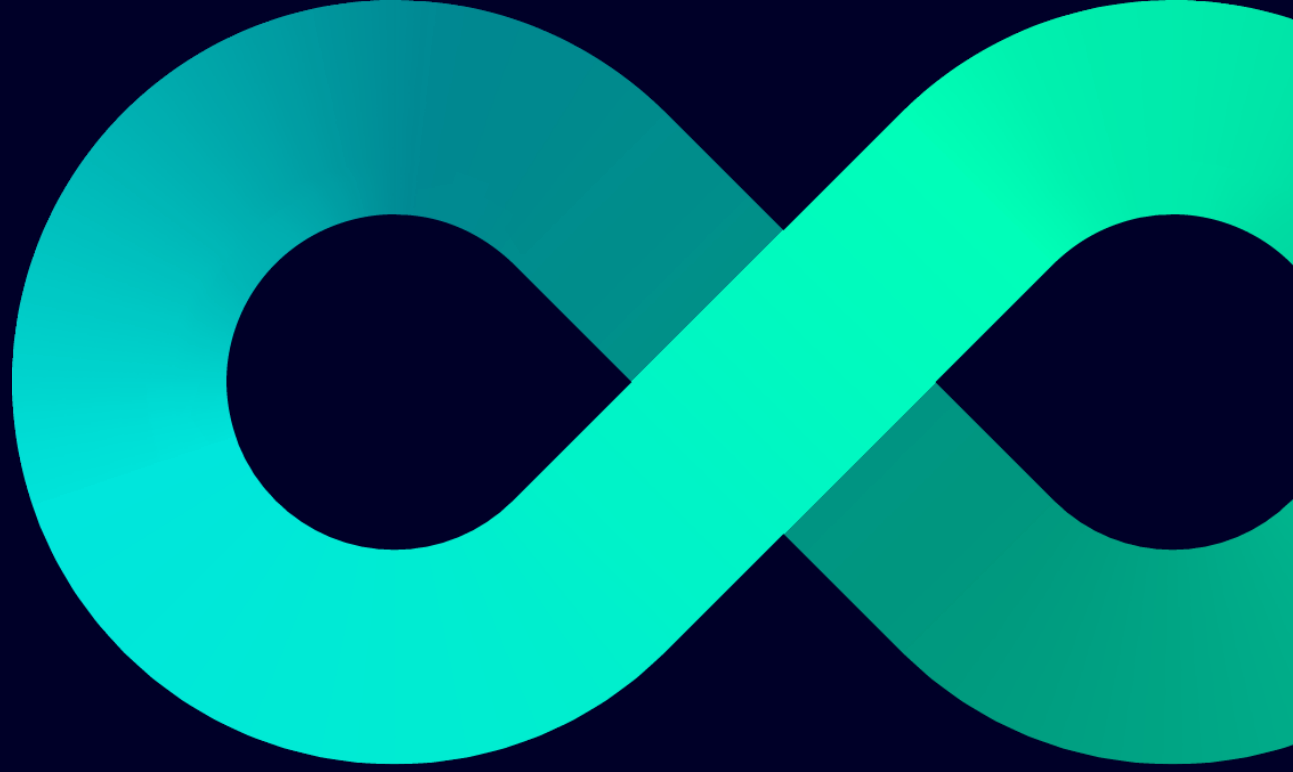

Engineering AI Solutions

Athanasios Besikiotis | Presales Solution Consultant

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Agenda

Introduction
Simcenter PhysicsAI
Simcenter PhysicsAI Usecases
Simcenter PhysicsAI Generate
Simcenter RomAI
HEEDS AI Simulation Predictor

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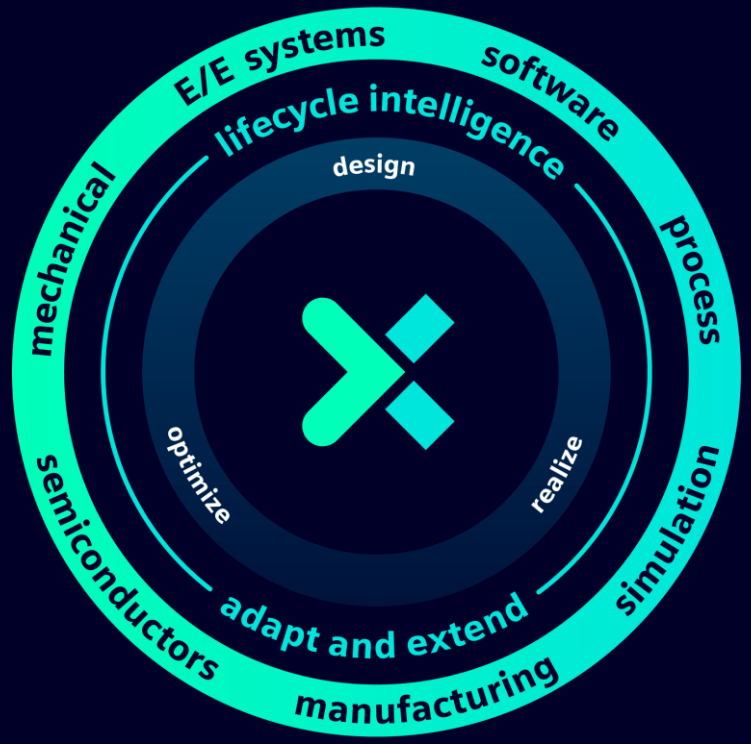
Integration of Altair Capabilities

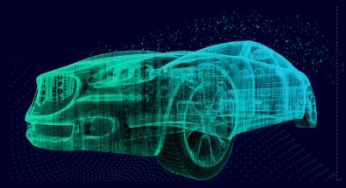
Creating the world's most complete AI-powered design and simulation portfolio



ALTAIR

Simulation and Analysis

Multi-domain simulation, generative design and optimization

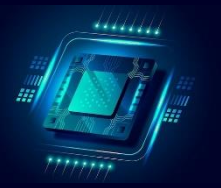


AI

AI-powered workflows to accelerate CAE and product development

High-Performance Computing

Scalable and optimized HPC platforms to accelerate simulation



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Leaders in AI adoption achieve 4x the results in ½ the time

MIT Machine intelligence for manufacturing and operations & McKinsey, 2023

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Simcenter PhysicsAI

Geometric Deep Learning Engine for Fast Predictions

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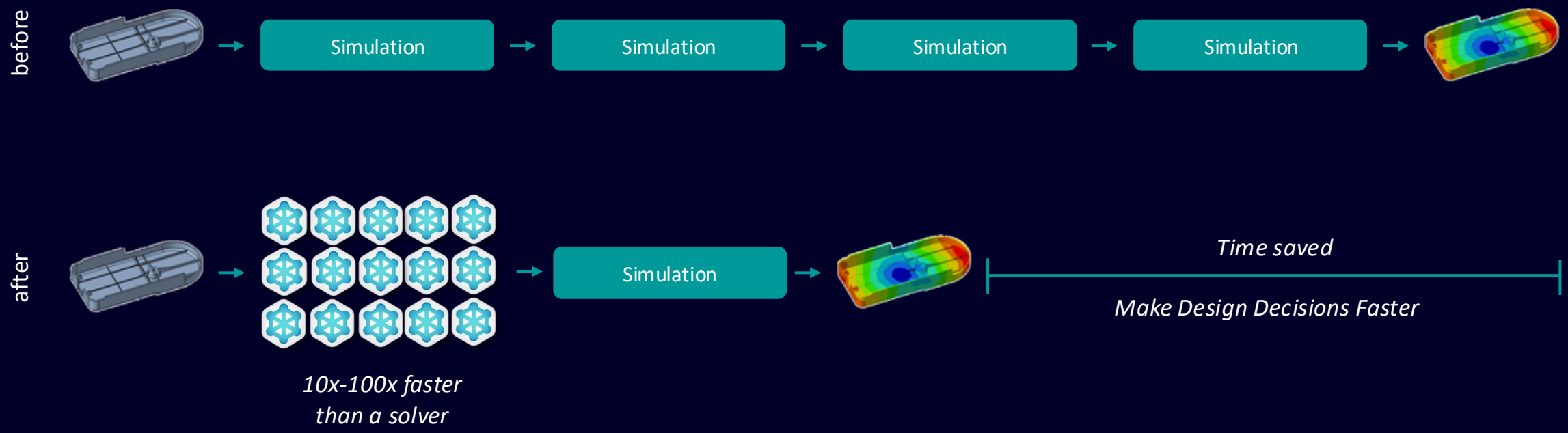
Benefit of PhysicsAI
Accelerate your design process



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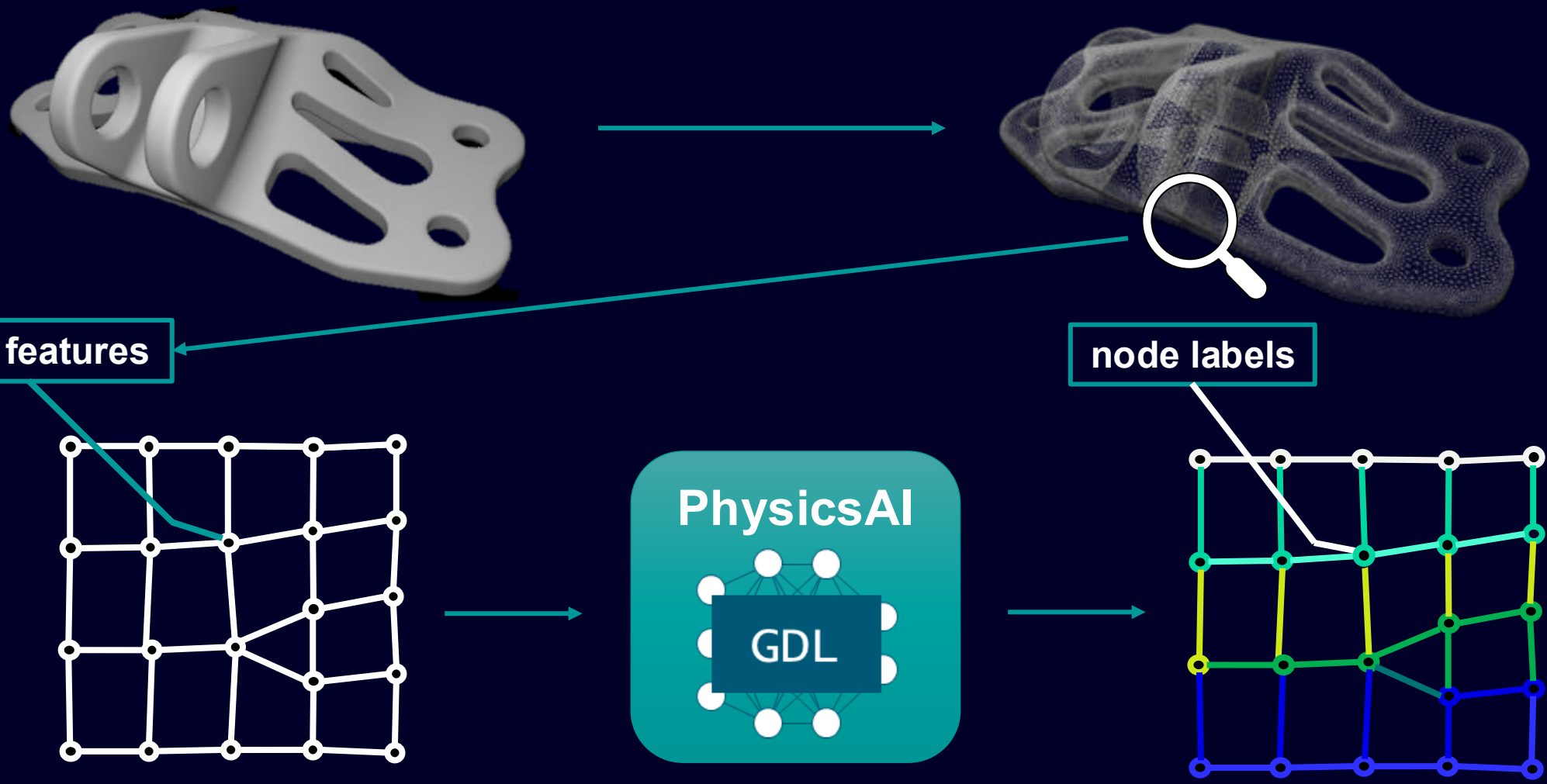
How Does PhysicsAI Process Geometries?



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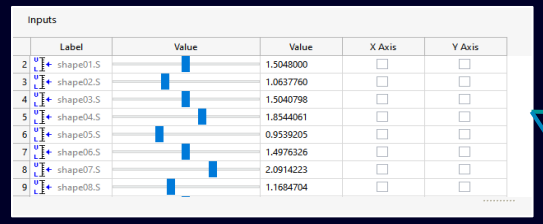
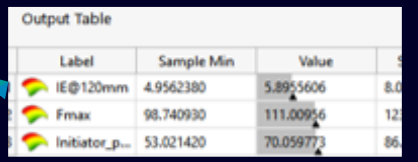
PhysicsAI - Unlock Historical Data for Predictive Models

Structured Data
Explicit parameterization
Design Variables

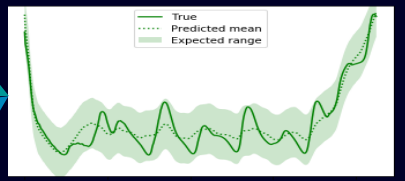


Surrogate Models

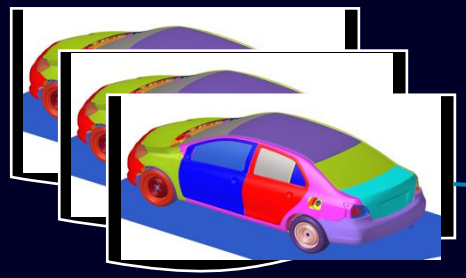
Scalar Predictions



Curve Predictions

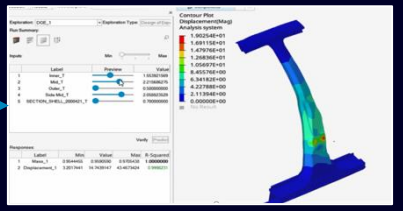


Unstructured Data
Implicit parametrization
Shapes



PhysicsAI

Field Predictions



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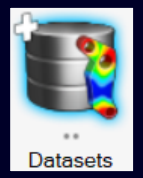
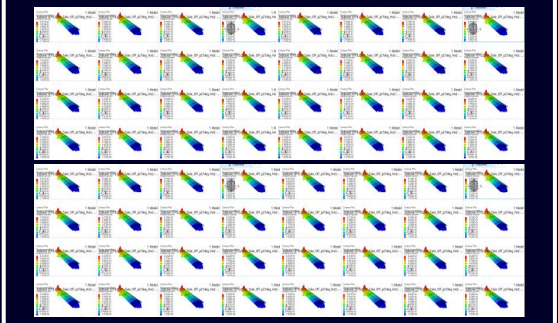
Process of PhysicsAI

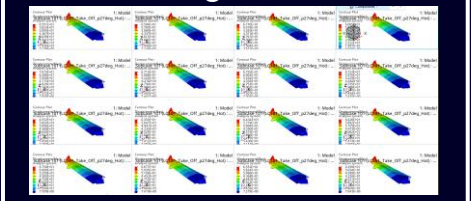
Historical Data



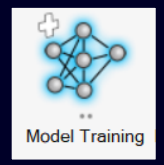
Training Dataset

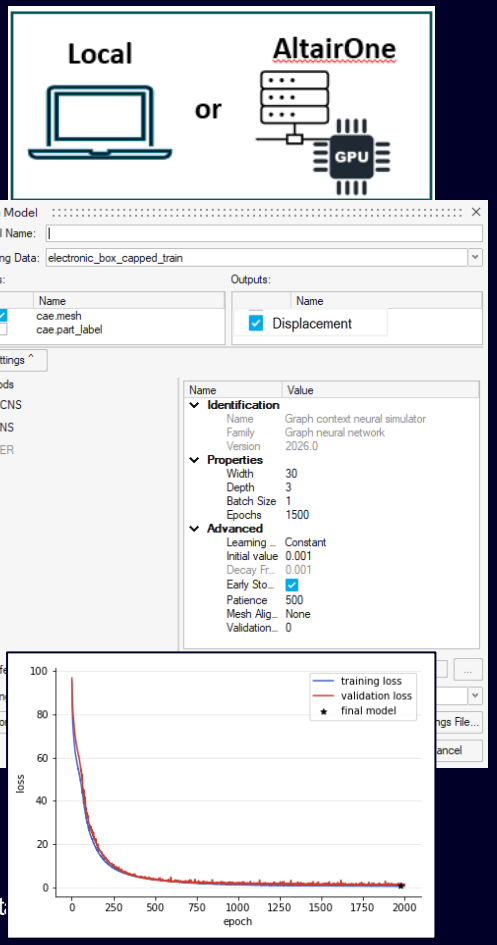


Testing Dataset

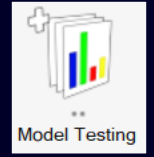


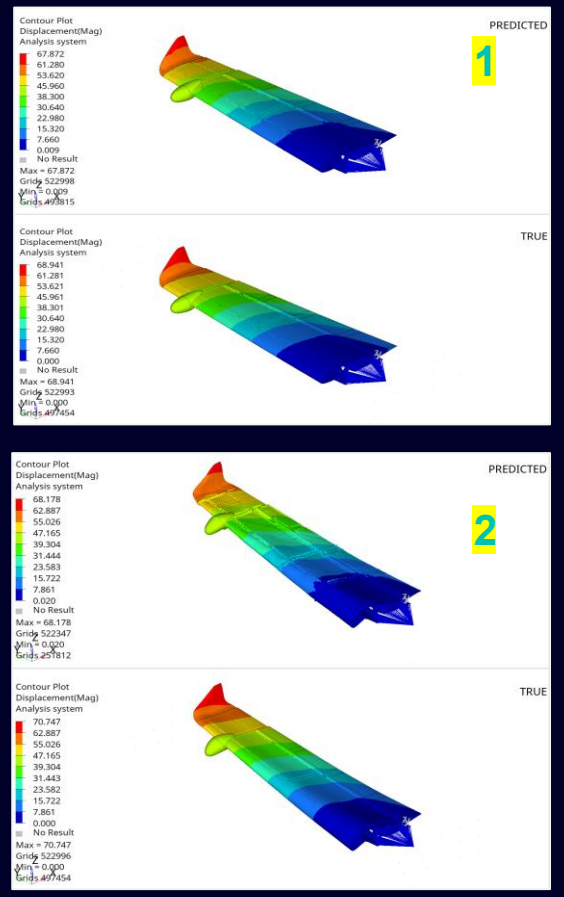
Train PhysicsAI



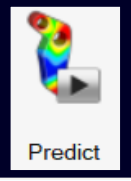


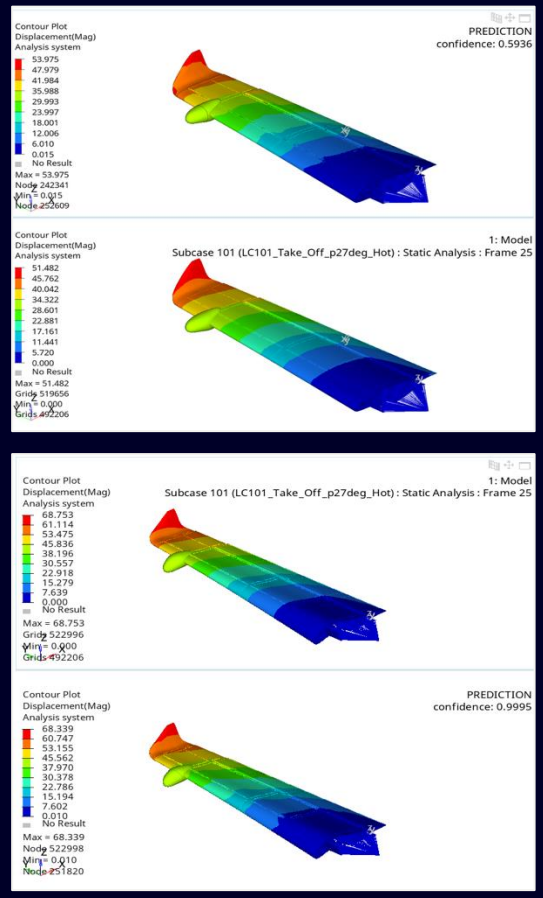
Validate with Test Data





Real-time Exploration





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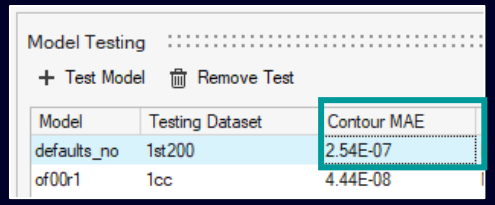
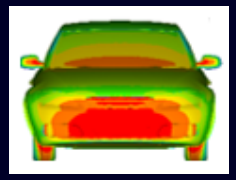
How do I know the GDL Models are Correct?

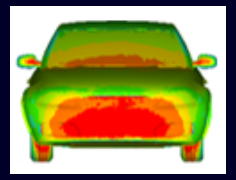
Prediction error: *How well do PhysicsAI predictions match the solver?*

Ensure that PhysicsAI is accurate for our objectives





PhysicsAI

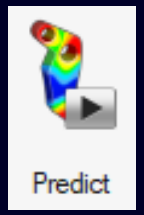


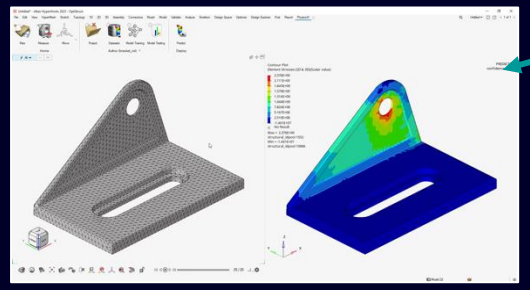
Solver

= Prediction error

Prediction confidence: *How similar is the new design to the training data?*

Ensure that the trained model applicable for the new design data



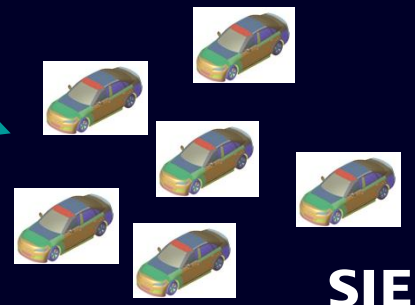


PREDICTION
similarity score: 0.5853

New design

vs

Training data



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PhysicsAI is Domain Neutral

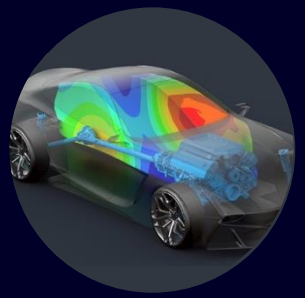
Heavy Machinery

Structural

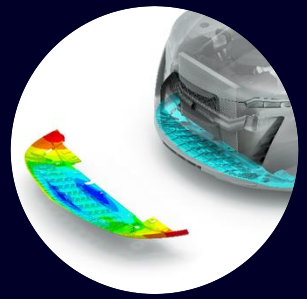
PhysicsAI

Crash

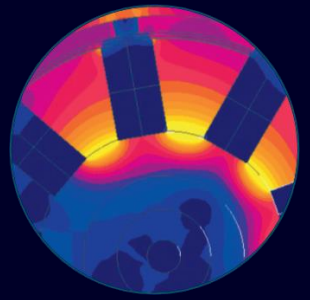
Aerospace



NVH



Manufacturing



Electromagnetics

Thermal

Fluid

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Simcenter PhysicsAI Usecases

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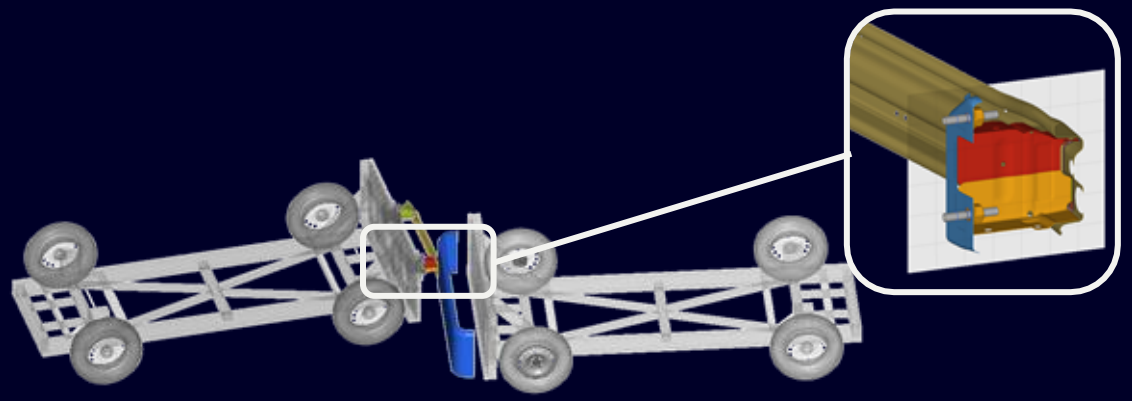
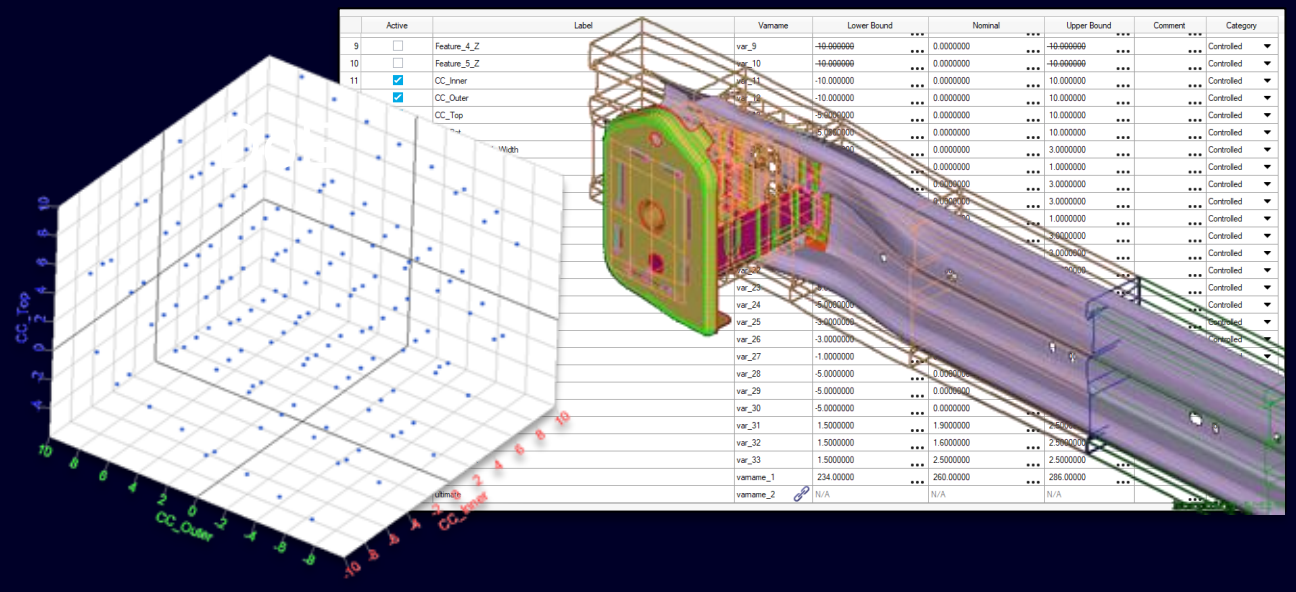
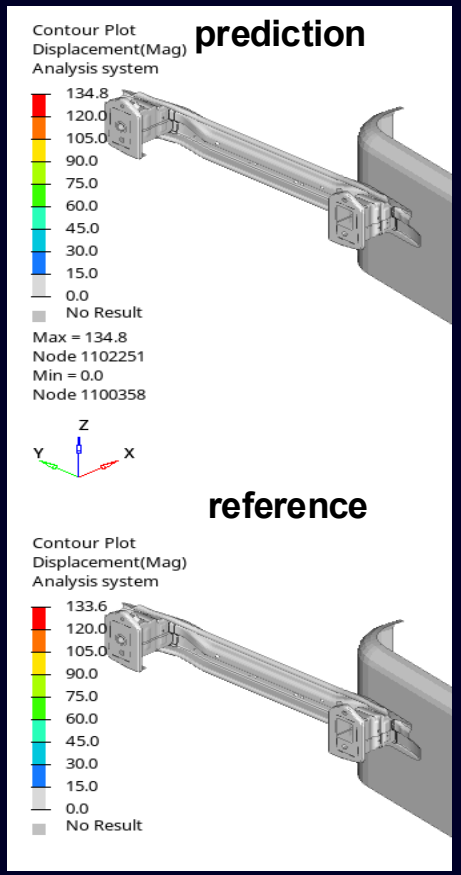
Crash Application





Displacement



PhysicsAI
10 s

Solver
14 hrs

Accuracy >97%

Dropping simulation runtime from 14h to 10s!

AI-Driven Airbag Design

Challenge

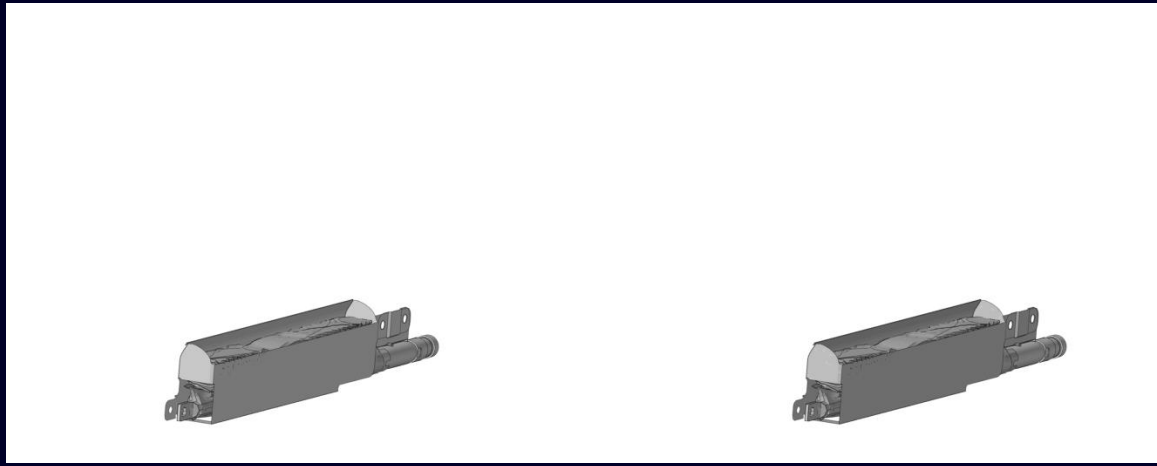
- Airbag simulation is very challenging due to highly transient and complex physics, with high variability of both the airbag and impactor
- Simulation times can be long, slowing the development process

Solution

- PhysicsAI implemented to gain rapid design insight
- Results data from Radioss used to train the machine learning (ML) model

Result

- **Runtime reduced from 2 hours to less than 30 seconds**
- Excellent correlation between true and predicted results
- Intensity and timing captured by the training model with good degree of accuracy and precision



Traditional Solver (True)	PhysicsAI (Predicted)
2 hours on 64 CPU runtime	**30 seconds** for prediction, CAE post-processing environment
50 samples (6400 CPU-hrs) for training and validation	-- Setup + Train time

PhysicsAI Embedded in Simcenter STAR-CCM+

AVAILABLE FROM 2602

Challenge

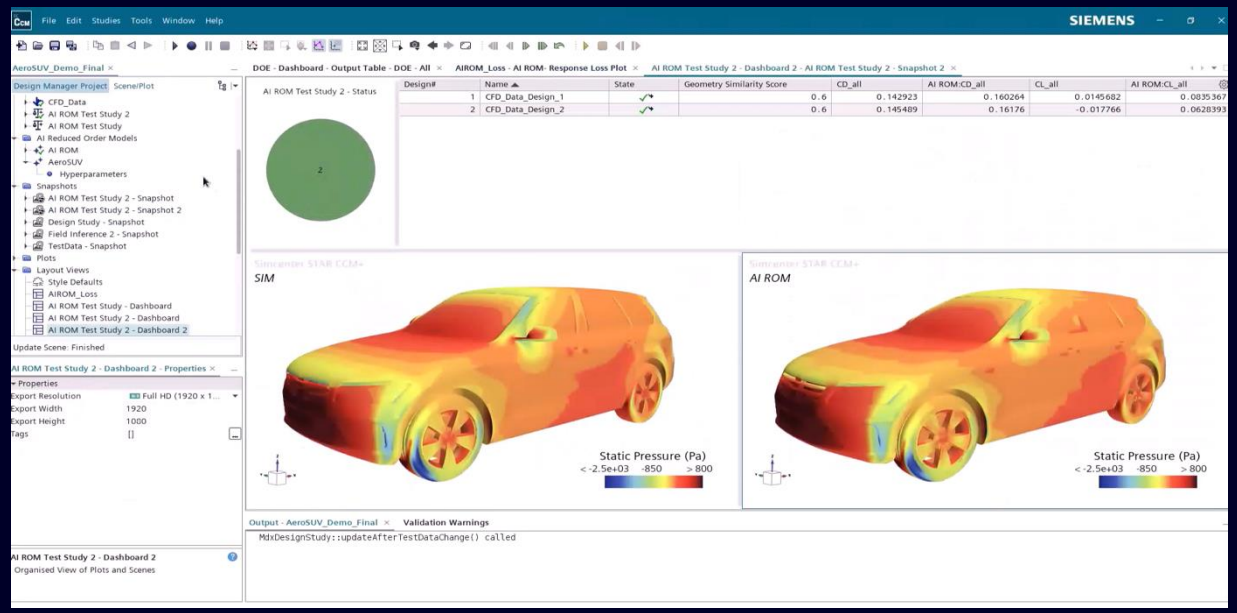
- Assess product trends early in the design phase
- Increase simulation return on investment by exploiting all accumulated knowledge

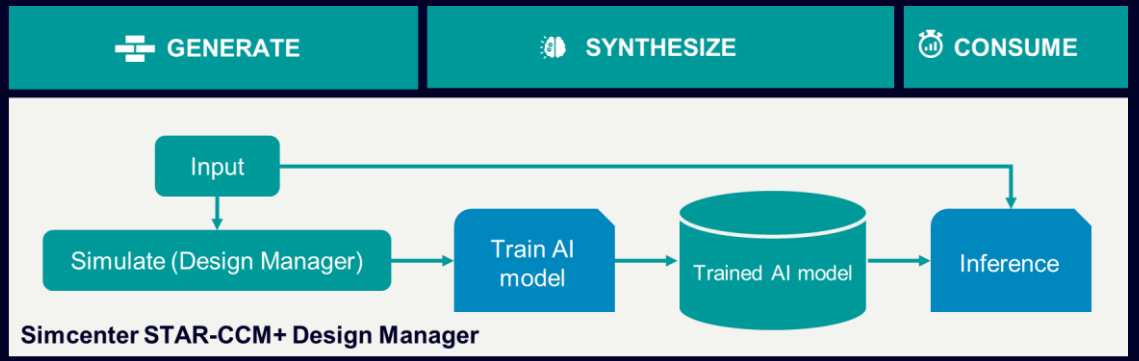
Solution

- Leverage any existing or upcoming simulation data to create and train the AI model that will assess the performance of new design in seconds
- Predict both 3D fields and scalar values
- Integrated workflow

Benefits

- Make design decision faster
- Leverage all existing data to train model
- Break down the barrier to simulation for designers





Simcenter PhysicsAI Generate

Experimental

3D GenAI for Engineering Design

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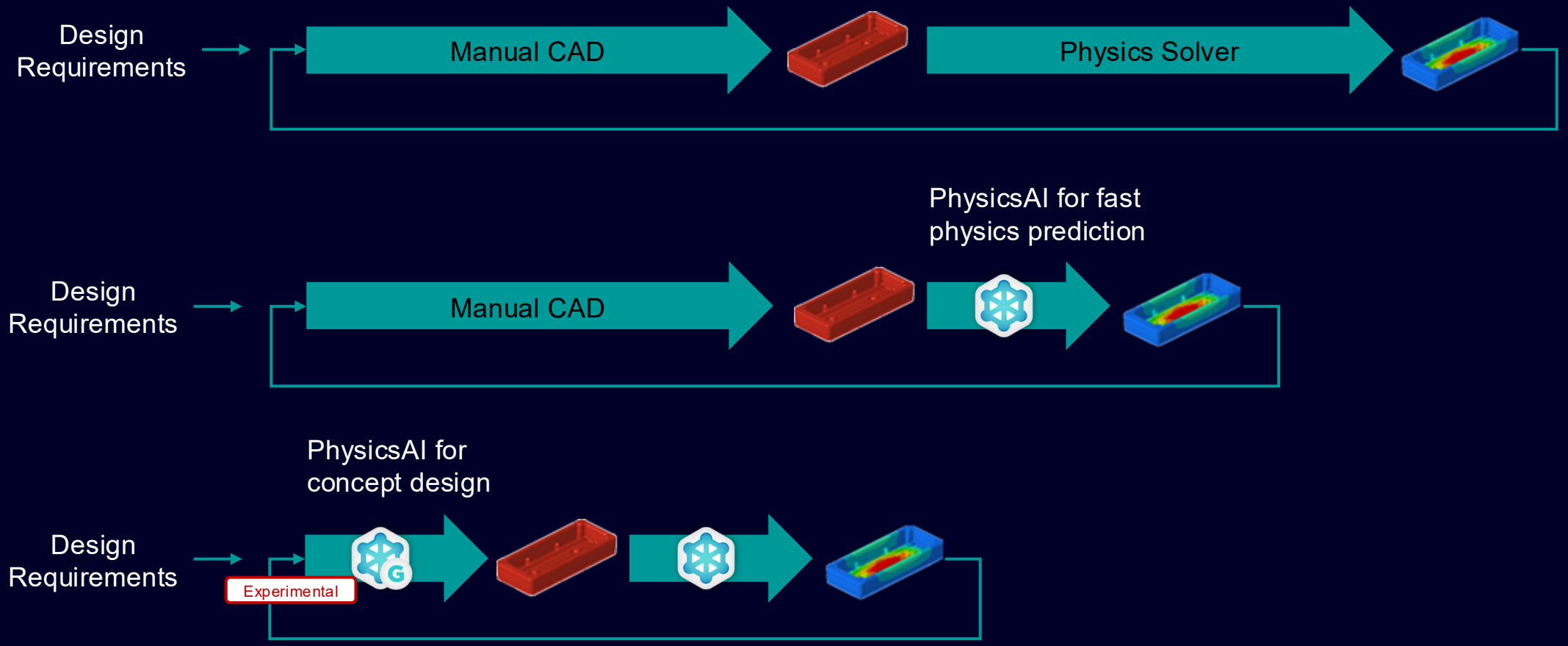
Designing Faster with PhysicsAI Generate



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Process of PhysicsAI Generate

1. Create dataset

2. Train

3. Generate

Design targets

These can be **any** custom scalar values, like KPIs or dimensions

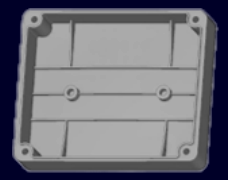
width: 0.04
length: 0.06
disp: 3.1e-4

width: 0.05
length: 0.03
disp: 2.8e-4

width: 0.04
length: 0.11
disp: 3.5e-4

...

Historical designs



~24 hours

GPU

New design targets

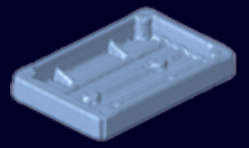
width: 0.04
length: 0.03
disp: 2.9e-4

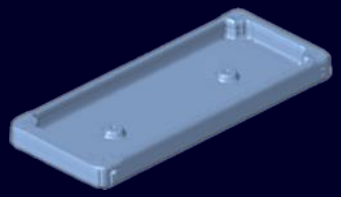
width: 0.05
length: 0.10
disp: 3.4e-4

~10 seconds

...

Design concept





.h3d, .fem

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Simcenter RomAI

Reduced Order Modelling Technology for Complex Systems

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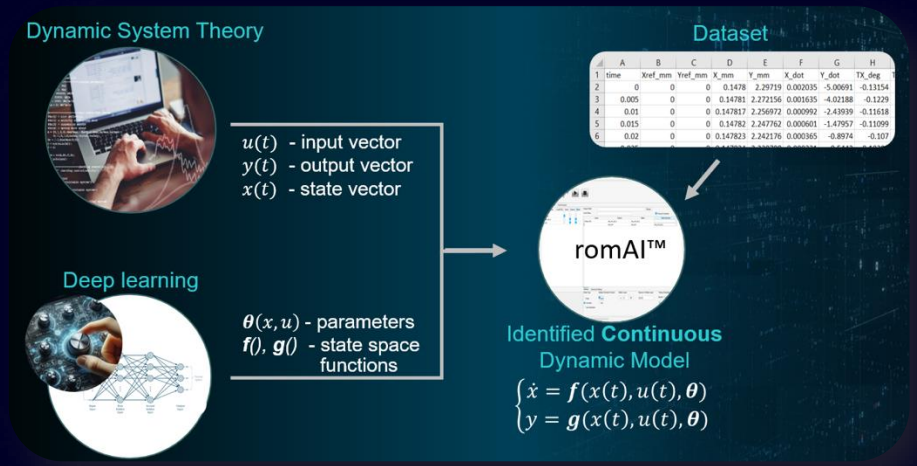
Simcenter RomAI Highlights

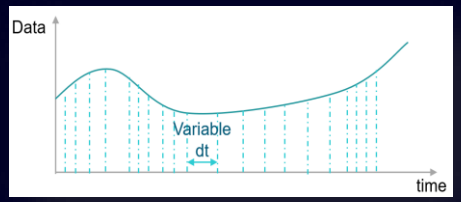
Approach

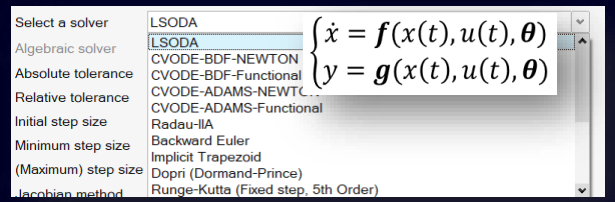
- **Proprietary method** which combines deep learning and dynamic system theory to approximate the system mathematics using data



Dynamic systems

- Can process data available at different sampling rates
- Creation of **continuous** dynamic models working with any solvers either fixed or variable-step





Usability

- Easy to use
- Application in many different usecases (replacement of traditional simulations, installation on hardware for real-time predictions, etc.)

"RomAI allowed us to work with incredible precision and eliminate technical bottlenecks. For those of us in engineering who may not excel in AI or programming, RomAI's visual interface makes training AI models simple and accessible."

— Wang Shuang, supervisor analyst,
Chery Automobile Company

CHERY

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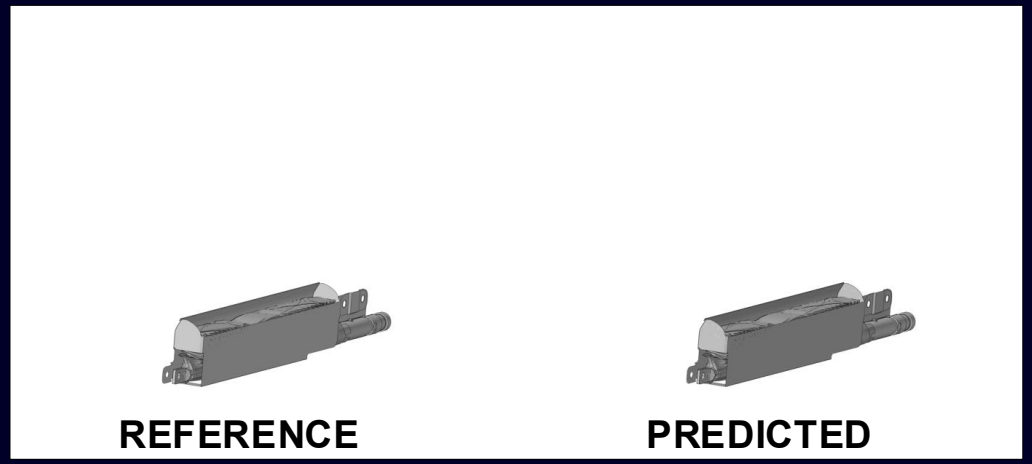
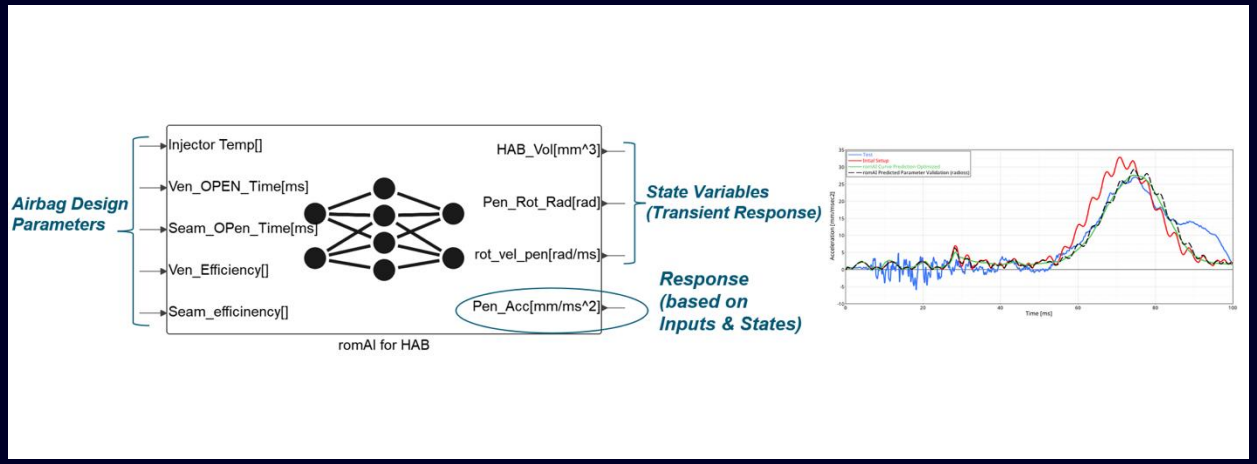
AI-Driven Airbag Study

Contact Force Contour with **PhysicsAI**



Field results

Acceleration Curve with **RomAI**



Curves

HEEDS AI Simulation Predictor

Save time, accelerate your optimization with AI

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HEEDS AI Simulation Predictor

Challenges of MDAO (Multidisciplinary Design Analysis and Optimization)

- **Simulation time**: Very long running CAE simulations and process automation workflows
- **Compute cost:** Reduce hardware and software overhead within design
- **Shift left**: Pressure to save time, reduce cost of simulation and testing and increase quality of engineering product
- **Trustworthiness**: Designs optimized without consideration of uncertainty may lead to designs that are non-robust to manufacturing or operating environments
- **Knowledge re-use**: Desire to use prior simulation data knowledge for optimization of new product families, but no means to do so

HEEDS AI Simulation Predictor
AI technology that provides acceleration for optimization studies by means of trustworthy and accuracy aware AI models.

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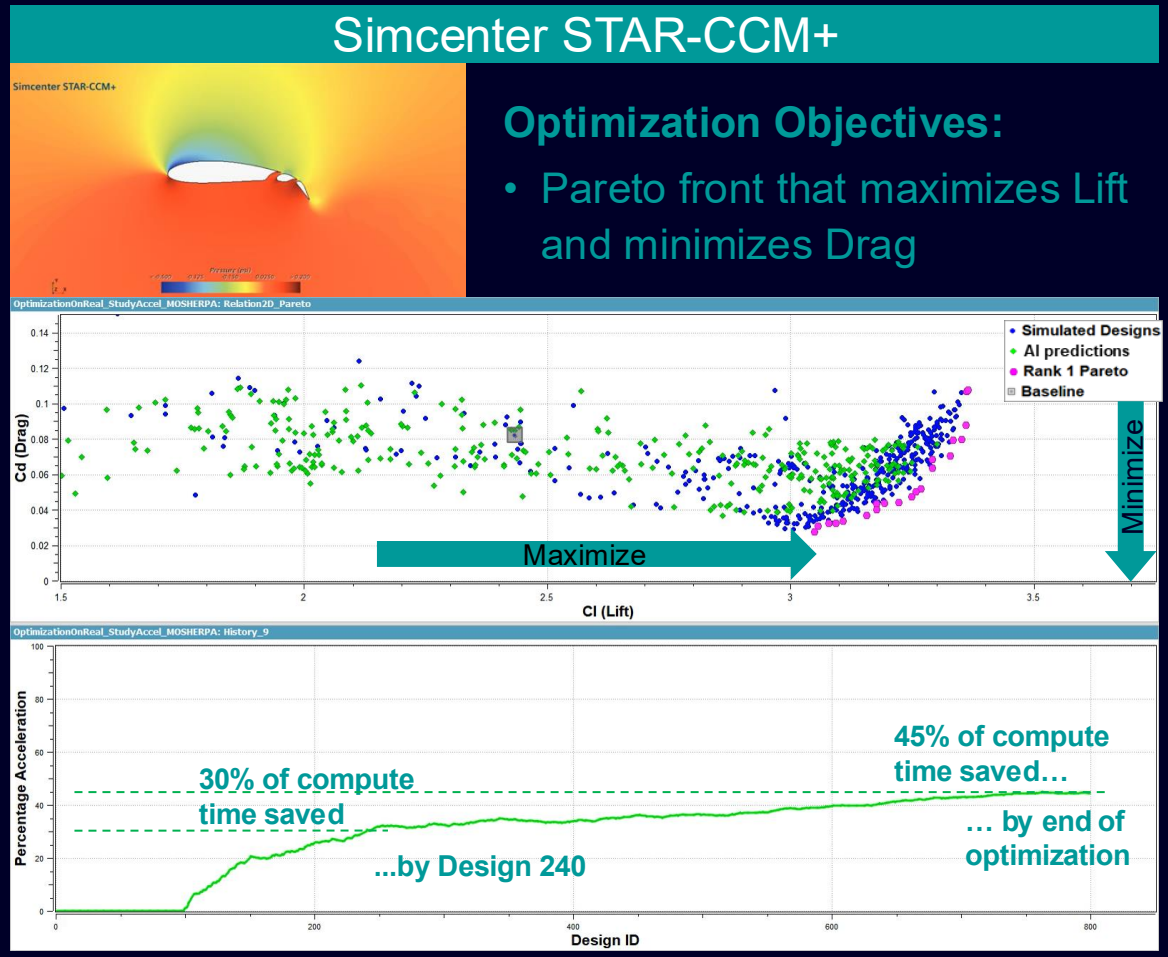
HEEDS AI Simulation Predictor

Automate discovery with boosting

- Smart use of accuracy-aware AI models
  - Results for each design come from either AI model or real simulation
  - Selection based upon accuracy (prediction tolerance) and/or predicted design performance (constraint confidence)
  - Continuous accuracy refinement with more data
- Advanced customization possible, but not required
  - Guidance provided directly within UI



Aerodynamic example: How HEEDS AI Simulation Predictor works

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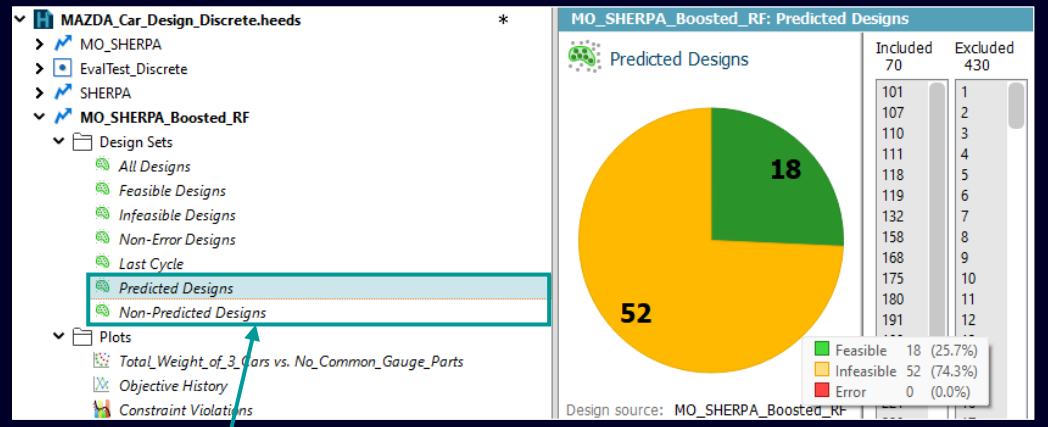
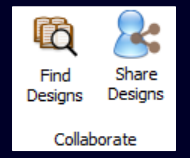
HEEDS AI Simulation Predictor

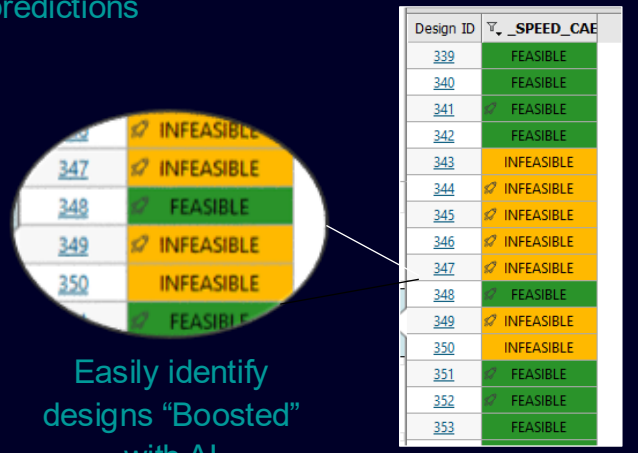
When should I use the HEEDS AI Simulation Predictor?

- When you have time-consuming CAE analyses
- When you need to perform lengthy optimizations
- When you have data available that you want learning leveraged, coming from:
  - The same study being boosted (Typical Scenario)
  - Prior results (Restart)
  - Results supplied as part of assembled studies (Find Designs)



Automatically created Predicted and Non-Predicted Design Sets indicate designs that have used AI predictions





Easily identify designs “Boosted” with AI

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