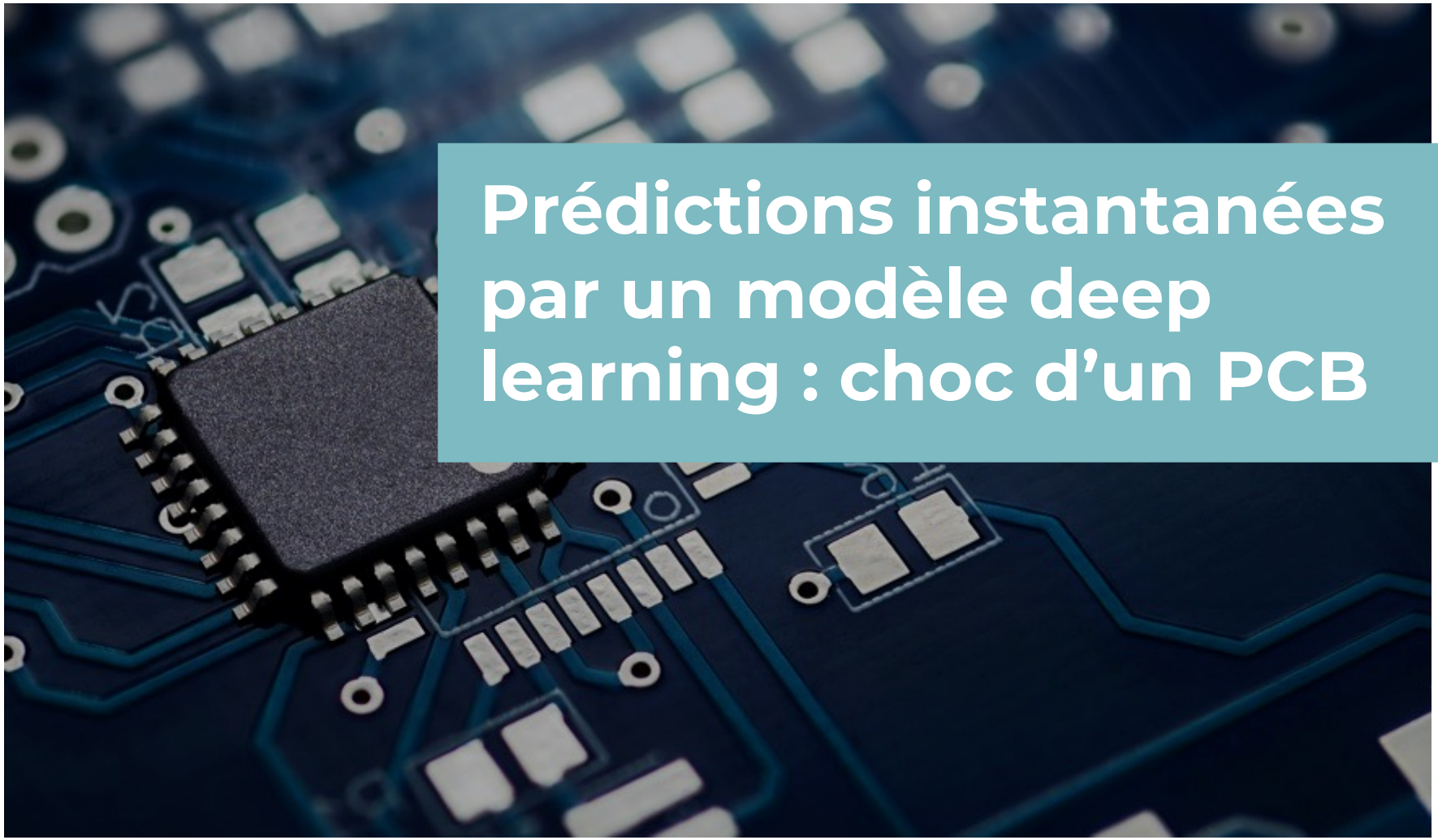


Prédictions instantanées par un modèle deep learning : choc d'un PCB

CADFEM

Ansys

NEURAL CONCEPT

Outline

- Introduction
- Deep Learning inside Ansys : How can we interface Ansys with NCS ?
- Example of PCB crash
- Which role for Deep Learning in the CAE world

Introduction

Neural Concept in short

Who we are

- A Swiss company with deep world-class academic background in Deep-Learning.
- Deep learning at its most practical and business relevance.

What we do

- Redefining how quickly new designs can be brought to production.
- Proving our value at world-class manufacturing companies from Airbus to Bosch.

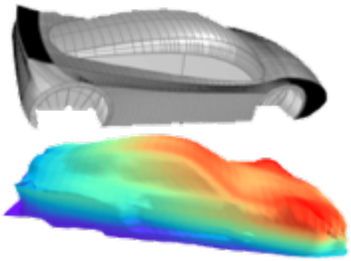
Technology

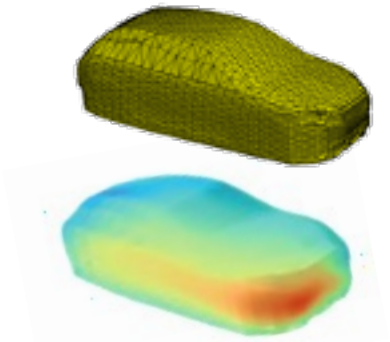
- Deep-Learning for interactive, real-time and more powerful simulation and design optimization.
- Massive complexity harnessed in an accessible design engineering toolkit

BOSCH PSA GROUPE mcpp Power to Perform SAFRAN AIRBUS DSM

Get the most out of existing simulations

1



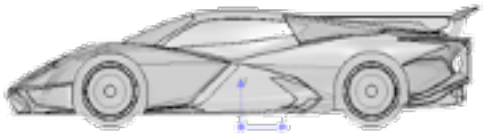


Your simulation data

50 to 10,000 simulations
IGS, .stl or contour format

Model

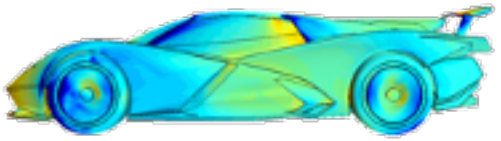
2



New CAD geometry

50ms

3



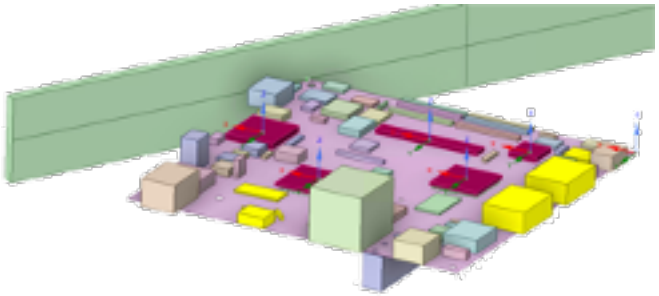
C_d C_L

Predict quantities of interest

real-time (≈ms)

Project context

- Provides the test case



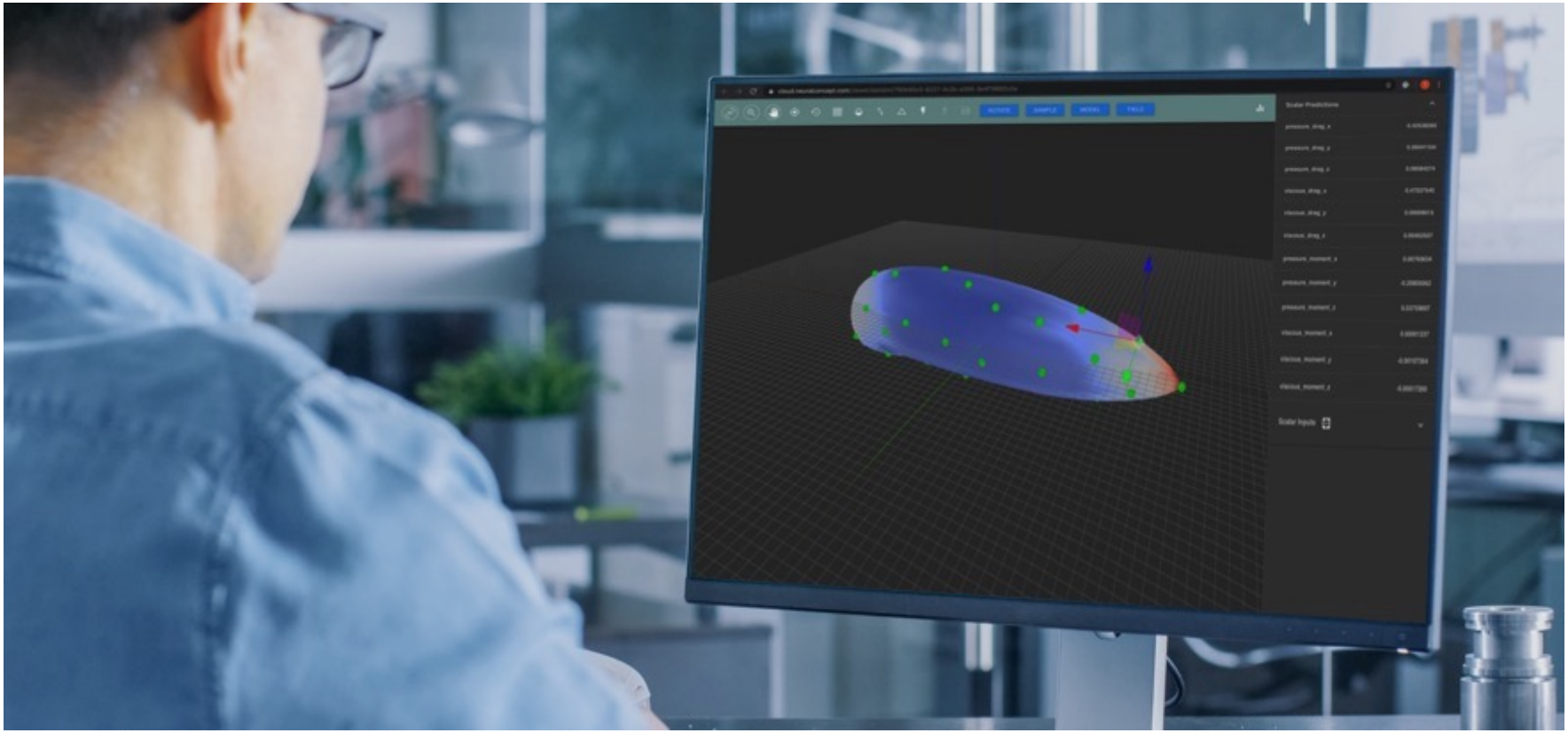
- Develops the sofware
- Trains surrogate models
- Integrates the software NCS with Ansys

- Provides technical support

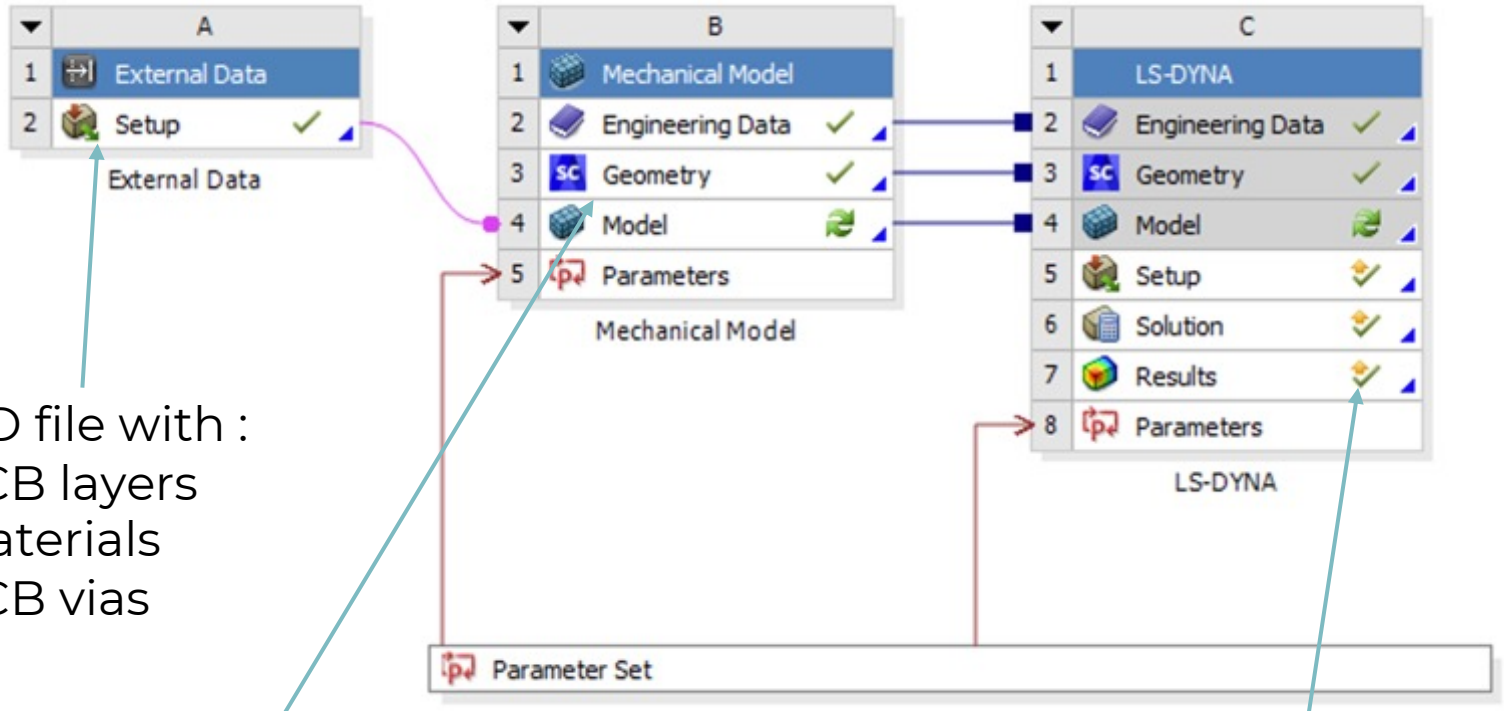
Demand to the ECAD designer :
«For the next smartphone generation, please add the new camera with the Miniswys actuation system and make sure the solders won't break if the phone is dropped by the user»

Goal of the project :
Develop a Deep Learning based ROM which can predict the force history in the solder balls and the PCB deformations when the PCB falls down

Deep Learning inside Ansys : how can we interface Ansys with NCS ?



Simulation Workflow (preparation of training set)



ECAD file with :

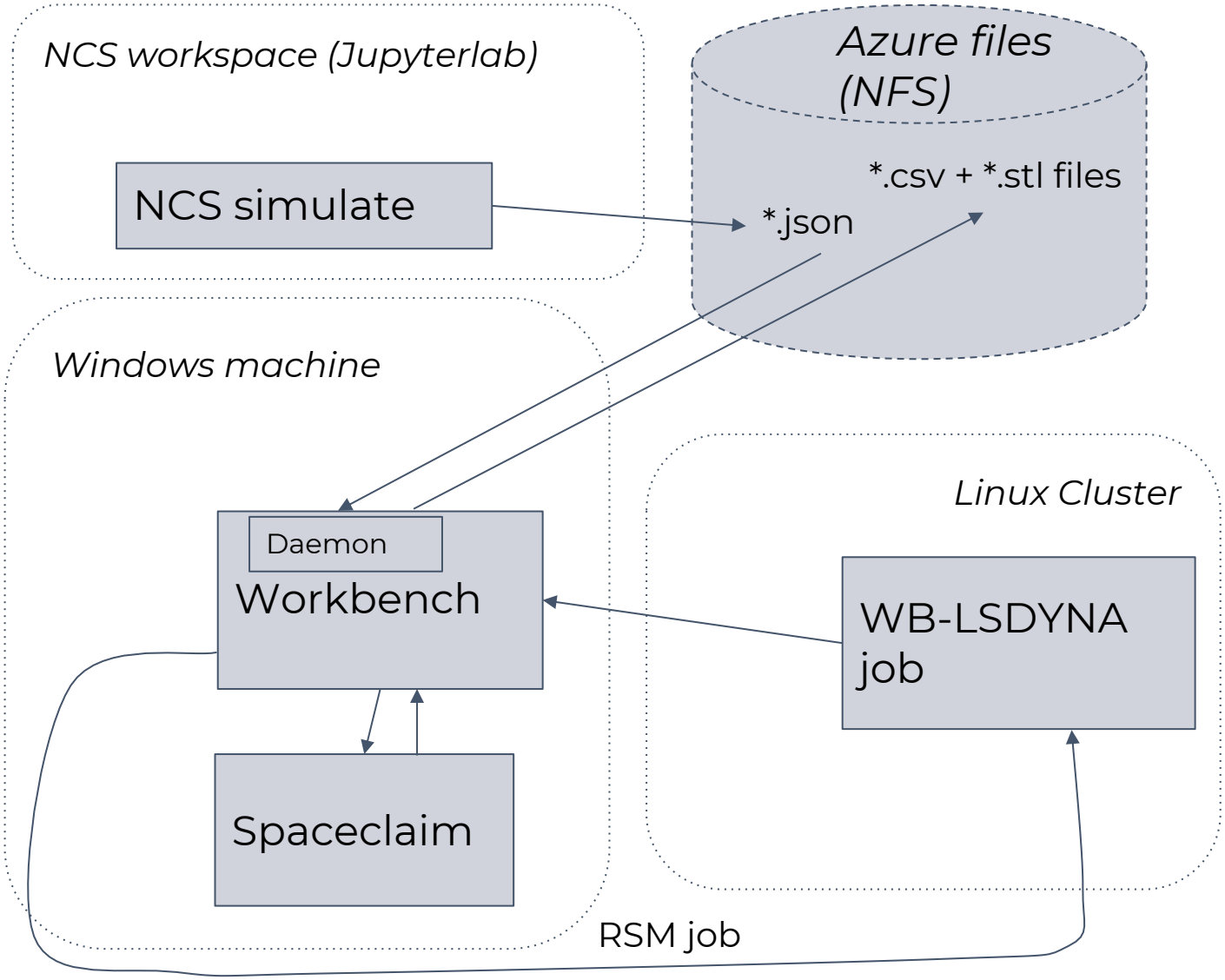
- PCB layers
- Materials
- PCB vias

- Parametric geometry (PCB orientation w.r.t. the wall)
- Chips positions on the PCB

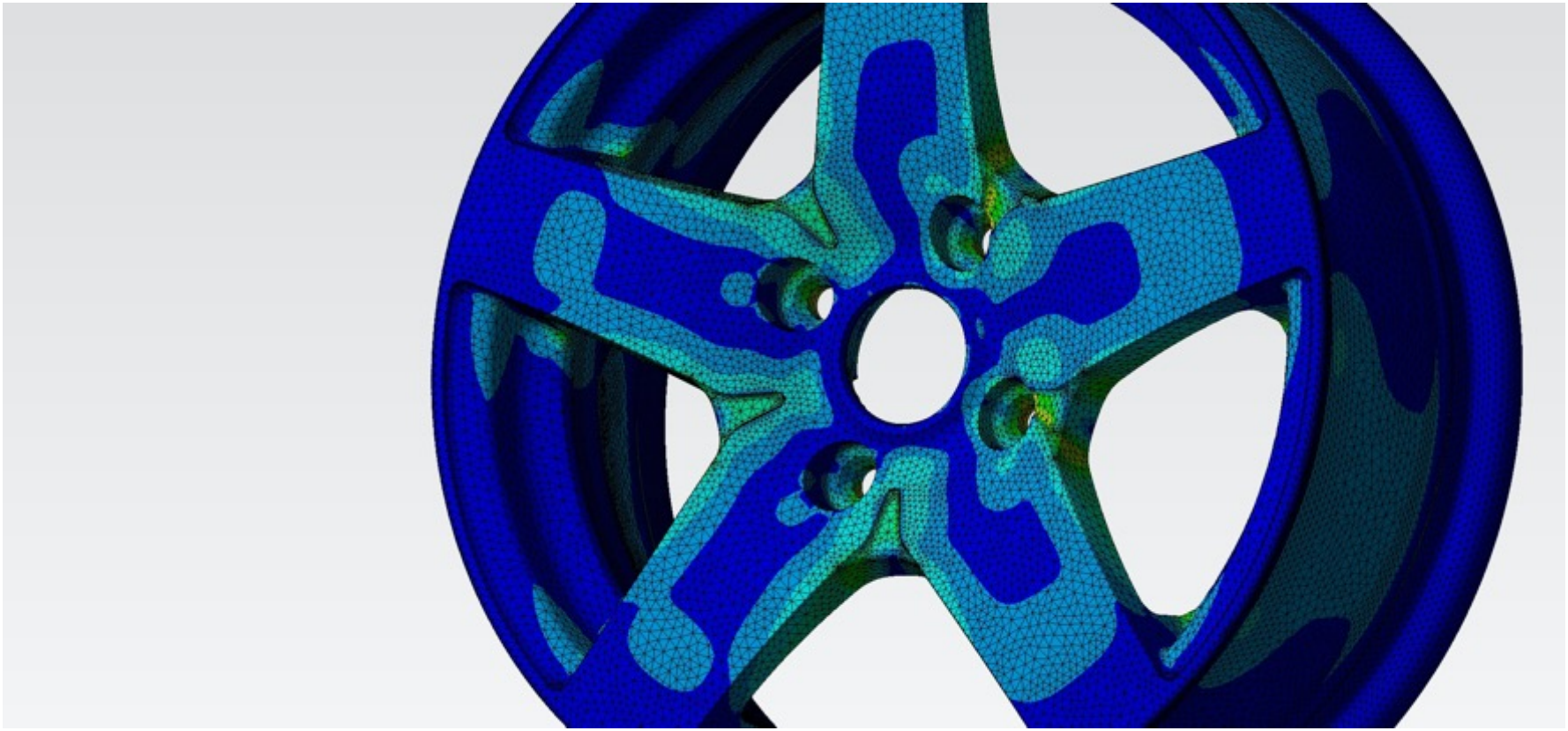
Results export for NCS automated with help of ACT

NCS ↔ Ansys interactions

- NCS interacts directly with Workbench projects which allows all workbench integrated simulation types to be handeled (Mechanical, WB-LSDYNA, Fluent, CFX etc.)
- NCS can trigger a new simulation and get the results back (useful for adaptive surrogate model refinement)
- NCS can request a new geometry to SpaceClaim and return result predictions

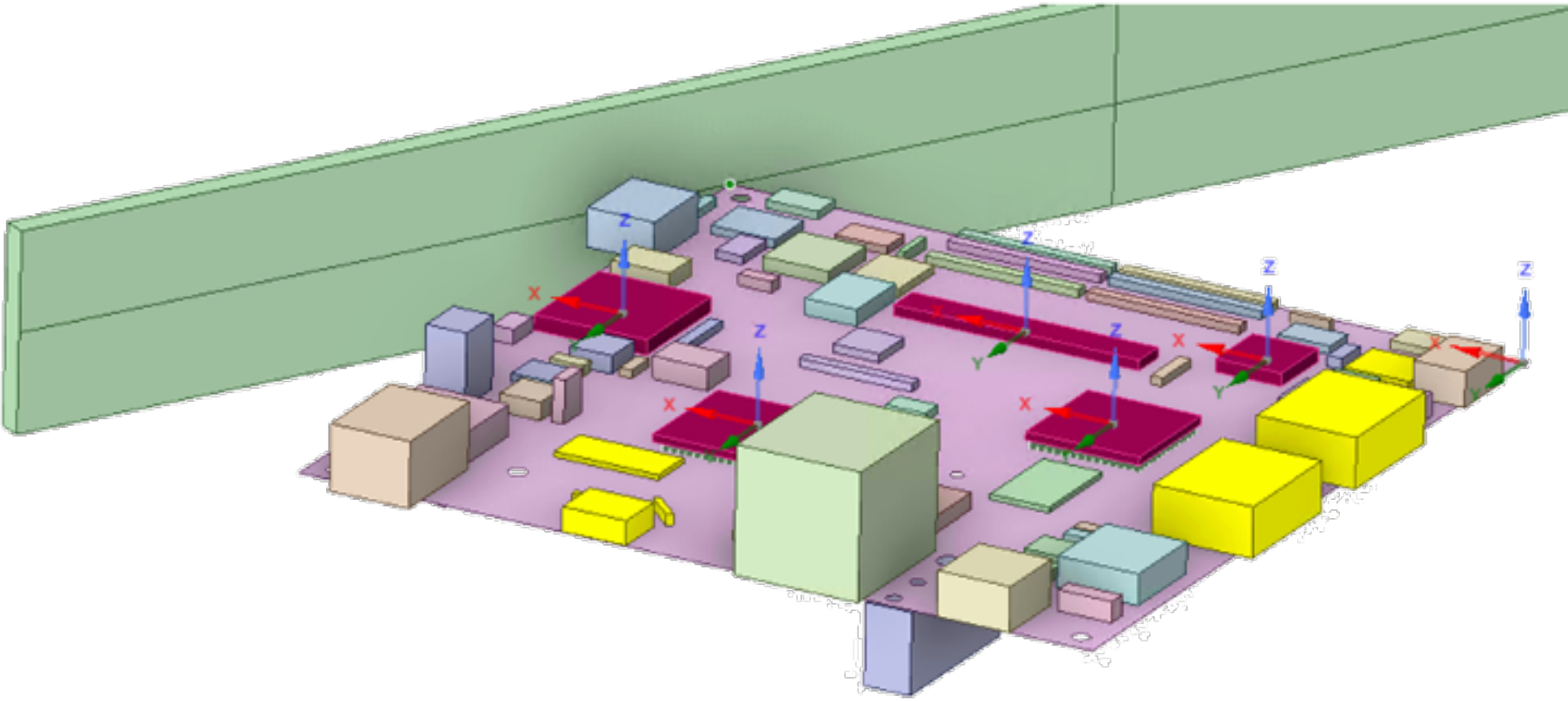


Example of a PCB crash



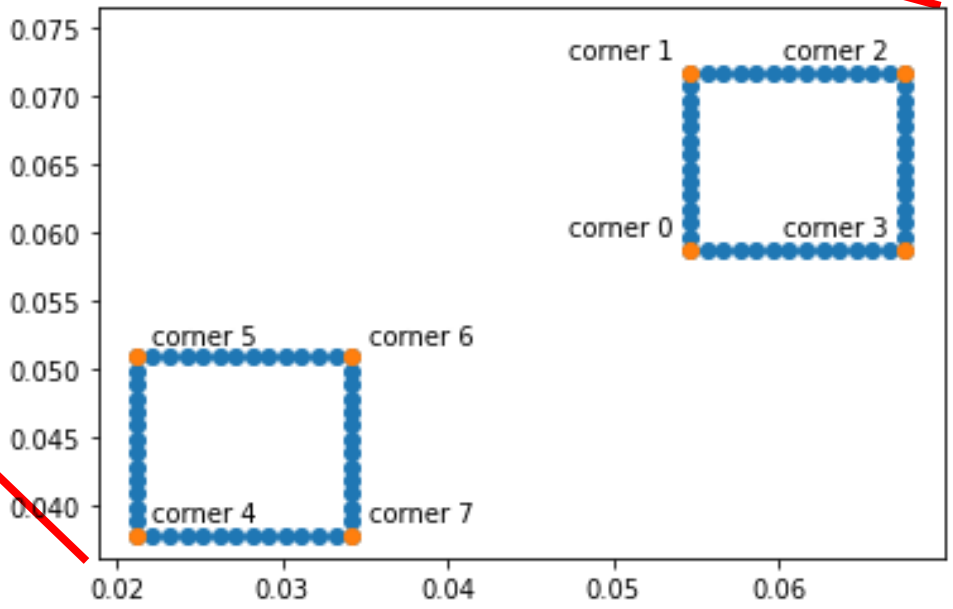
Geometry and parametrization

- PCB orientation w.r.t. the ground [0°;360°]
- Impact velocity [0.7 m/s,1.2 m/s]
- Packages positions (10 parameters)
- Chips status (5 parameters)



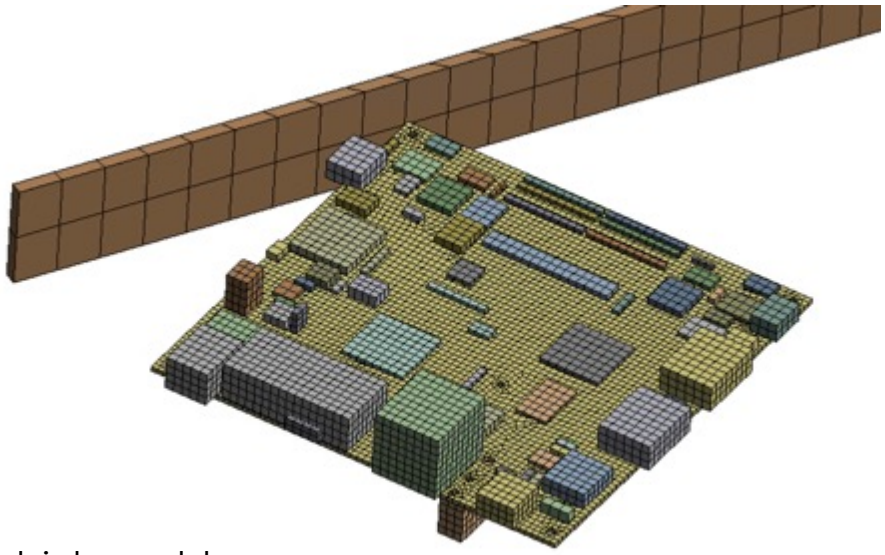
Solder Balls

- Solders are represented as beam elements
- Only external solders are considered for the deep learning prediction model (image on the bottom)



FE Model

- Parametric geometry prepared with SpaceClaim scripting.
- Packages represented as parallelipideds so that they keep the same mass and the same CG as the original packages.
- Explicit dynamics with LS-DYNA solver, model prepared with WB-LSDYNA.
- Fully integrated shell for the PCB board
- Fully integrated solid elements for the chips which could shock the ground.
- Contacts between PCB components → snippet (bonded)
- Contact between PCB and ground → Mechanical Interface (frictionnal)



# elements	# nodes
~8000	~12500

Simulation outputs

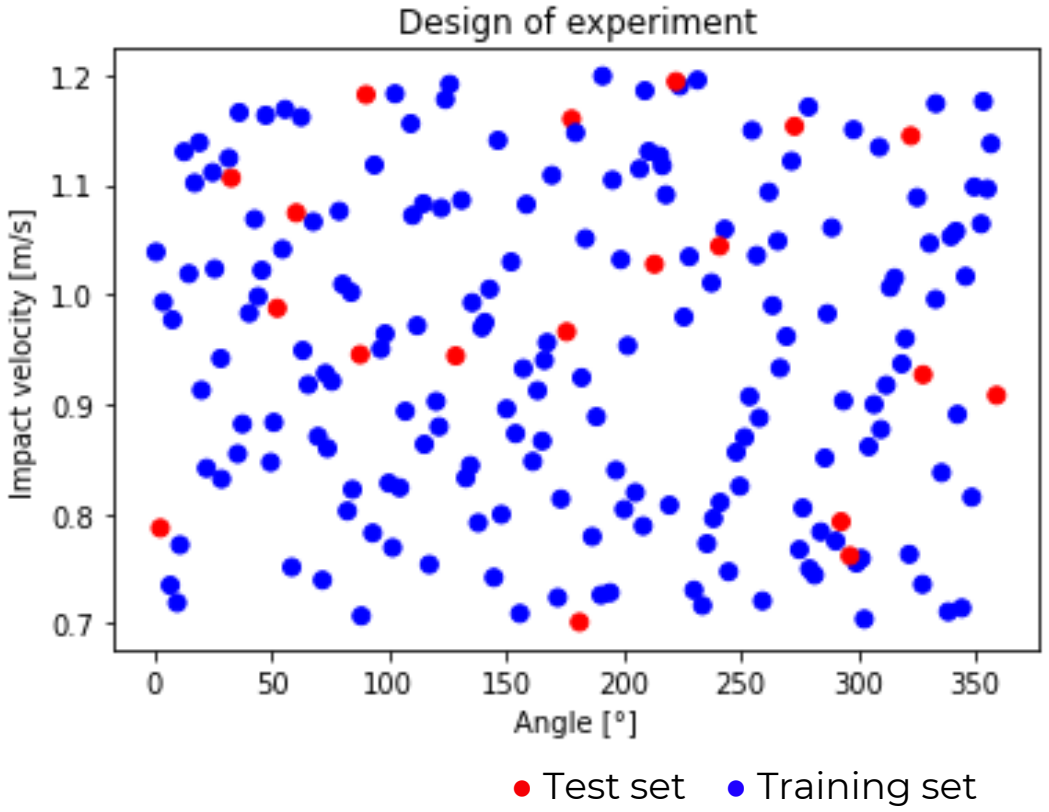
Time history of shear force in the solders
Time history of axial force in the solders
Time history of displacements on every point of the mesh

Simulation dataset

200 parameter sets are randomly sampled (Latin Hypercube).
8 simulation discarded (wrong results).
10% of the remaining data are used for model verification and validation (test set)

Output quantities

- Time history of shear force in the solders
- Time history of axial force in the solders
- Time history of displacements on every point of the mesh



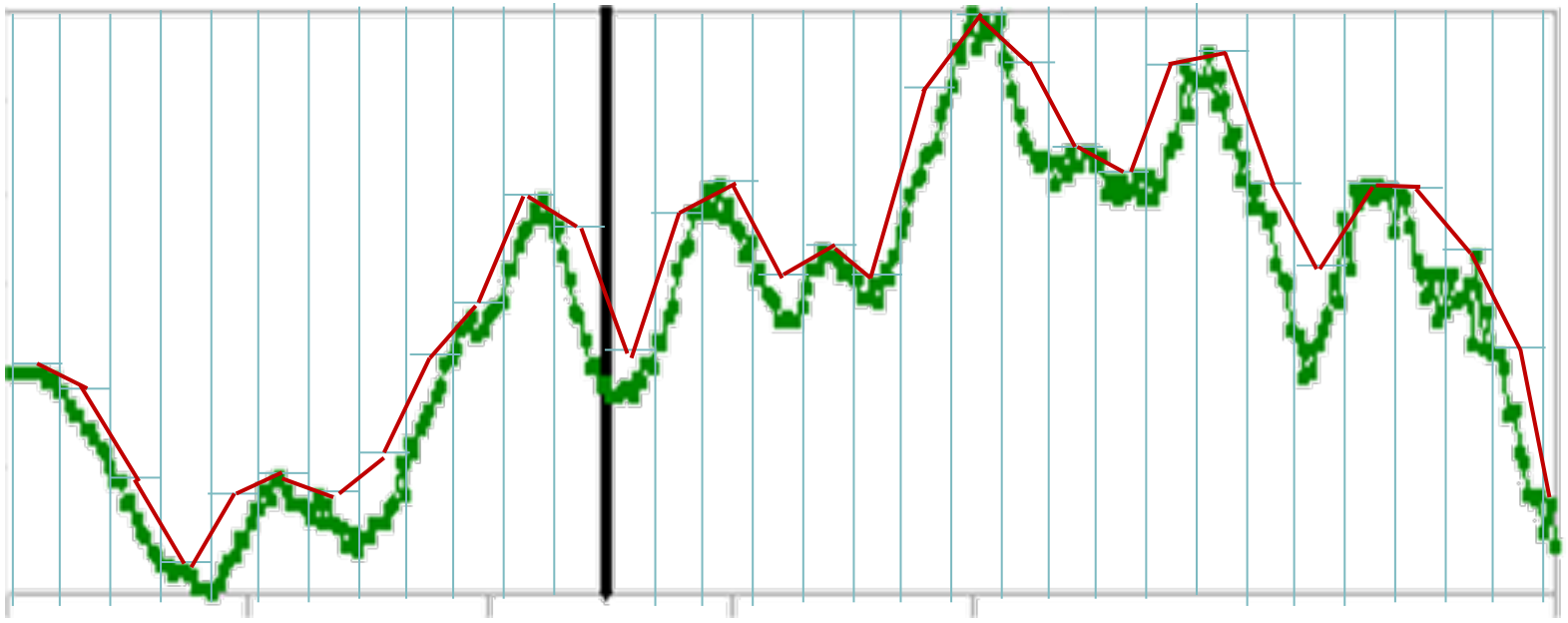
Data transformation before training :

- Downsampling time-dependent data (300 to 50 time points)
- Data augmentation

Downsampling

- Interest in the maximum of the signal
- Remove small oscillations (not relevant)

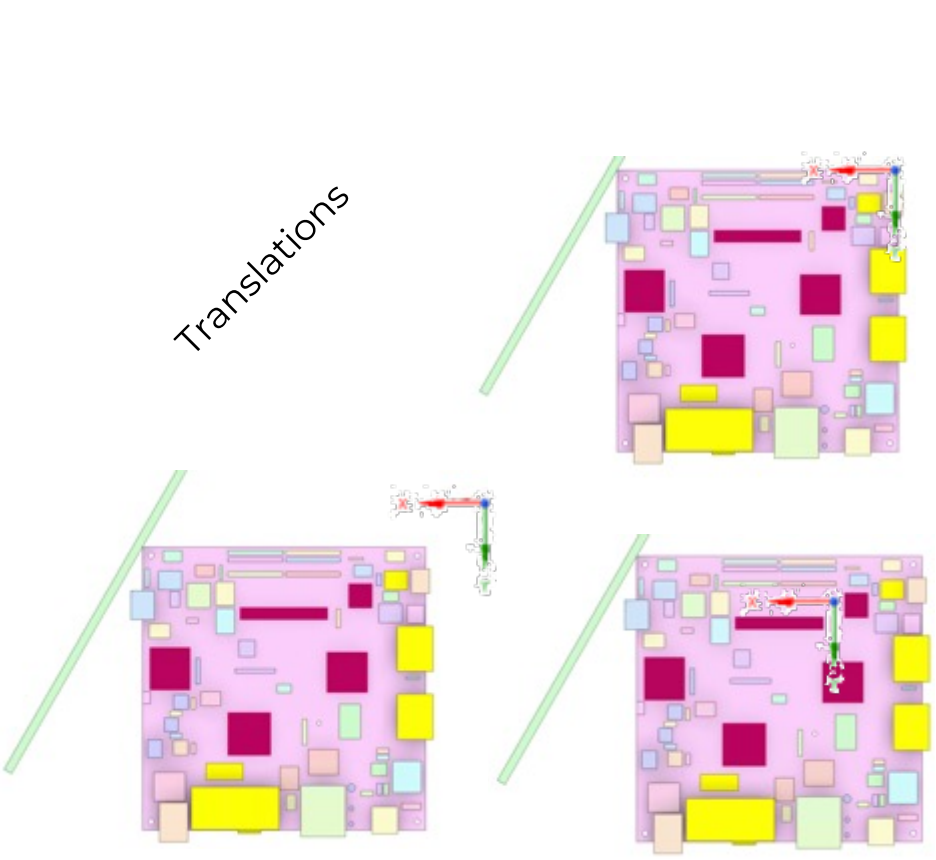
→ Downsampling with max windowing

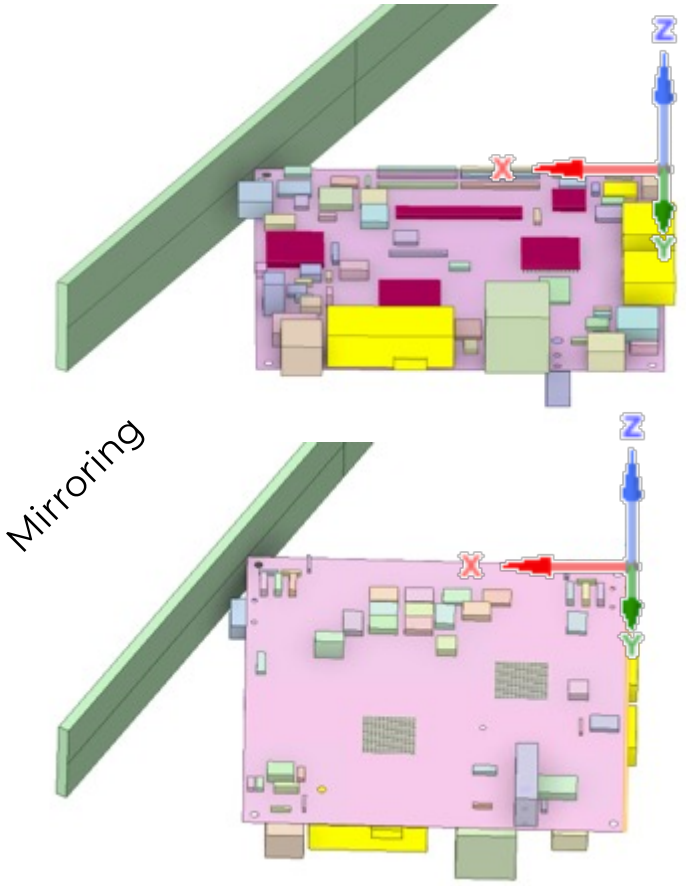


Data augmentation

Present one sample (geometry and simulation results) from another «point of view» to the Neural Network.

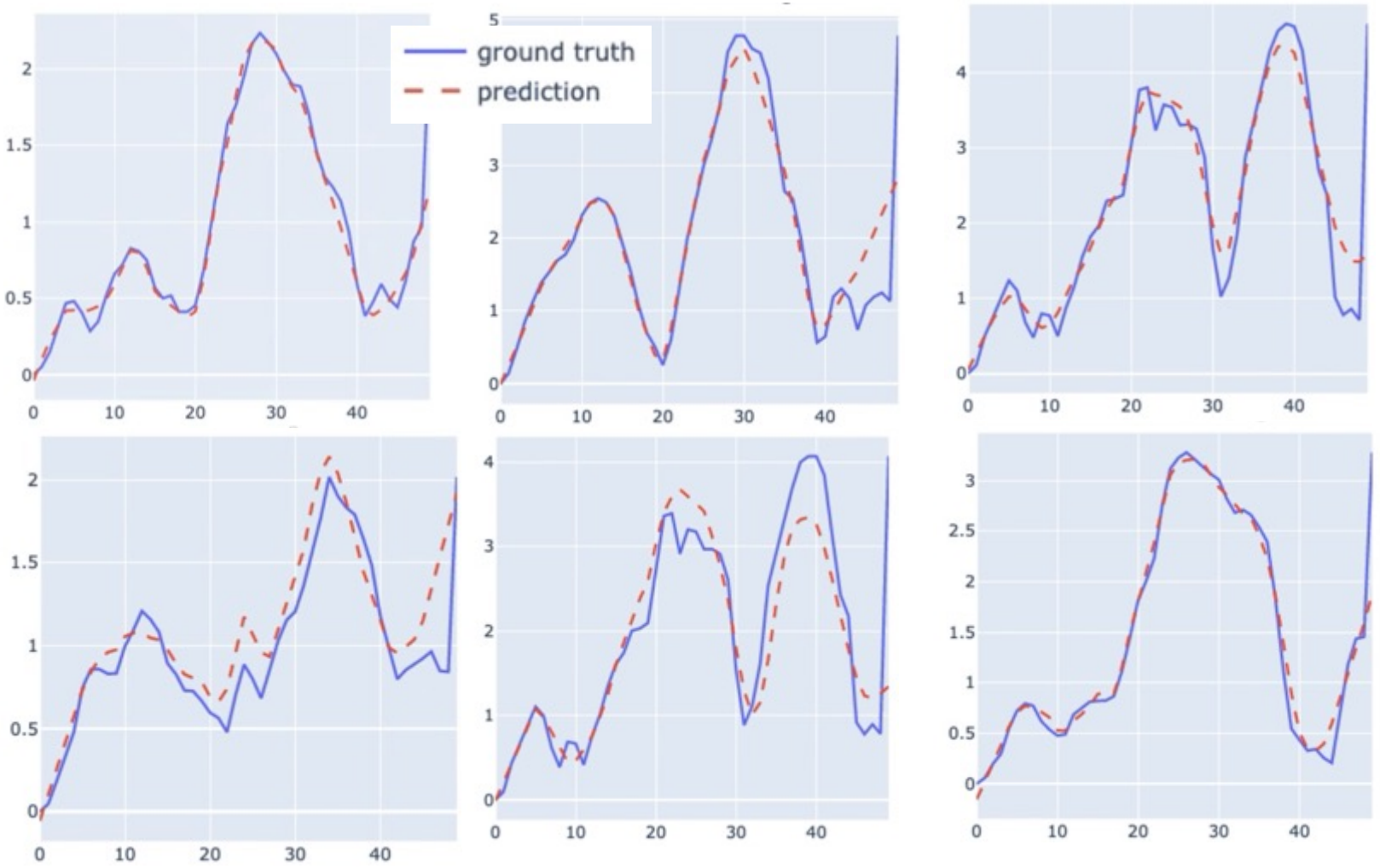
Physics is invariant with respect to isometric transformations :





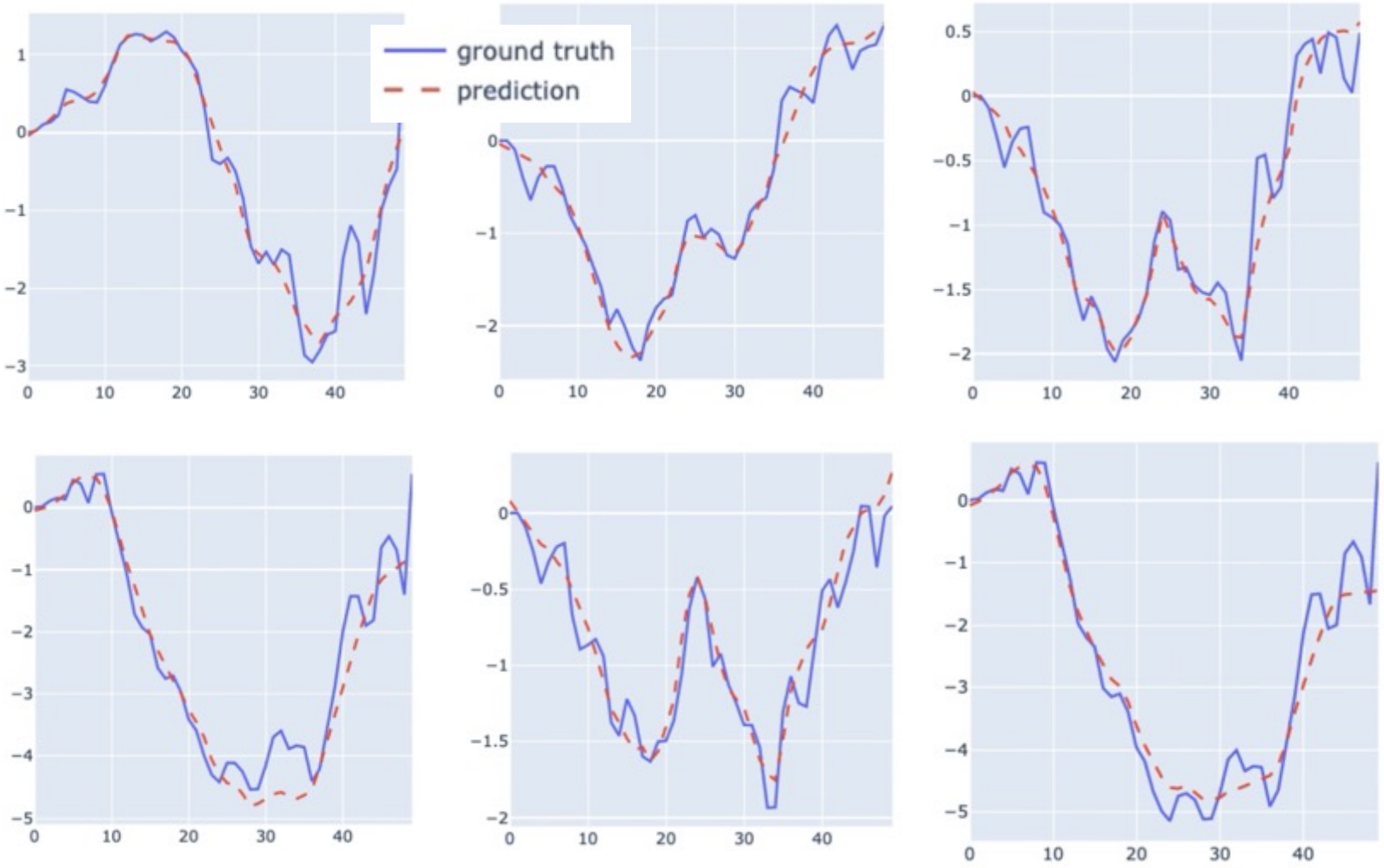
Shear force Results on corner 0

Results on test dataset (15 configurations never seen by the network during training)



Axial force Results on corner 1

Results on test dataset (6 configurations of the test set never seen by the network during training)



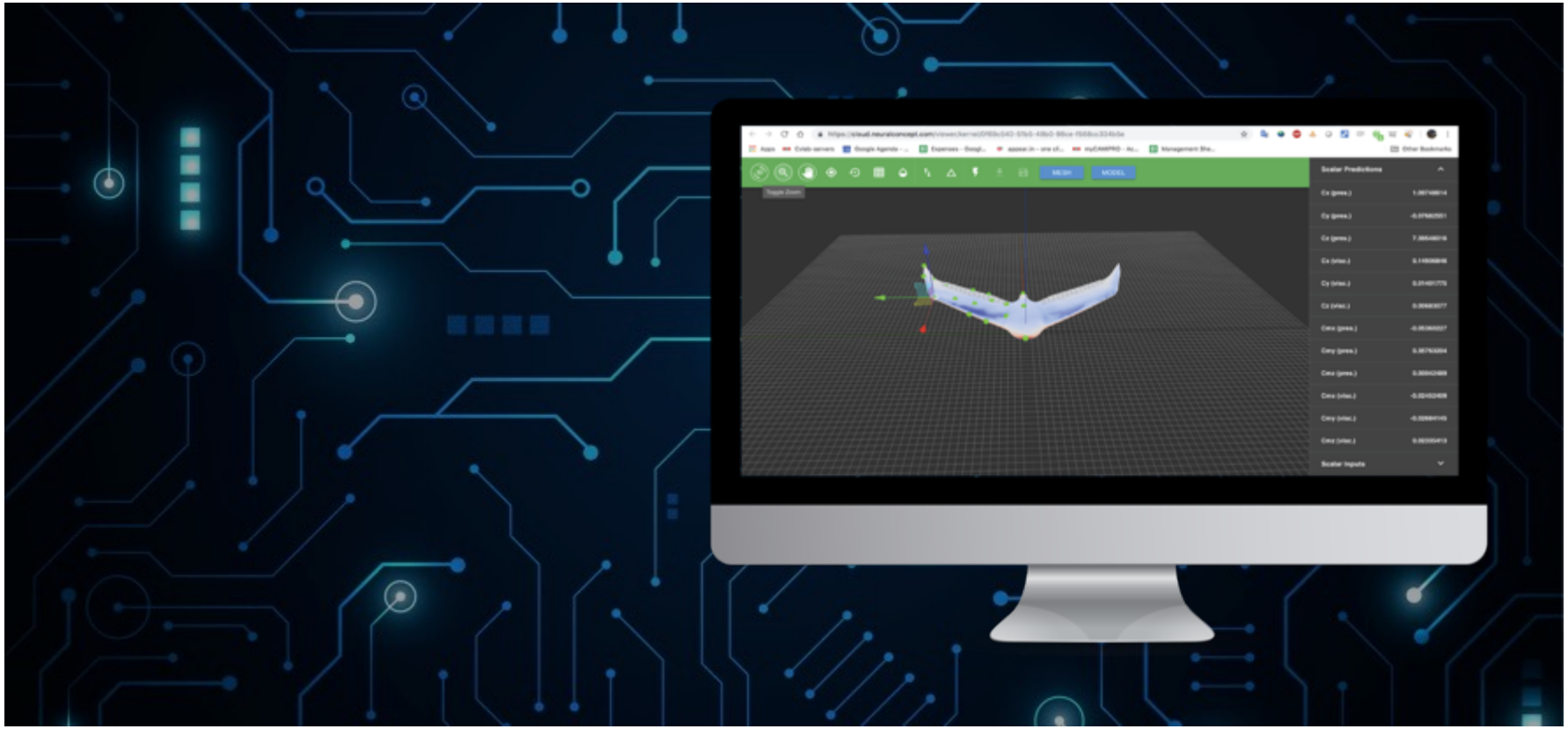
Time dependent vertical displacement field

Displacement comparison between ground truth and predictions (scale factor of 20)

Predictions

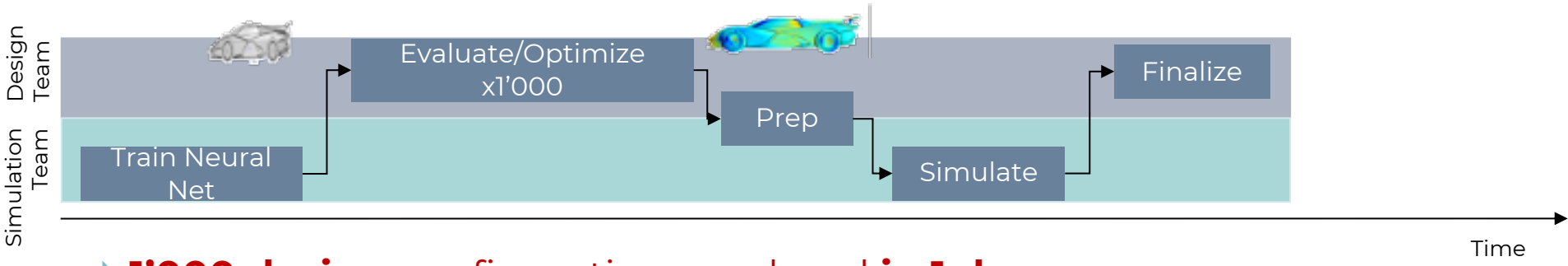
Ground truth

Which role for Deep Learning in the CAE world

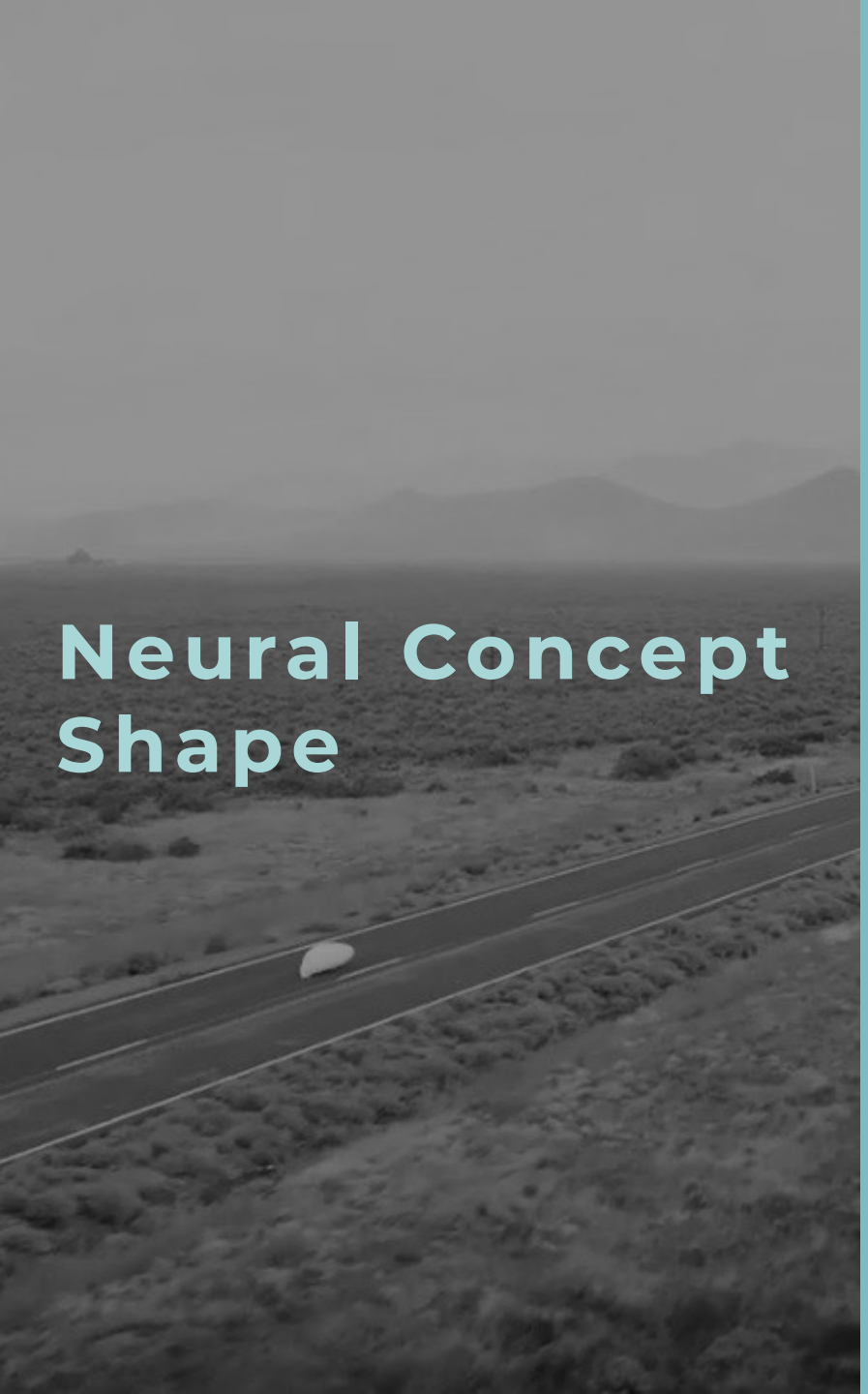


Our customers explore 1’000 more designs

Neural Concept design workflow



➡ **1’000 design** configurations explored **in 1 day**



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Thank you

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