



NAFEMS

VMAP for AI: Standardizing High-Fidelity Training Data for Industrial Interoperability

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VMAP Users Forum 2026

nafems.org

THE INTERNATIONAL ASSOCIATION FOR THE ENGINEERING MODELLING, ANALYSIS, AND SIMULATION COMMUNITY.





What is NAFEMS?

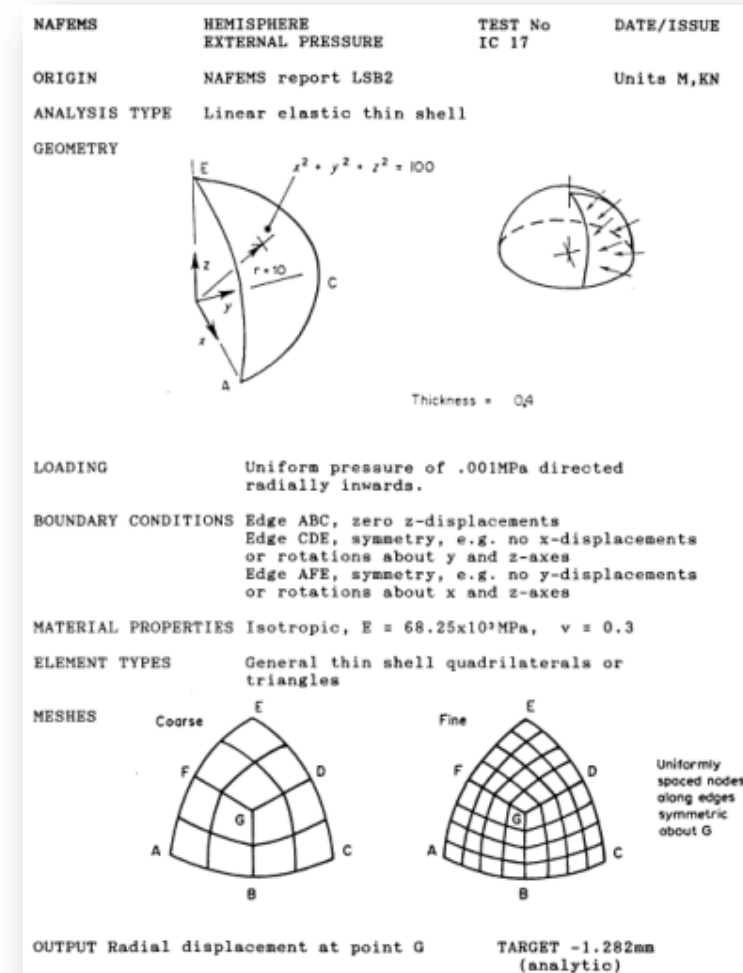
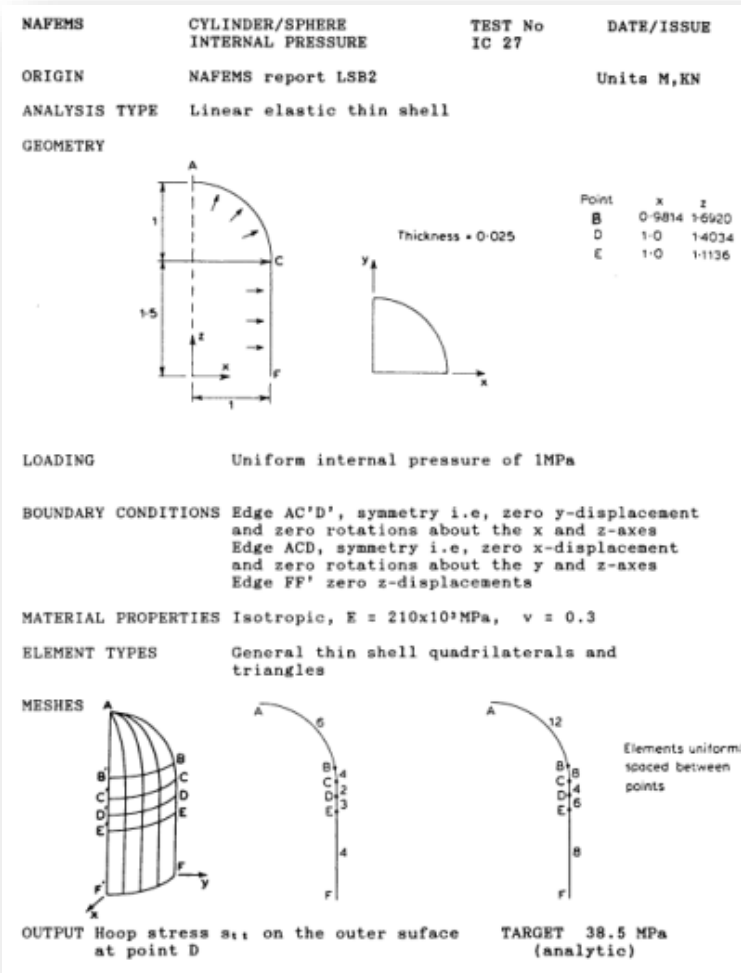
What is NAFEMS?

November 1983

NAFEMS is born

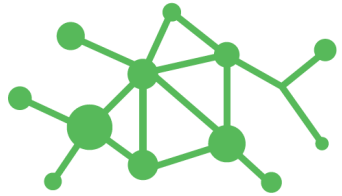
The National Agency for Finite Element Methods and Standards (NAFEMS) is launched as a subject-based division of the government research body, National Engineering Laboratory (NEL), in East Kilbride, Scotland. Bill Mair is the first Chair of the new body.

What is NAFEMS?

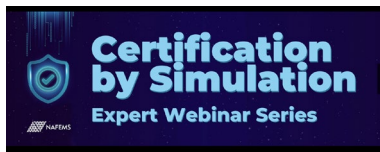


What is NAFEMS?

Events



**NAFEMS
REGIONAL
CONFERENCES**



Publications



EMAS
Engineering Modelling,
Analysis & Simulation
THE NAFEMS JOURNAL



Training



Certification



Communities

Technical Groups

Regional Groups

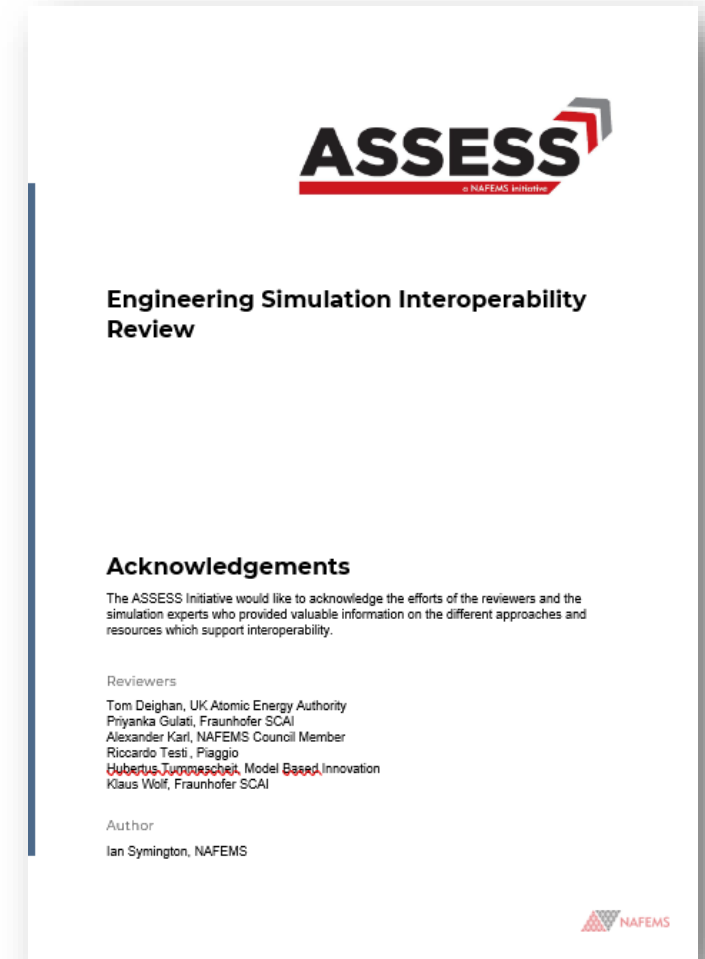




NAFEMS & VMAP

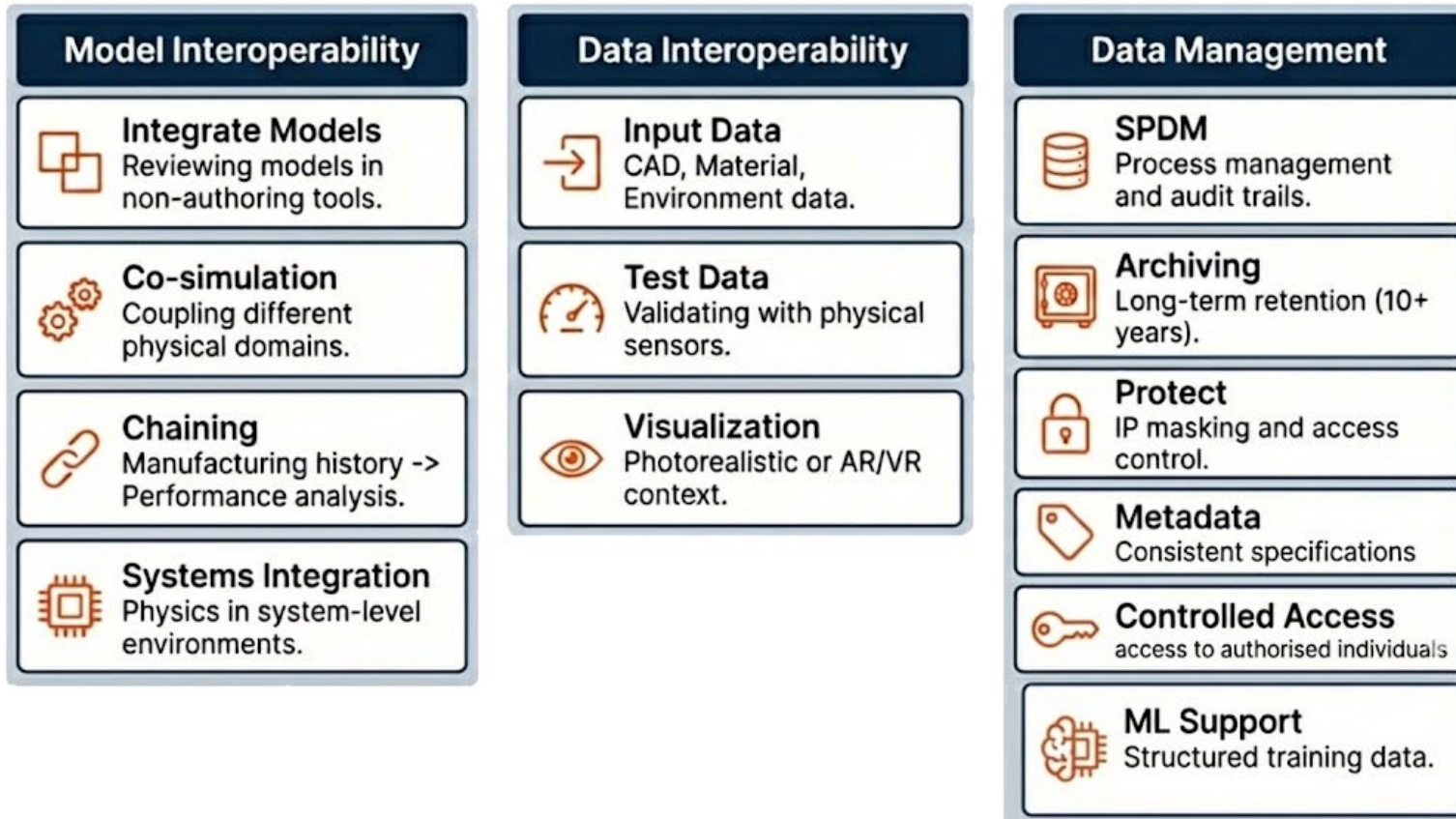
NAFEMS & VMAP

- Original project partner
- Engineering Simulation Interoperability Review
 - Due for publication March 26



NAFEMS & VMAP

- Engineering Simulation Interoperability Review
 - 13 interoperability scenarios defined



NAFEMS & VMAP

- Engineering Simulation Interoperability Review
 - 13 interoperability scenarios defined
 - 11 standards, resources & recommendations mapped against the scenarios

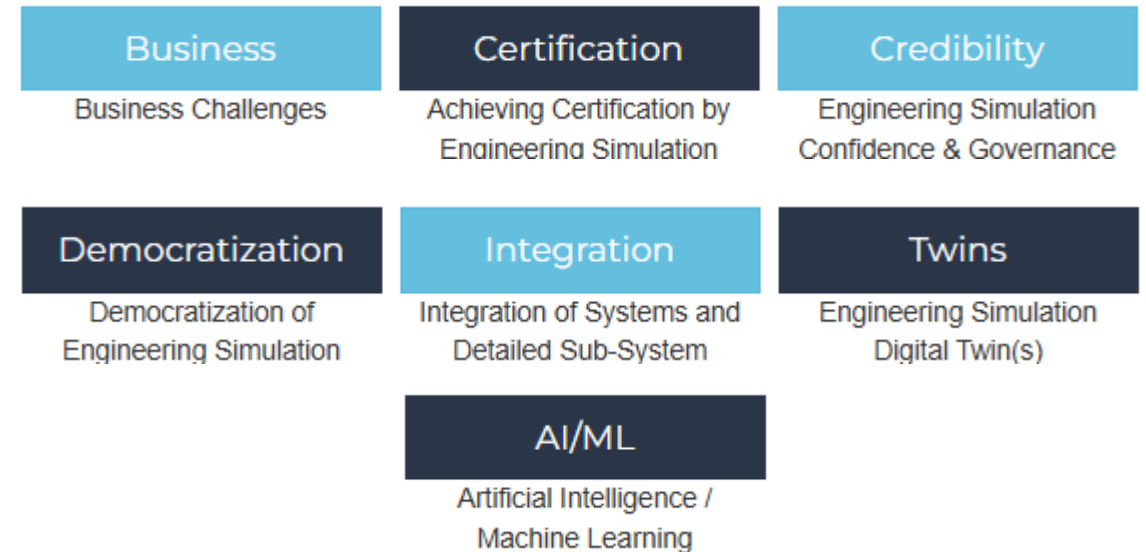
		ISO 10303 AP209	VMAP	FMI	OpenUSD	CGNS	EXODUS II	VTK	MPCCI	preCICE	Metadata Specifications	PSI 4 & PSI 9
Simulation Model Interoperability	Integrate Models	H	H	M	L	H	H	H	L	L	L	L
	Co-Simulation	M	L	H	L	L	L	L	H	H	L	L
	Chaining	M	H	M	L	M	M	L	L	L	L	L
	Systems Integration	L	L	H	L	L	L	L	M	L	L	L
Data Interoperability	Input Data Integration	M	L	L	L	L	L	L	L	L	L	M
	Test Data Integration	M	H	L	M	M	M	M	L	L	L	L
	Visualisation	L	M	L	H	M	M	H	L	L	L	L
Data Management	Simulation Process & Data Management	L	L	L	L	L	L	L	L	L	M	M
	Archiving & Retrieval	H	M	M	L	M	M	M	L	L	M	M
	Controlled Access	L	L	L	L	L	L	L	L	L	L	L
	Protect	L	H	H	L	L	L	L	L	L	L	L
	Support for ML	L	M	L	L	M	M	M	L	L	M	M
	Metadata	M	M	M	L	L	L	L	L	L	H	H



VMAP for data-driven simulation 1

Data-driven simulation benchmarks

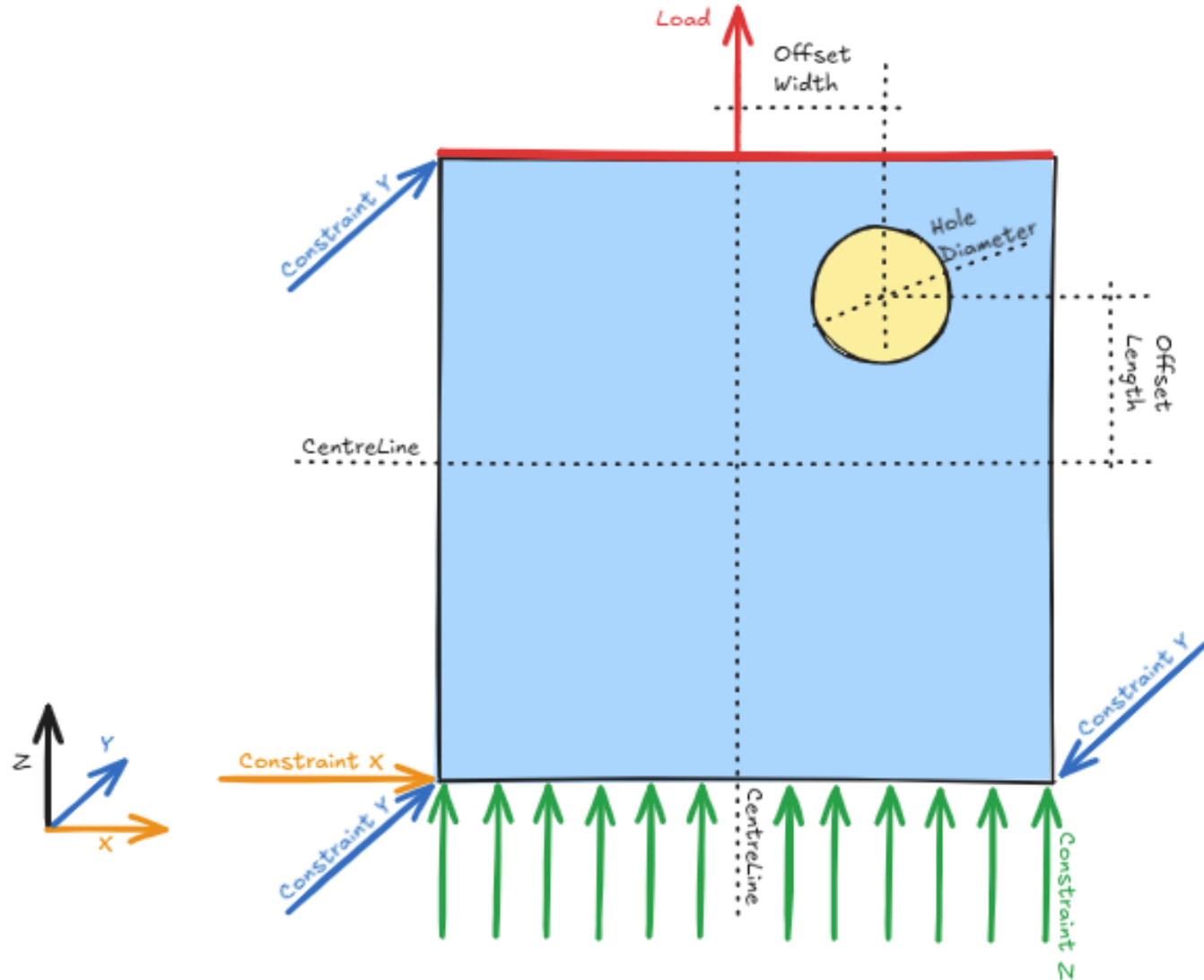
1. Simple educational benchmark
2. Industry representative challenge problem



Simple data-driven benchmark

- Demonstrate the potential of geometric deep learning in engineering simulation
- Create a problem with educational merit
 - Quantity of data required
 - Sampling the parameter space
 - Explore different models and hyperparameters
 - Error estimation

Simple data-driven benchmark



Nodes at plate lower edge constrained in Z
3 plate corners constrained in Y
1 plate corner constrained in X

Constraint equation used to ensure nodes at plate upper edge have the same Z displacement i.e. the top edge remains plane

Point load applied to parent node in the constraint equation. Load is effectively distributed across the top edge of plate

Linear elastic material
 $E=2E5\text{MPa}$
 $\nu=0.3$

Quantity of Interest - Maximum Principal Stress

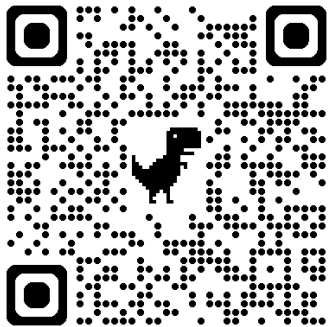
Simple data-driven benchmark

Variable	Range Lower Bound	Range Upper Bound
Hole diameter	30mm	240mm
Plate width	300mm	1000mm
Plate length	300mm	1000mm
Plate thickness	1mm	20mm
Applied load	5000N	100000N
Offset width direction	0mm	0.4 x (Plate Width - Hole diameter)
Offset length direction	0mm	0.4 x (Plate Length - Hole diameter)

- 6 datasets where different combinations of variables are modified
- Separate models trained for each dataset
- \approx 200 training samples
- Data available in VMAP, Nastran and Hypermesh format

Simple data-driven benchmark

- Datasets are available to download
- Summary of our experience developing a GDL model using this data will be published in March '26
- We want to hear how others have got on using the dataset
 - What tools and algorithms were used?
 - Mean and Maximum absolute error measures?
 - Share plots of best and worst fit stress distributions?

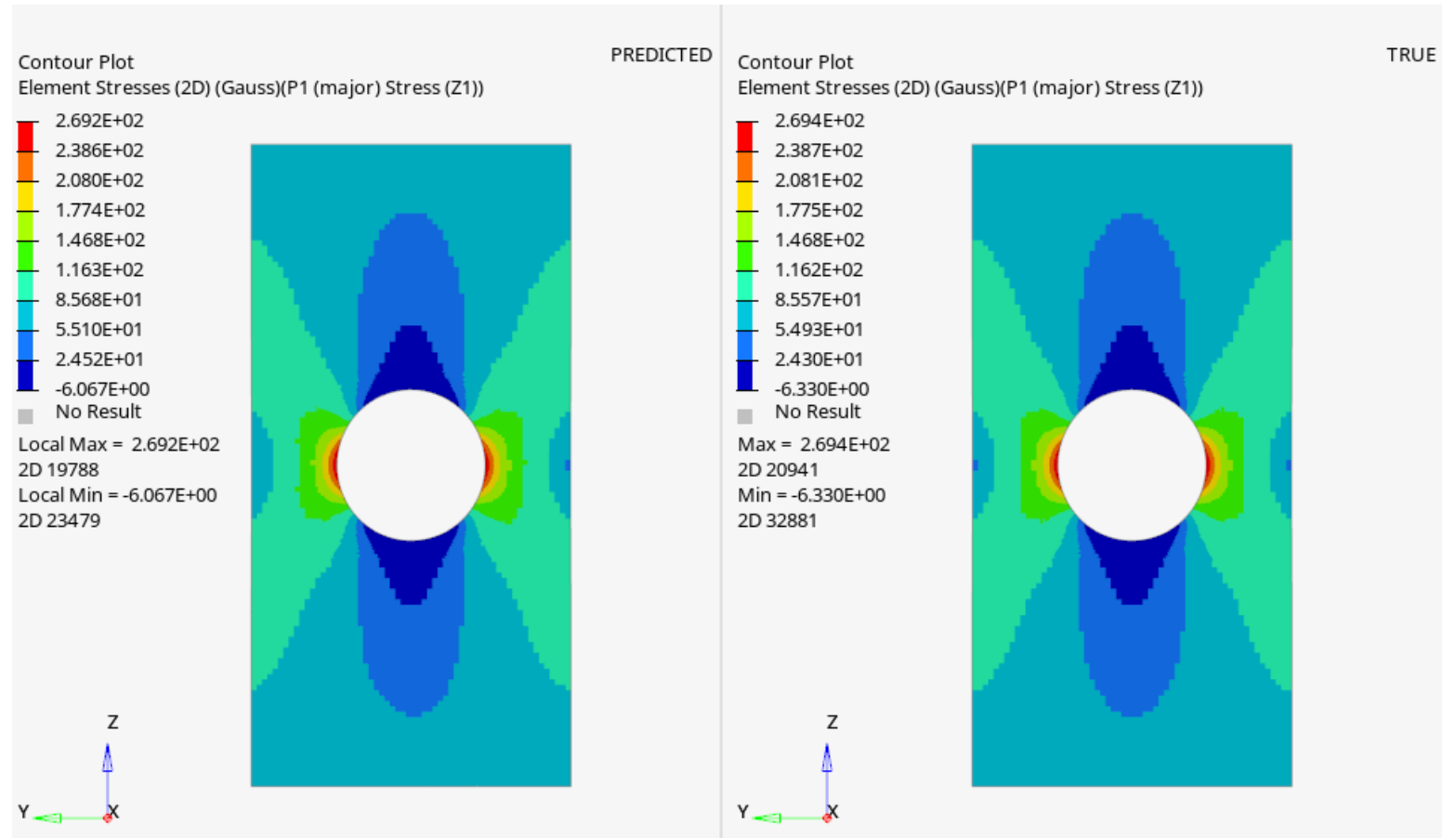


The screenshot shows the NAFEMS website interface. At the top, there is a search bar and navigation links for Membership, 2026 Regional Conferences, Training, Events, Community, Resources, Professional Development, Services, About Us, and Careers. The main heading is "Data Driven Benchmark - Plate with Hole - Dataset 1". Below this, there is a diagram of a plate with a hole, showing stress distributions and boundary conditions. The text describes the dataset's origin and purpose, mentioning the NAFEMS ASSESS Initiative and the use of AI in engineering simulation. It also provides information on the data format (VMAP, HyperMesh, Nastran) and a link to download the problem description. A table of problem variables is also visible.

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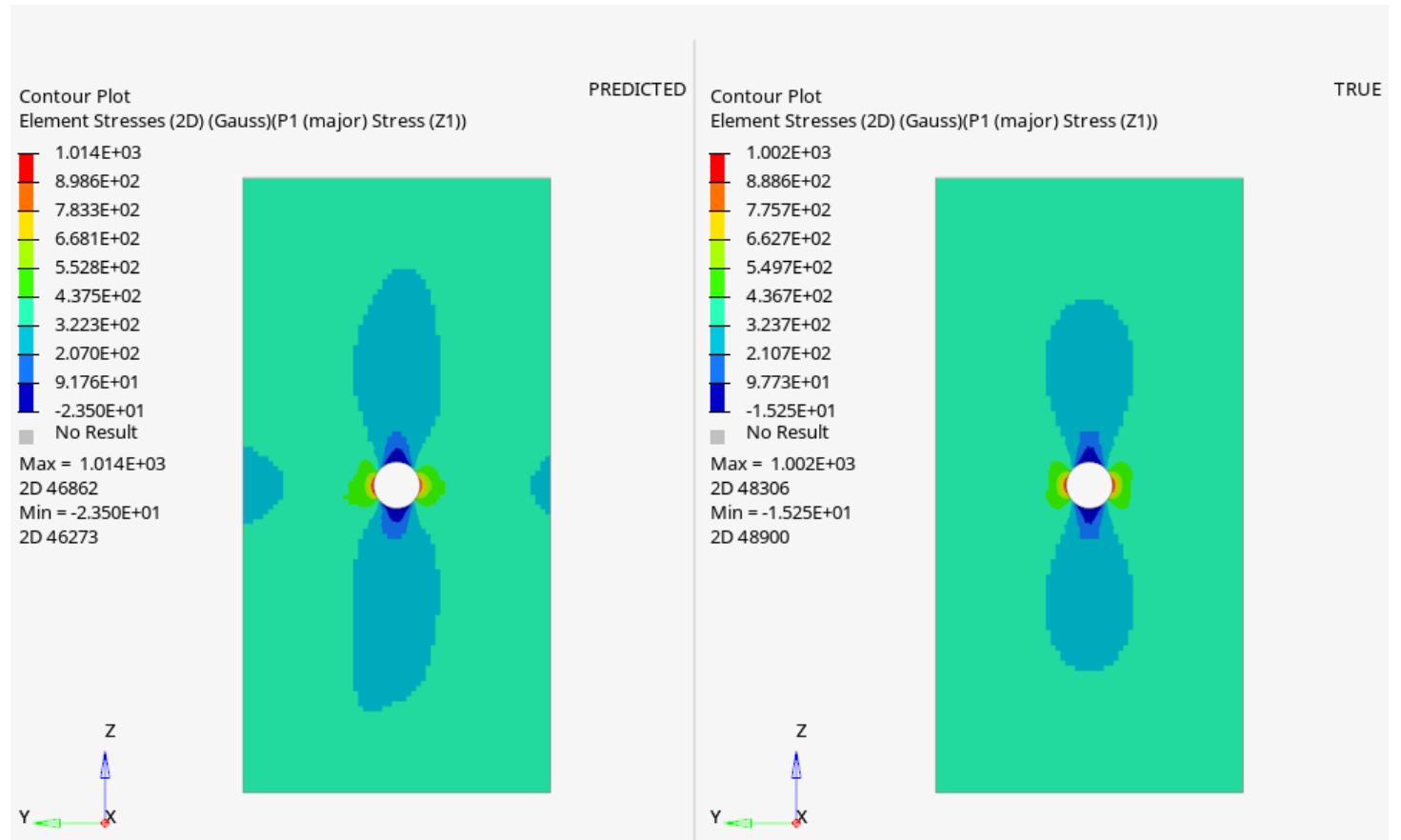
Simple data-driven benchmark

- Dataset 1 – Variable hole diameter



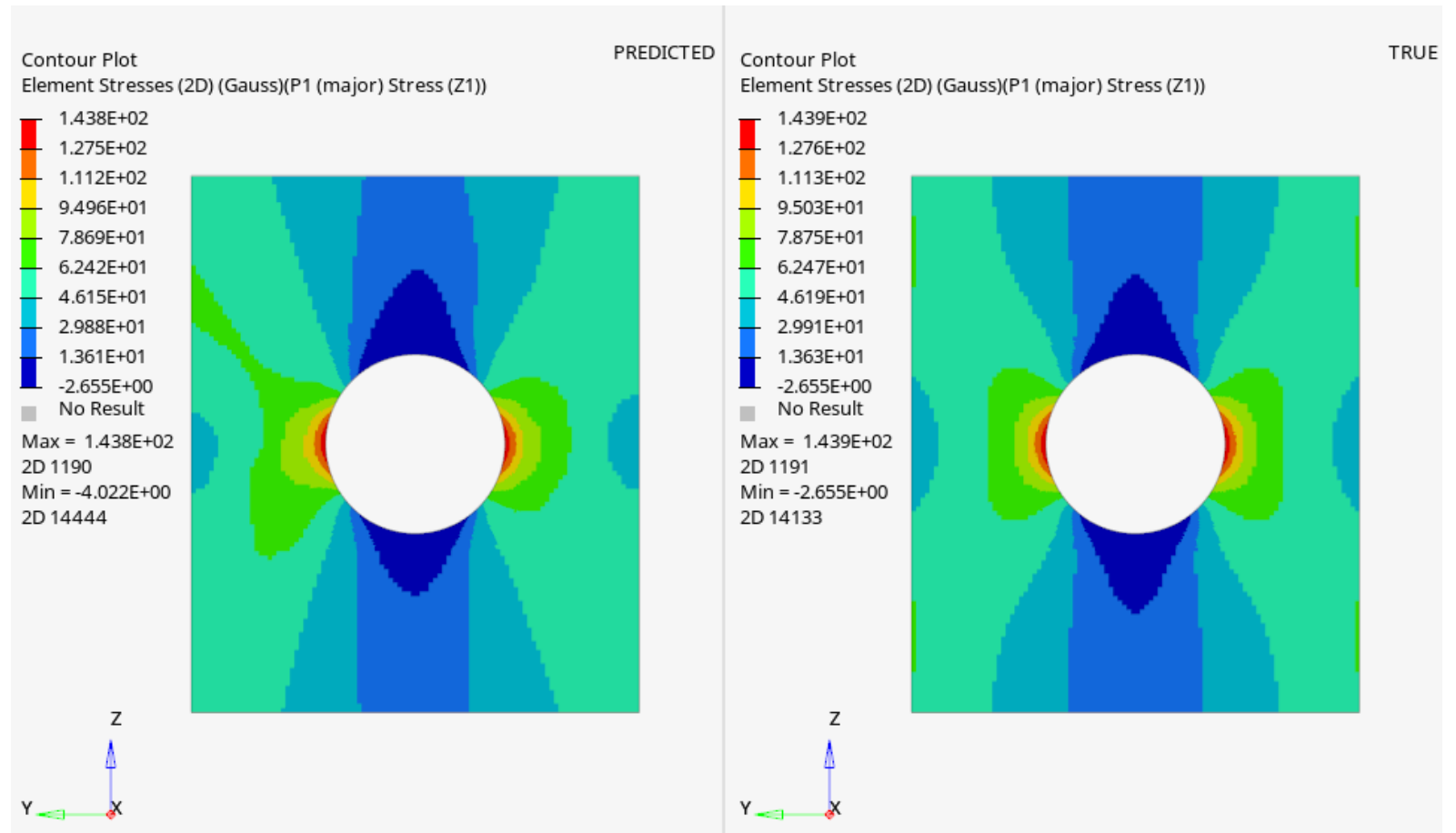
Simple data-driven benchmark

- Dataset 2 – Vary hole diameter & plate thickness



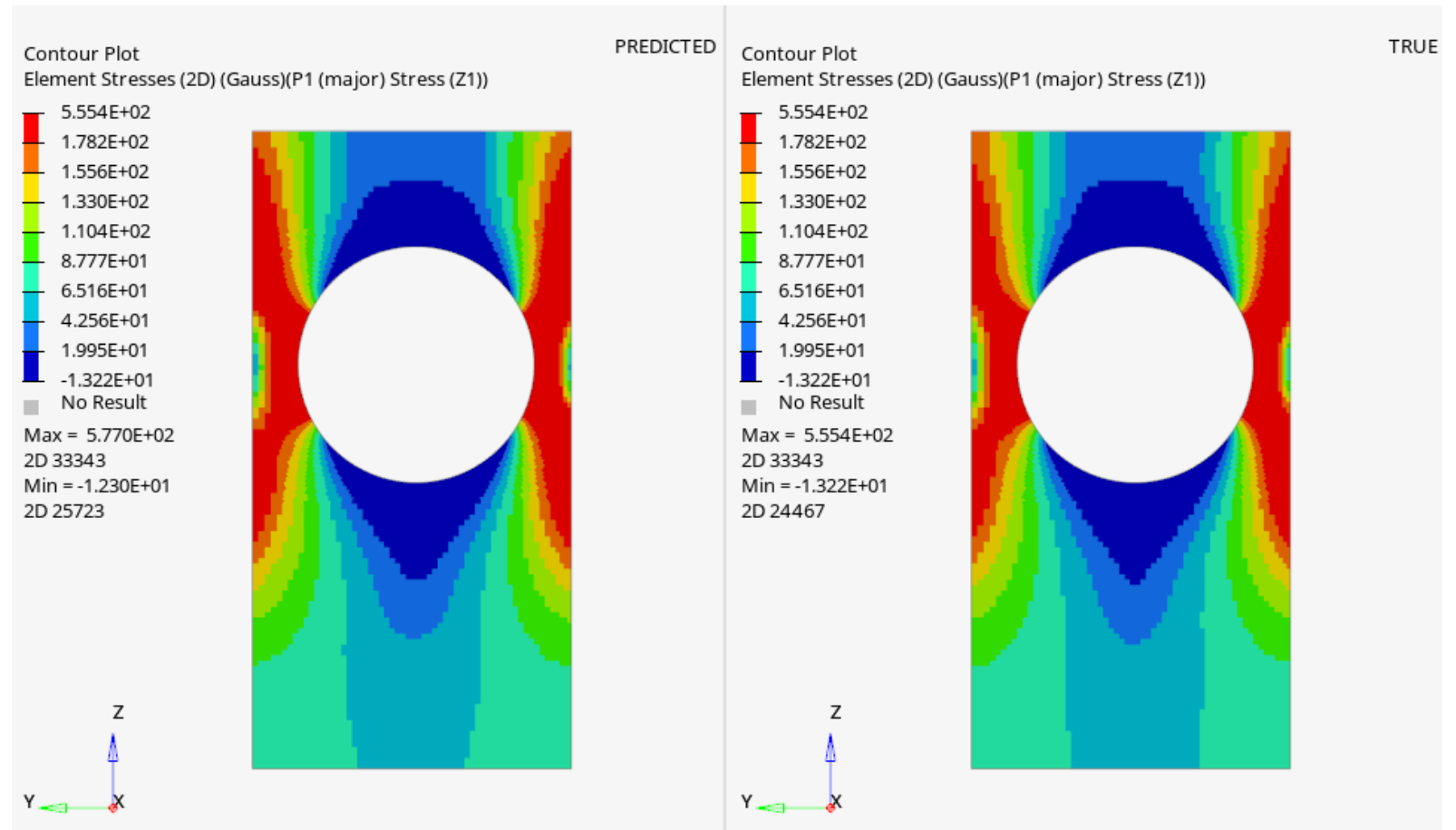
Simple data-driven benchmark

- Dataset 3 – Hole diameter and plate extent



Simple data-driven benchmark

- Dataset 5 – Hole diameter and hole location





VMAP for data-driven simulation 2

Data-driven benchmark – Industry example

Goal – to create a challenging data driven benchmark that is representative of a real-world engineering problem.

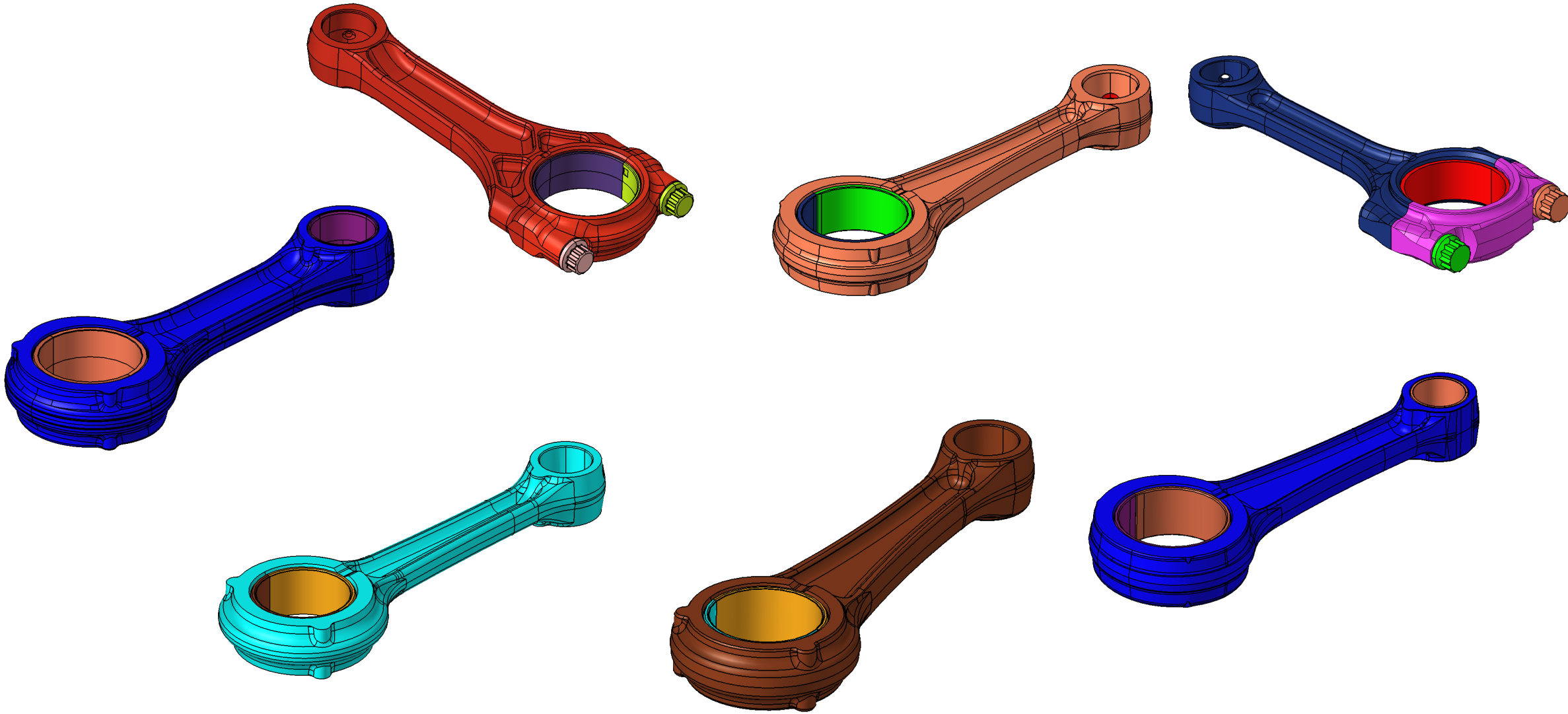
Evaluate the maturity of GDL tools – not to score vendor products

Challenge comes from a proof of concept study carried out by Piaggio.

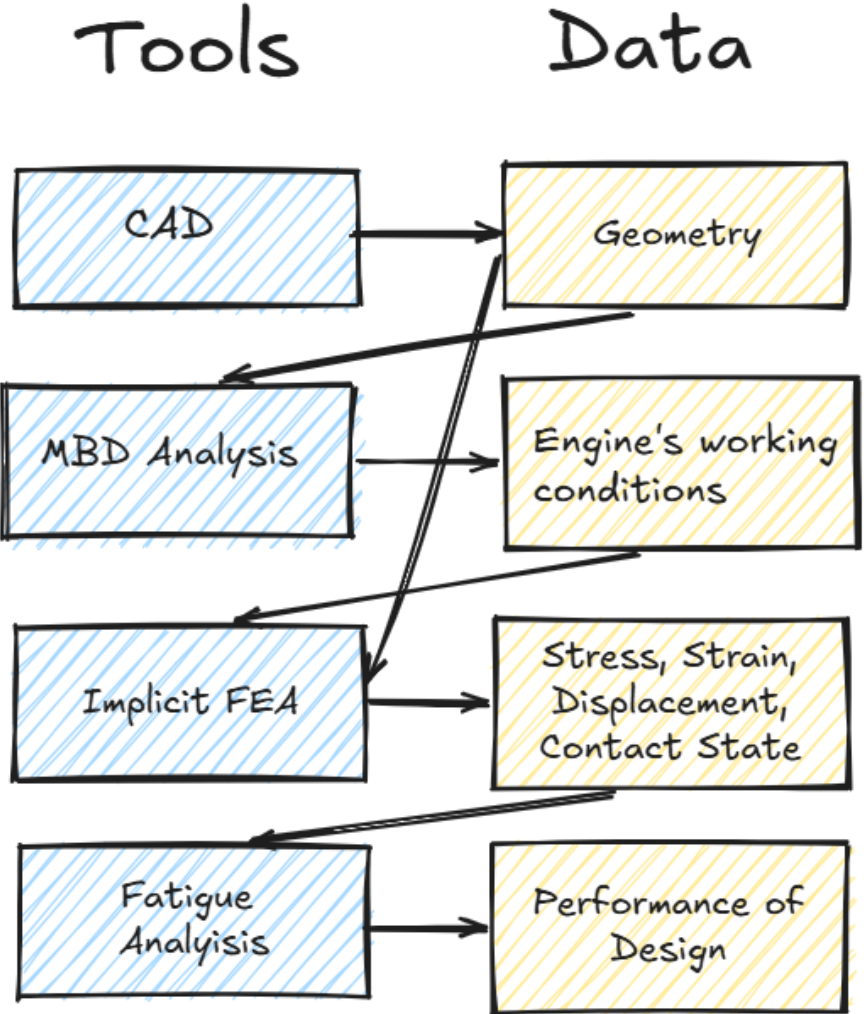


PIAGGIO®

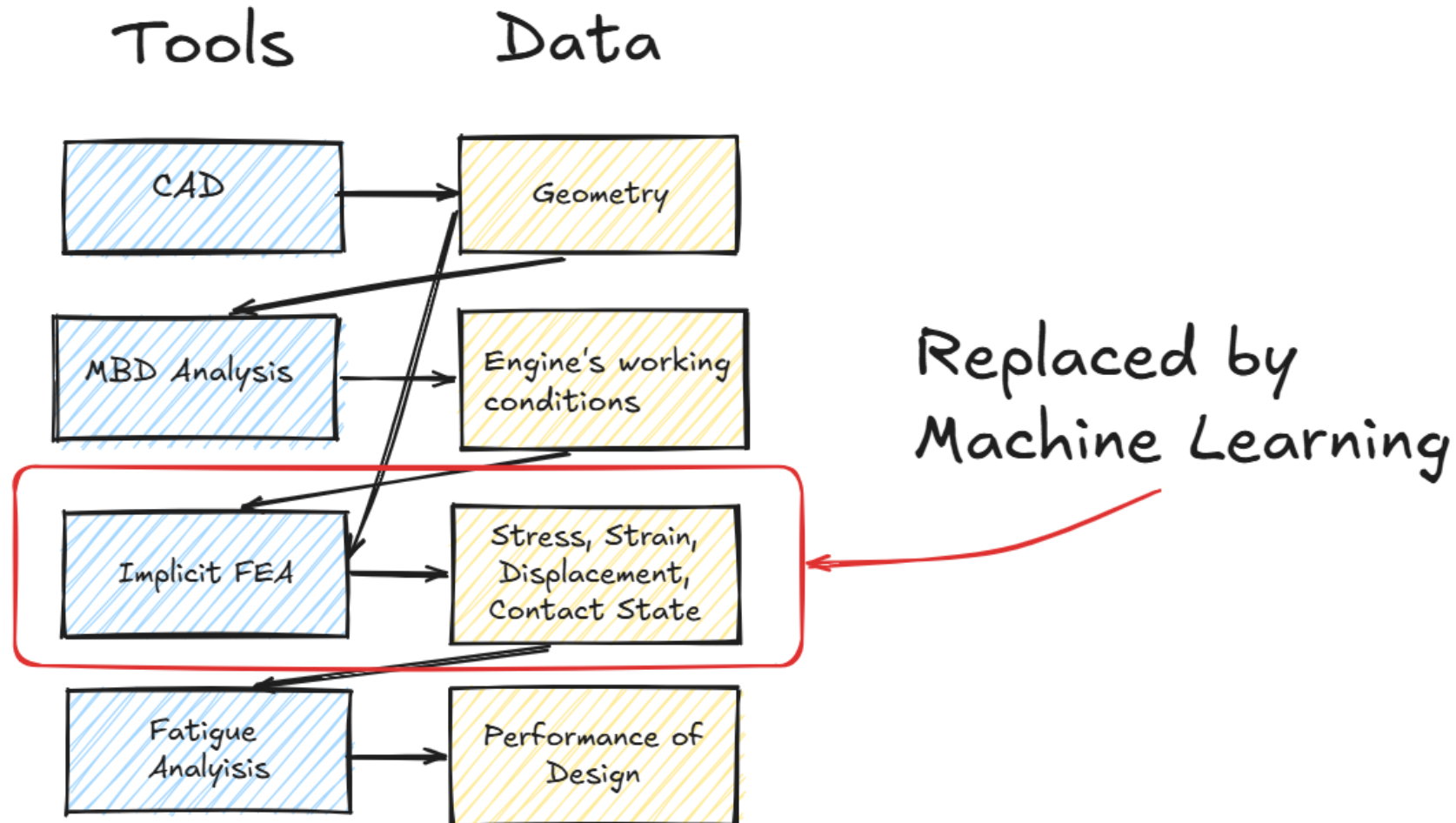
Data-driven benchmark – Industry example



Data-driven benchmark – Industry example



Data-driven benchmark – Industry example



Data-driven benchmark – Industry example

- VMAP – a standardized format for ML training data
- VMAP – a standardized format to pass data along the workflow

Data-driven benchmark – Industry example

- The challenge
 - Predict full field VM Stress, Displacement Results & Contact status (stick/slip)
 - Vendors asked to supply details of their method, error metrics and plots at at specified locations and times
 - Training times, AI architecture, training infrastructure
- Build complexity
 - Prediction based on geometry that is included in the training set but for a load condition that has been omitted
 - Ask respondents to make a prediction on a conrod variant and load conditions that have not been provided in the training data
- Data will be provided in VMAP format to support vendor neutrality
- Results will be anonymized prior to publication



NAFEMS & VMAP

- Interoperability is a barrier to effective use of engineering simulation
- VMAP addresses many interoperability scenarios
- Proactively look for opportunities to utilise, promote and work with the VMAP standards community