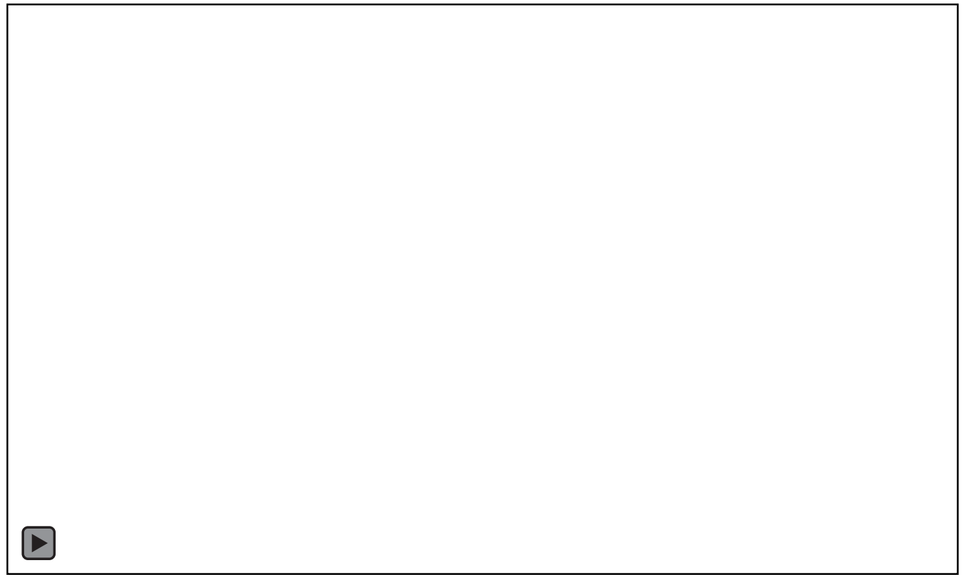
- OpemFOAM
- 15M, simpleFOAM

ROM

- romBOX geometrical & data encoder
- NN regression model

Validation

- 20 unseen random configurations
- average L2 error on pressure distribution



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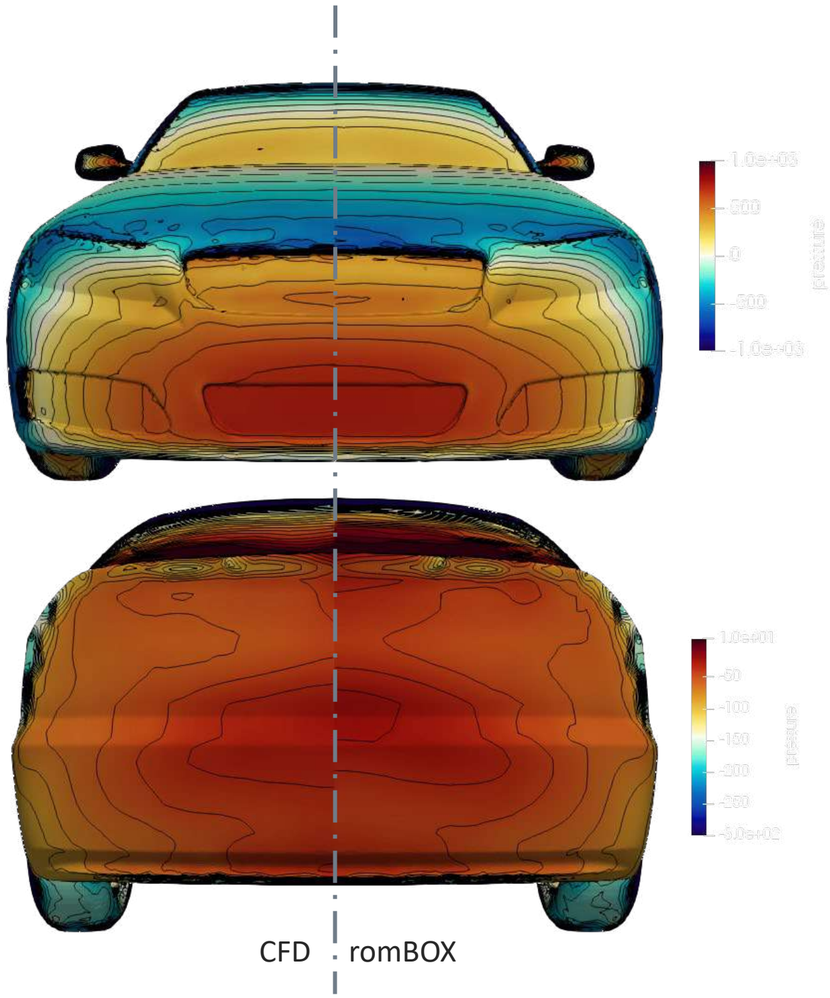
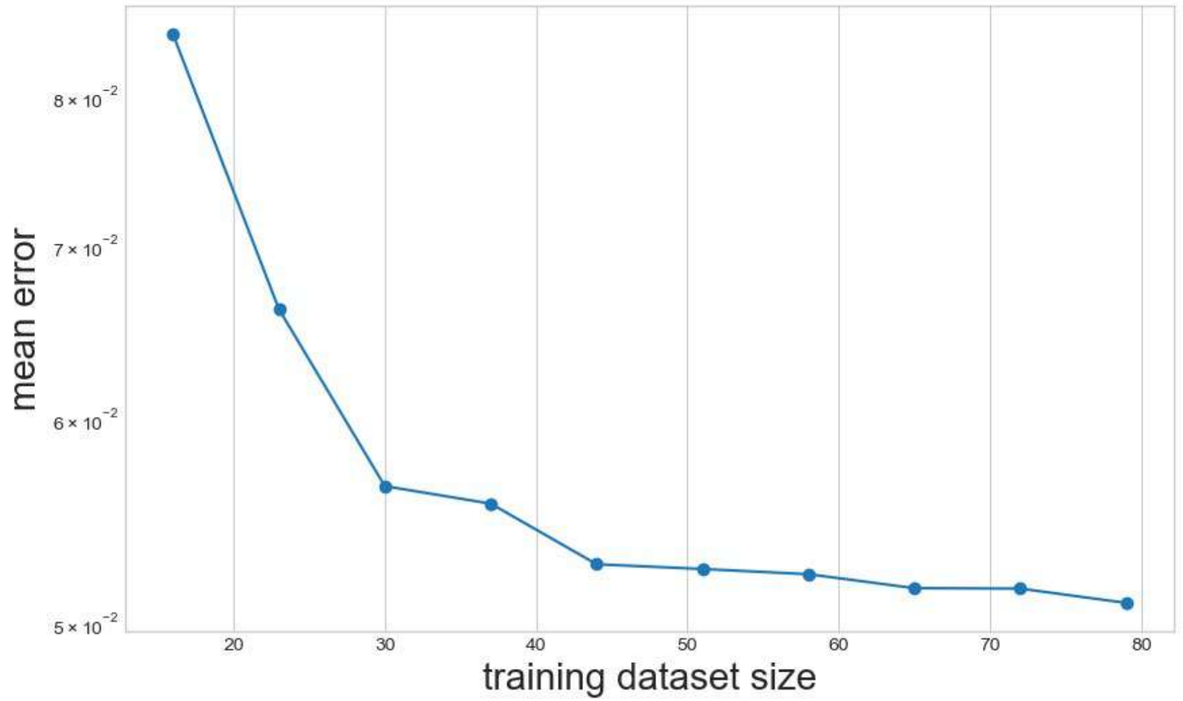
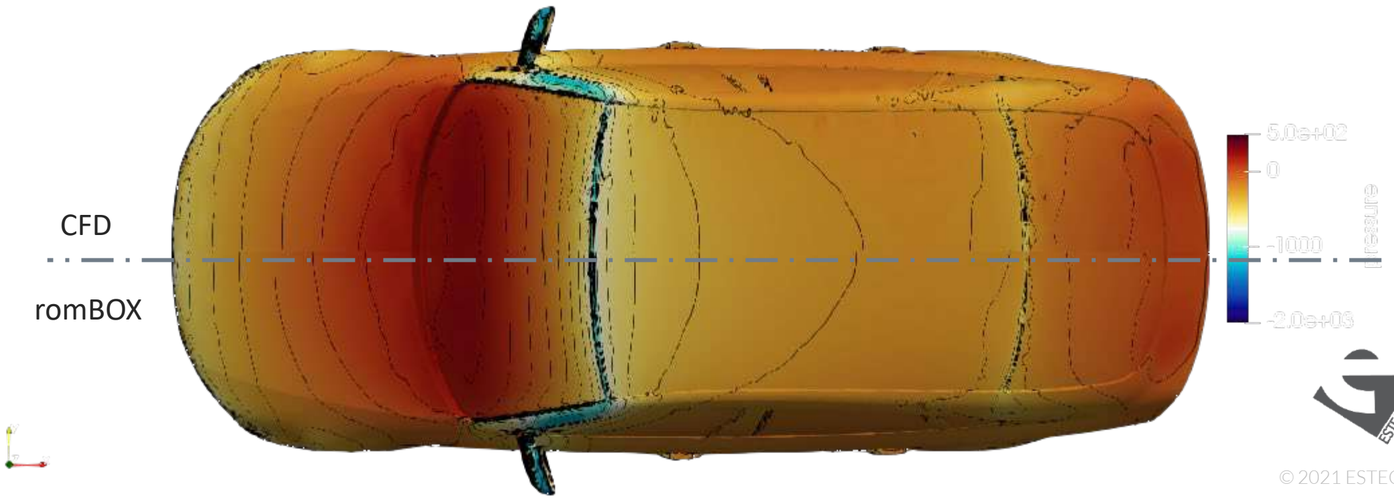
Example: real-time aerodynamic predictions

Validation







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Synergy between romBOX and VOLTA

Ensuring scalability and maintainability through VOLTA

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Data and user management

Mastering logistics to assure quality, scalability and maintenance

Data management & traceability

1st level Annotation

Raw data has been generated with which simulation model

Versioning

ROM has been trained with which data

2nd level Annotation

Results have been generated by which ROM

User management & roles

- simulation experts are responsible for generating high-value (automatic) workflows
- domain experts train and publish ROMs
- stakeholders can query the ES

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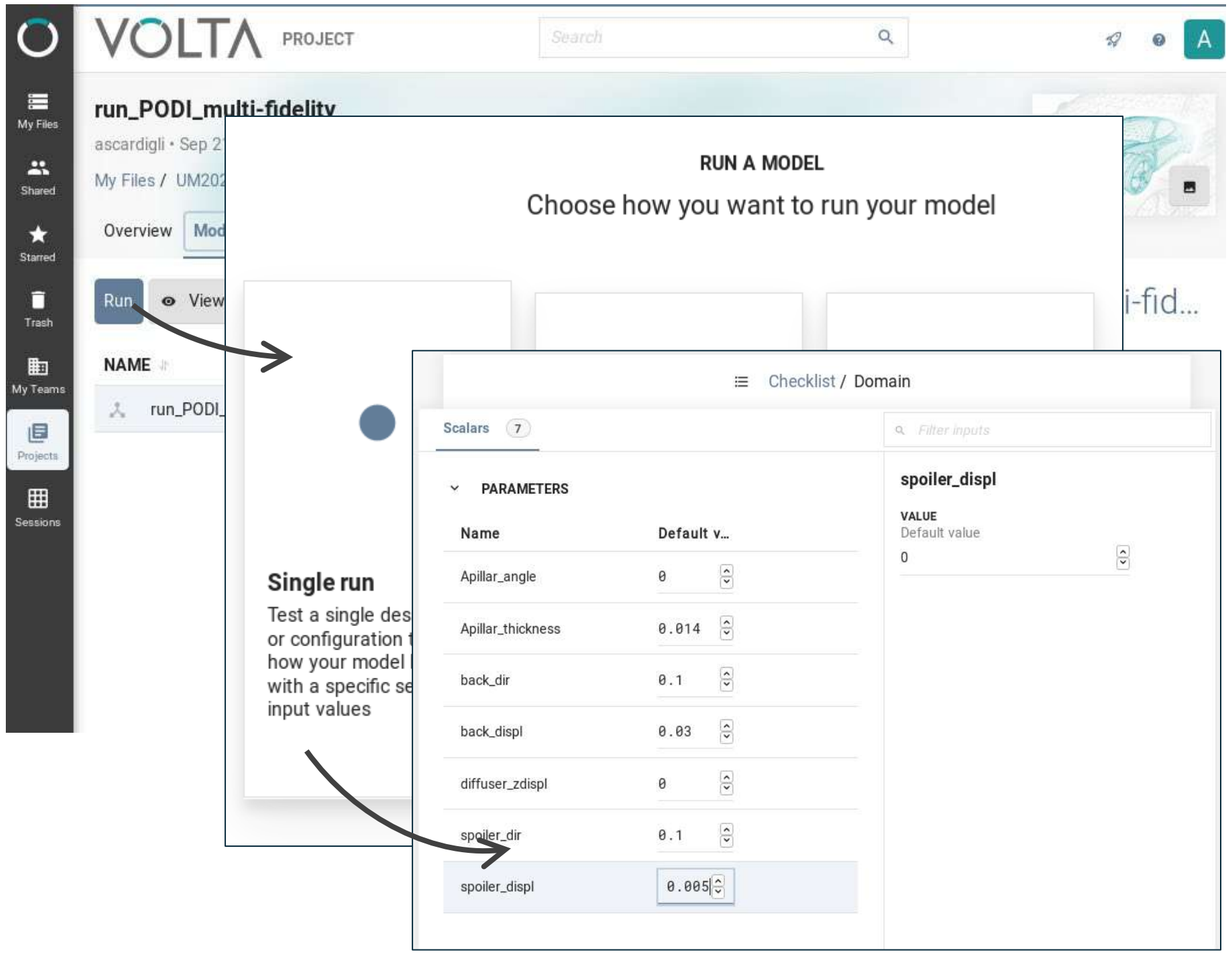
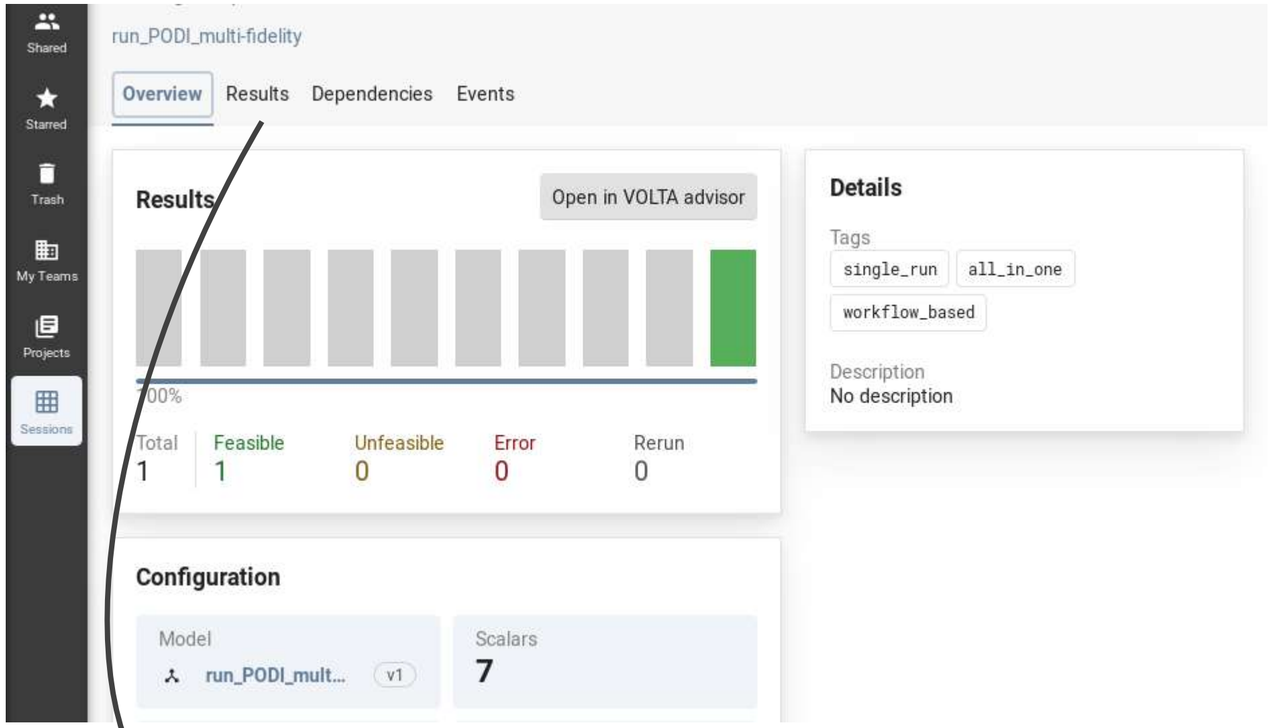
Deployment

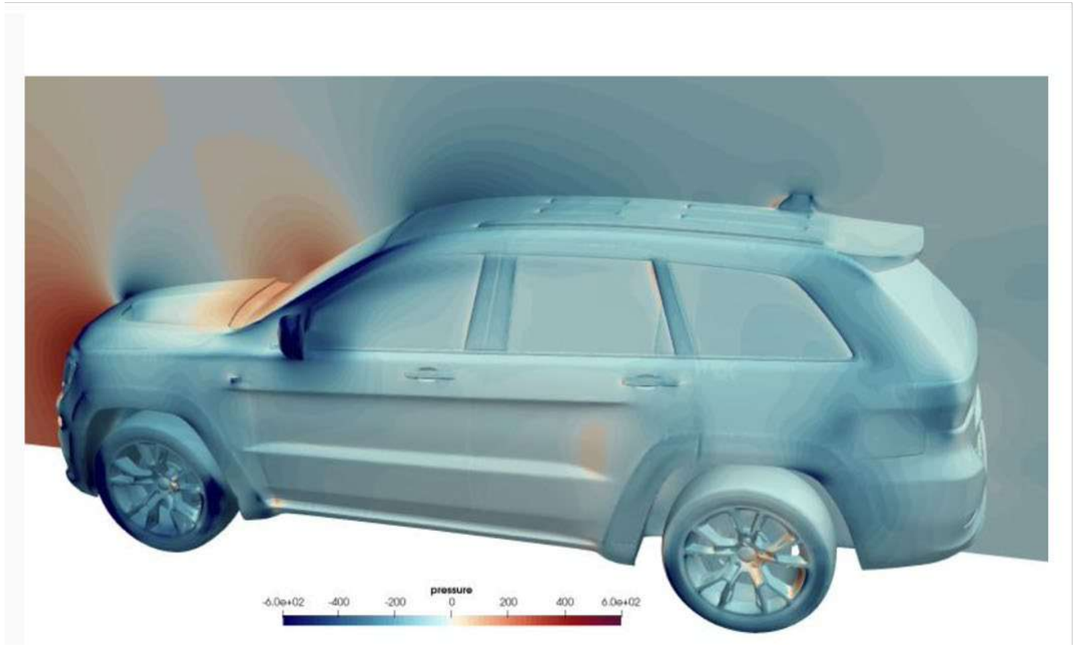
Run an error-constrained model



Deployment

Inspect results





Conclusions

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