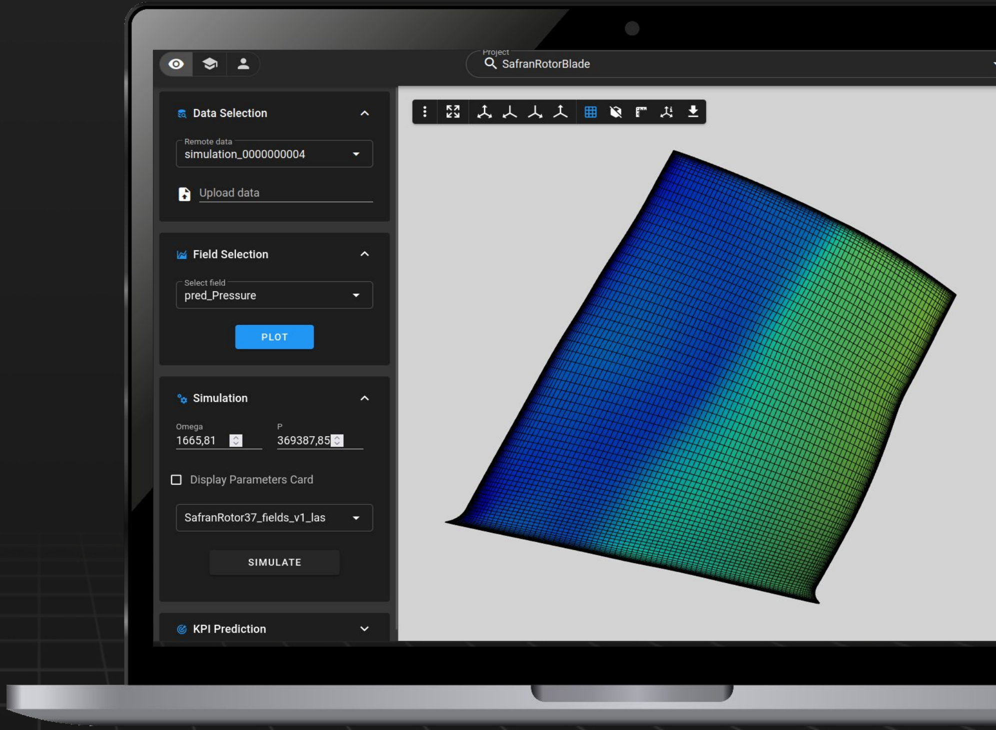
AUGUR

Séminaire
Couplage IA et Simulation

10 Juin 2026

Teratec

NAFEMS


Project: SafranRotorBlade

Remote data: simulation_0000000004

Select field: pred_Pressure

Omega: 1665,81

P: 369387,85

☐ Display Parameters Card

SafranRotor37_fields_v1_las

Programme

01 Déjà 1 an

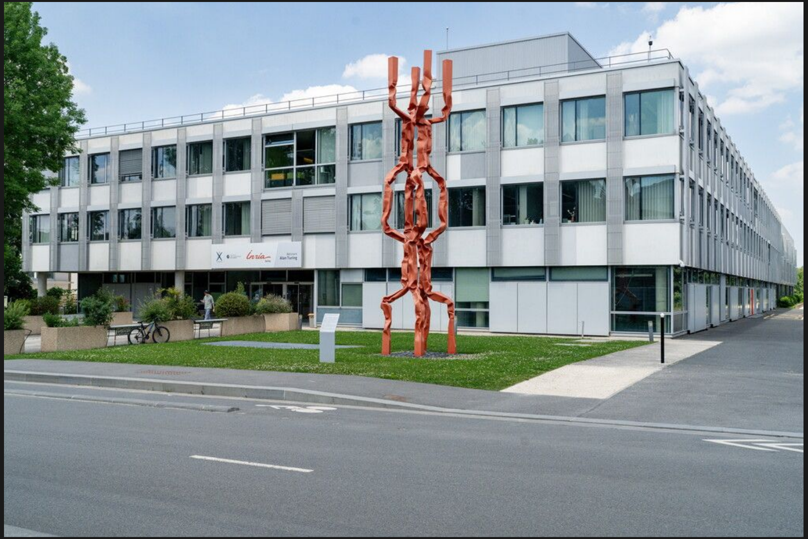
02 Parlons un peu de vous

03 Cas d’usage : IA pour la simulation thermique de composant électroniques

Nicolas KERUZORE (Thales)

Il y a un an ...

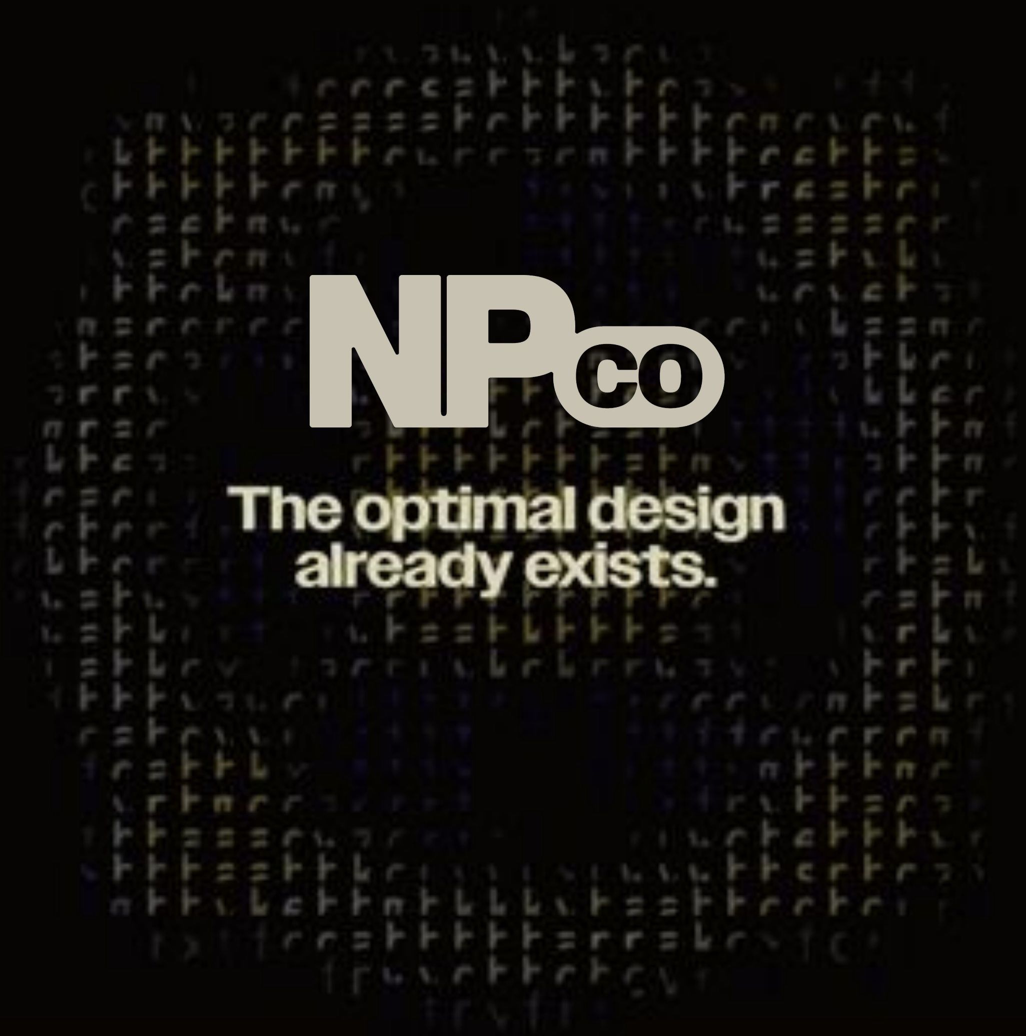
AUGUR



Inria

- Chercheurs de l'Inria, l'IFPEN et l'IRT SystemX
- Incubés au startup studio de Inria
- Augur a été créée il y a un an

npco.ai



NPco

The optimal design already exists.

NPco
The optimal design already exists

Pour chaque design, l’optimum se trouve quelque part dans un espace trop vaste pour être exploré de façon traditionnelle

Nous développons des modèles permettant à chacun de vos ingénieurs de le trouver instantanément, sans compromis

Performance radicale

L'ingénierie à la vitesse de l'imagination

Alchimie des données

Transformer efficacement vos données de simulations et opérationnelles en Intelligence

Efficacité extrême

quelle que soit la physique, la géométrie et ce avec peu de données

GEM

GENERALIZED ENGINEERING MODELS

Ingéniérie unifiée

Accessible à tous vos ingénieurs des designers aux experts

Souveraineté absolue

Votre IP, vos data, vos serveurs

NPco

The optimal design already exists

npco.ai

The NP Company lève 6M€ en Pre-Seed

avec Partech et la famille Peugeot

The optimal design already exists

Questionnaire

THALES
Building a future we can all trust

Thales x Augur

Foundation diffusion model for Semiconductors simulation

N. KERUZORÉ
NAFEMS- TERATEC 2026

www.thalesgroup.com

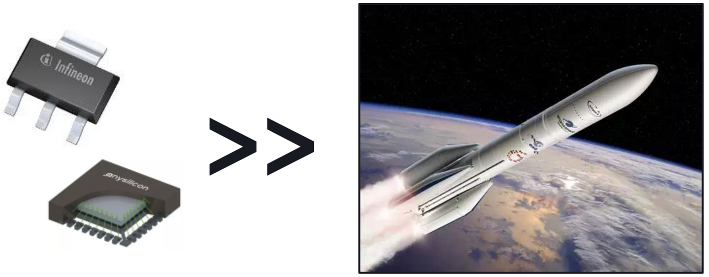
The problem

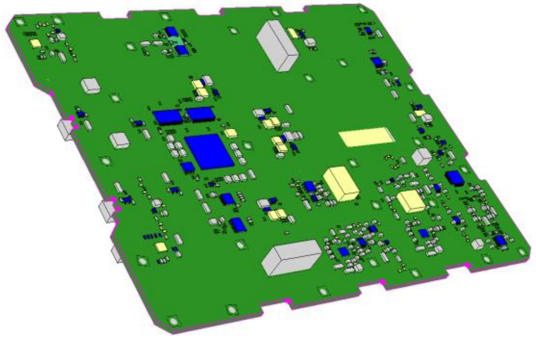
> Thales Technical context – Why do we need Thermal management ?

- Predicting electronic components' thermal behavior is critical for reliability.
- decreasing the temperature by 1°C on an electronic board is equivalent to reducing the failure rate by 4%.

> Some fun facts :

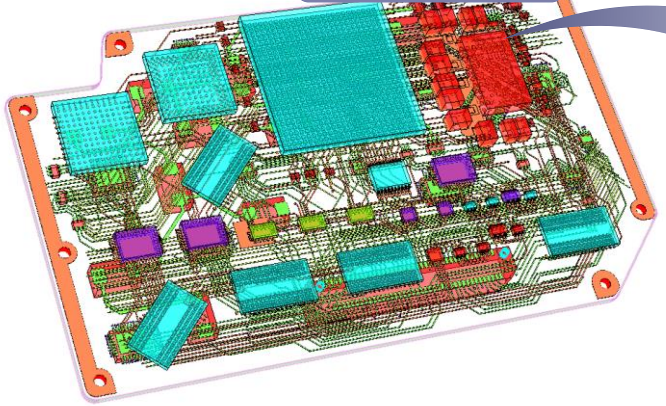
- On an equivalent scale, a component dissipates more energy than a rocket [10^9 Vs 10^7 W/m^3].
- The scale of our simulation extends from meters to micrometers (and soon 50 nanometers) [10^8].
- Without specific tooling, the simulation setup and calculation time would exceed hundreds of hours, even with HPC servers.





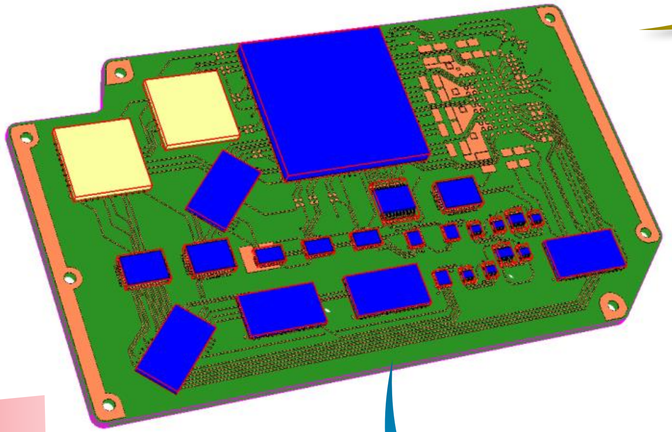
WATT – Worklow insight

IDF XTD files



Import

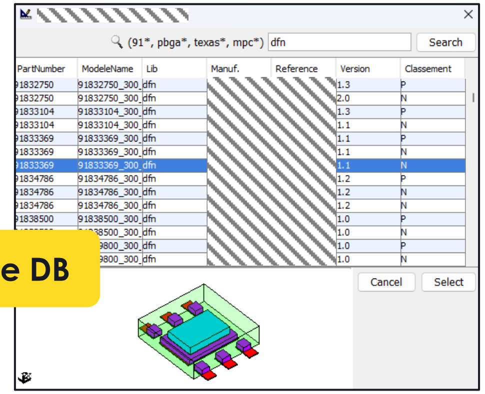
WATT



Fetch

Supply

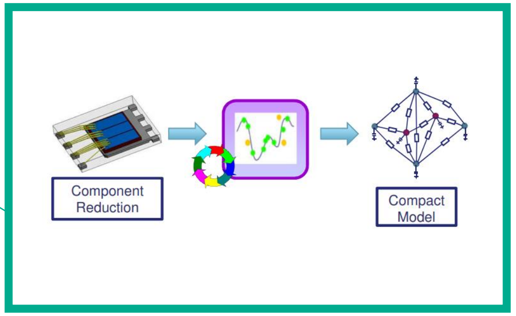
Corporate DB

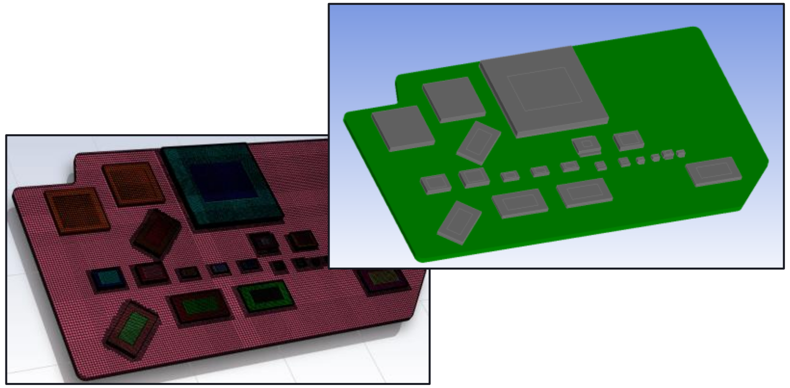


[redacted]

(91*, pbga*, texas*, mpc*) dfn Search

PartNumber	ModeleName	Lib	Manuf.	Reference	Version	Classement
91832750	91832750_300_	dfn	[redacted]	[redacted]	1.3	P
91832750	91832750_300_	dfn	[redacted]	[redacted]	2.0	N
91833104	91833104_300_	dfn	[redacted]	[redacted]	1.3	P
91833104	91833104_300_	dfn	[redacted]	[redacted]	1.1	N
91833369	91833369_300_	dfn	[redacted]	[redacted]	1.1	P
91833369	91833369_300_	dfn	[redacted]	[redacted]	1.1	N
91833369	91833369_300_	dfn	[redacted]	[redacted]	1.1	N
91834786	91834786_300_	dfn	[redacted]	[redacted]	1.2	P
91834786	91834786_300_	dfn	[redacted]	[redacted]	1.2	N
91834786	91834786_300_	dfn	[redacted]	[redacted]	1.2	N
91838500	91838500_300_	dfn	[redacted]	[redacted]	1.0	P
	38500_300_	dfn	[redacted]	[redacted]	1.0	N
	9800_300_	dfn	[redacted]	[redacted]	1.0	P
	9800_300_	dfn	[redacted]	[redacted]	1.0	N





Export

COTS

IPK

SC FLT

M

SC EFD

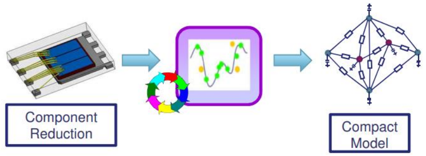
F

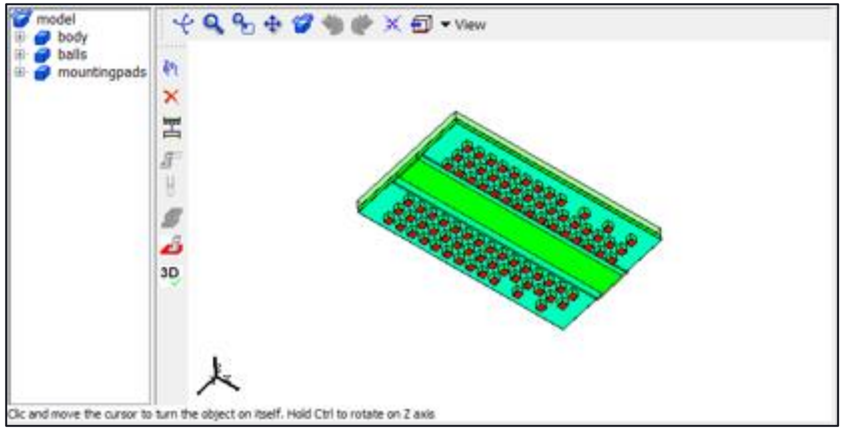
Thales Rules
Thales Processes

Set & Inspire

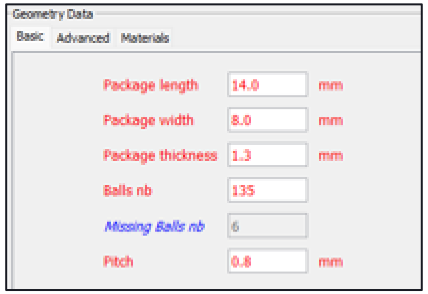
THALES
Building a future we can all trust

WATT – 3D model to surrogate reduction feature

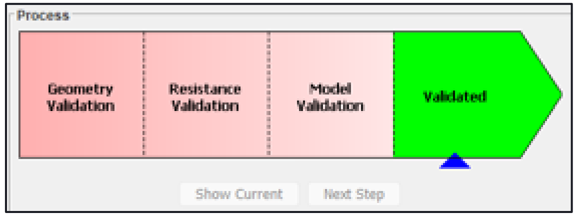




Clic and move the cursor to turn the object on itself. Hold Ctrl to rotate on Z axis



Package length	14.0	mm
Package width	8.0	mm
Package thickness	1.3	mm
Balls nb	135	
Missing Balls nb	6	
Pitch	0.8	mm



> 3D Modeler – Component Genetator

> Standardized Reduced Order Models

> Powerful Thales tailored Algorithms

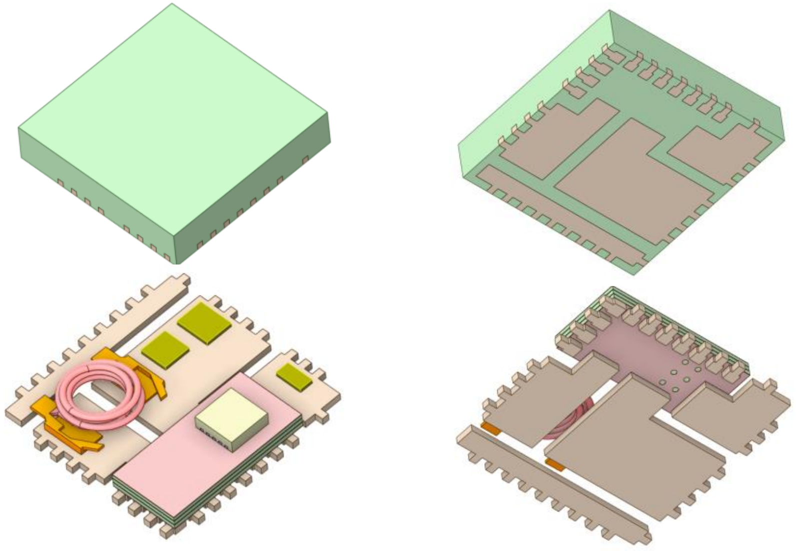
Thermal Surrogates Factory

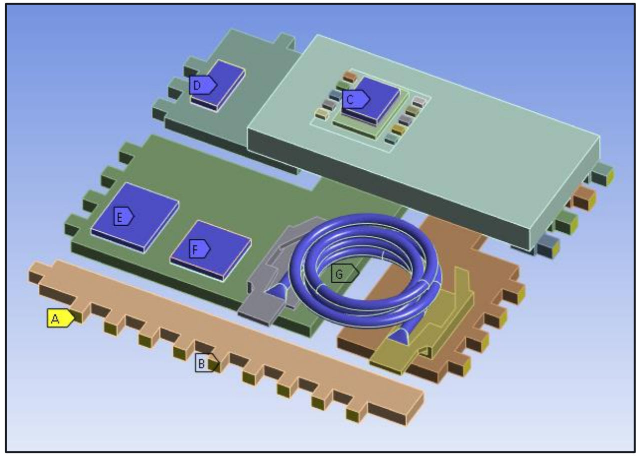
WATT – What next ?

> Limits of actual process

- Modeler hit a hard limit :
  - ‘Complex’ geometries are not supported.
  - Every shape besides cubic and cylinder shapes are considered ‘Complex’.

- Computations takes a lot of time :
  - ‘Complex’ packages are not supported.
  - Every semiconductor with more than 1 heat source is considered ‘Complex’.
  - (50 steady + 9 transient computation) x (#sources + 1).
  - 1 to 10 iterations per package…





For this SiP

(54 steady + 9 transient) x 6 computations are needed :

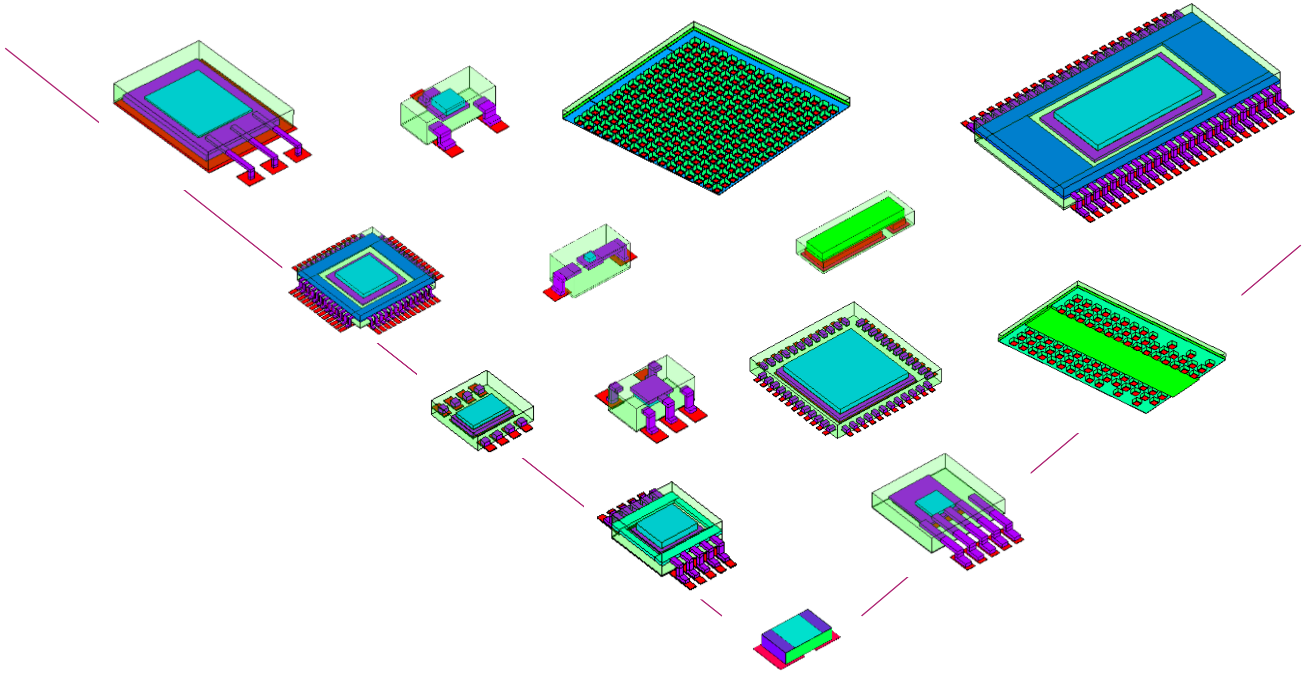
➔ 324 steady computations.

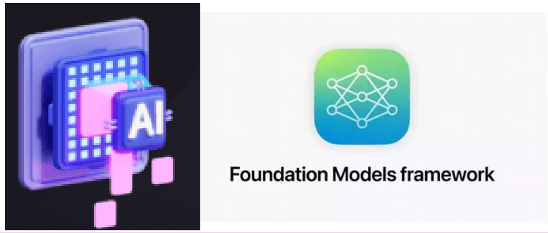
➔ 54 transient computations.

The Idea…

> How about a model that could :

- V1 (MVP) - Handle quickly any geometry :
  - Not limited by shapes and material properties.
  - Not limited by meshes number (or at least up to 10M).
- V1 (MVP) - Compute temperature :
  - For a given and fixed DOE (JEDEC - DELPHI).
  - Return transient temperature of any points (field) or given set of points (scalars).
  - With thermal diffusion physics only.
- V12++ - Be plugged into a simulation software :
  - Declines itself as many times as there are components on a PCB based on each extracted mesh.
  - Exchange informations back and forth with the solver.





This solve
The issue of reducing increasingly complex geometries
The issue of how quickly (DELPHI) models are created
The issue of having to manage a model by geometry

The first step…

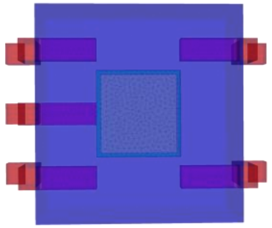
> Geometry Generalization & Reduced Simulation Budget

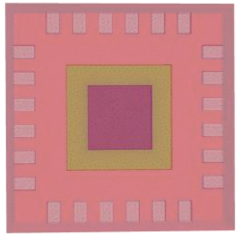
- AUGUR's surrogate models can be pre-trained on a base of existing components and then fine-tuned on new geometries with only a handful of additional simulations. This amortizes the simulation cost across the entire component catalog: each new package leverages all the thermal knowledge accumulated from previous ones, rather than starting at zero.

- Over time, this transforms the economics of thermal modeling:
  - Today : (50 steady + 9 transient)*nb_heat_source + 1. Linear scaling with no reuse.
  - With AUGUR : initial pre-training corpus + fine-tuning batches per new component.

- The current step focuses on validating the methodology.

Dataset


Geometry A with Leads


Geometry B without Leads

> Geometries

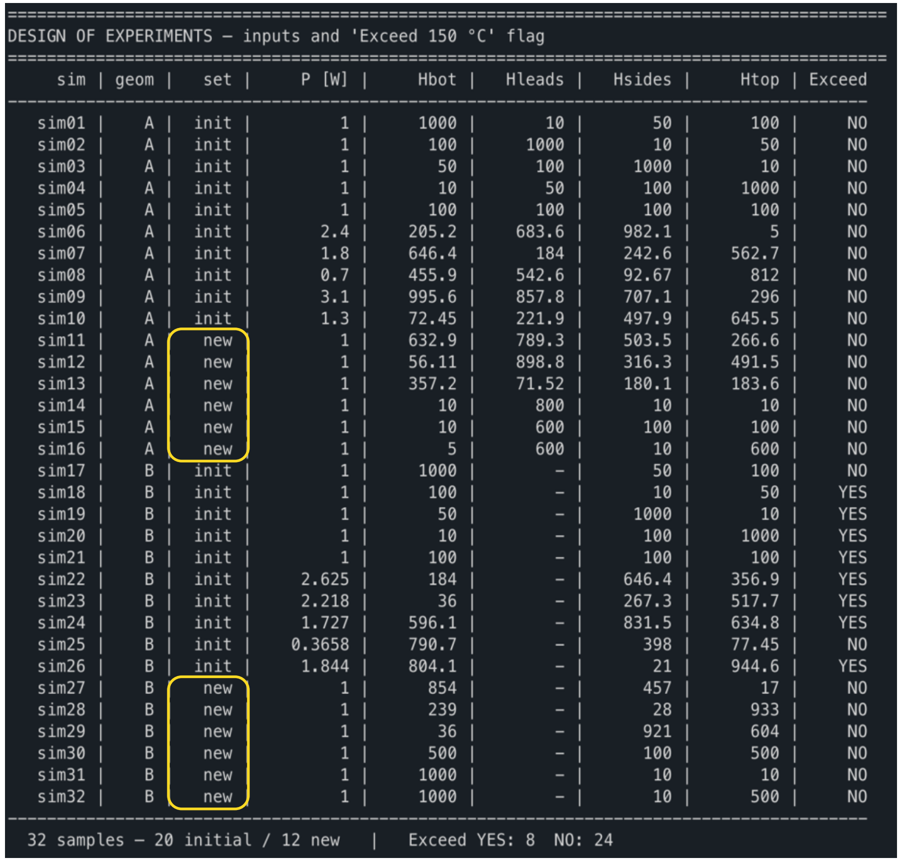
- 32 transient thermal simulations, distributed across 2 fixed geometries with 16 simulations / geometry.

> Inputs scalars

- **P** : Dissipated power in the junction[W].
- **Hbot** : Heat transfer coefficient on bottom surface [W/m².K].
- **Htop** : Heat transfer coefficient on top surface [W/m².K].
- **Hsides** : Heat transfer coefficient on lateral surfaces [W/m².K].
- **Hleads** : Heat transfer coefficient on leads (0 for geometry B) [W/m².K].

> Outputs

- Junction Temp : mean temperature at the junction.
- Top / Bot / Leads Temp : mean temperature at the top / bottom / leads.



```
================================================================================
DESIGN OF EXPERIMENTS – inputs and 'Exceed 150 °C' flag
================================================================================
    sim | geom |    set |     P [W] |      Hbot |    Hleads |    Hsides |      Htop | Exceed
-------------------------------------------------------------------------------------------
  sim01 |    A |   init |         1 |      1000 |        10 |        50 |       100 |     NO
  sim02 |    A |   init |         1 |       100 |      1000 |        10 |        50 |     NO
  sim03 |    A |   init |         1 |        50 |       100 |      1000 |        10 |     NO
  sim04 |    A |   init |         1 |        10 |        50 |       100 |      1000 |     NO
  sim05 |    A |   init |         1 |       100 |       100 |       100 |       100 |     NO
  sim06 |    A |   init |       2.4 |     205.2 |     683.6 |     982.1 |         5 |     NO
  sim07 |    A |   init |       1.8 |     646.4 |       184 |     242.6 |     562.7 |     NO
  sim08 |    A |   init |       0.7 |     455.9 |     542.6 |     92.67 |       812 |     NO
  sim09 |    A |   init |       3.1 |     995.6 |     857.8 |     707.1 |       296 |     NO
  sim10 |    A |   init |       1.3 |     72.45 |     221.9 |     497.9 |     645.5 |     NO
  sim11 |    A     new          1 |     632.9 |     789.3 |     503.5 |     266.6 |     NO
  sim12 |    A     new          1 |     56.11 |     898.8 |     316.3 |     491.5 |     NO
  sim13 |    A     new          1 |     357.2 |     71.52 |     180.1 |     183.6 |     NO
  sim14 |    A     new          1 |        10 |       800 |        10 |        10 |     NO
  sim15 |    A     new          1 |        10 |       600 |       100 |       100 |     NO
  sim16 |    A     new          1 |         5 |       600 |        10 |       600 |     NO
  sim17 |    B |   init |         1 |      1000 |         – |        50 |       100 |     NO
  sim18 |    B |   init |         1 |       100 |         – |        10 |        50 |    YES
  sim19 |    B |   init |         1 |        50 |         – |      1000 |        10 |    YES
  sim20 |    B |   init |         1 |        10 |         – |       100 |      1000 |    YES
  sim21 |    B |   init |         1 |       100 |         – |       100 |       100 |    YES
  sim22 |    B |   init |     2.625 |       184 |         – |     646.4 |     356.9 |    YES
  sim23 |    B |   init |     2.218 |        36 |         – |     267.3 |     517.7 |    YES
  sim24 |    B |   init |     1.727 |     596.1 |         – |     831.5 |     634.8 |    YES
  sim25 |    B |   init |    0.3658 |     790.7 |         – |       398 |     77.45 |     NO
  sim26 |    B |   init |     1.844 |     804.1 |         – |        21 |     944.6 |    YES
  sim27 |    B     new          1 |       854 |         – |       457 |        17 |     NO
  sim28 |    B     new          1 |       239 |         – |        28 |       933 |     NO
  sim29 |    B     new          1 |        36 |         – |       921 |       604 |     NO
  sim30 |    B     new          1 |       500 |         – |       100 |       500 |     NO
  sim31 |    B     new          1 |      1000 |         – |        10 |        10 |     NO
  sim32 |    B     new          1 |      1000 |         – |        10 |       500 |     NO
-------------------------------------------------------------------------------------------
  32 samples – 20 initial / 12 new    |    Exceed YES: 8  NO: 24
```

Strategy

> Metrics

- Given the very low number of samples (32 total), we evaluate using a “LOO” (Leave One Out) strategy.
- LOO = Given N samples, train on N-1 and evaluate on the target sample.
- The metric used is a relative RMSE given in %. For the LOO we take the mean over the predictions.

$$RMSE_{rel}^{(i)} = 100 \times \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\hat{y}_{i,t} - y_{i,t}\right)^2}}{y_{max} - y_{min}}$$

> Benefits extrapolation

- In addition to last week result, we will investigate the benefit of adding the 12 new data.

➔ **IT1 = we train on 20 LDB and predict on 12 VDB.**

➔ **IT2 = we train on 19 LDB and predict on 1 LDB.**

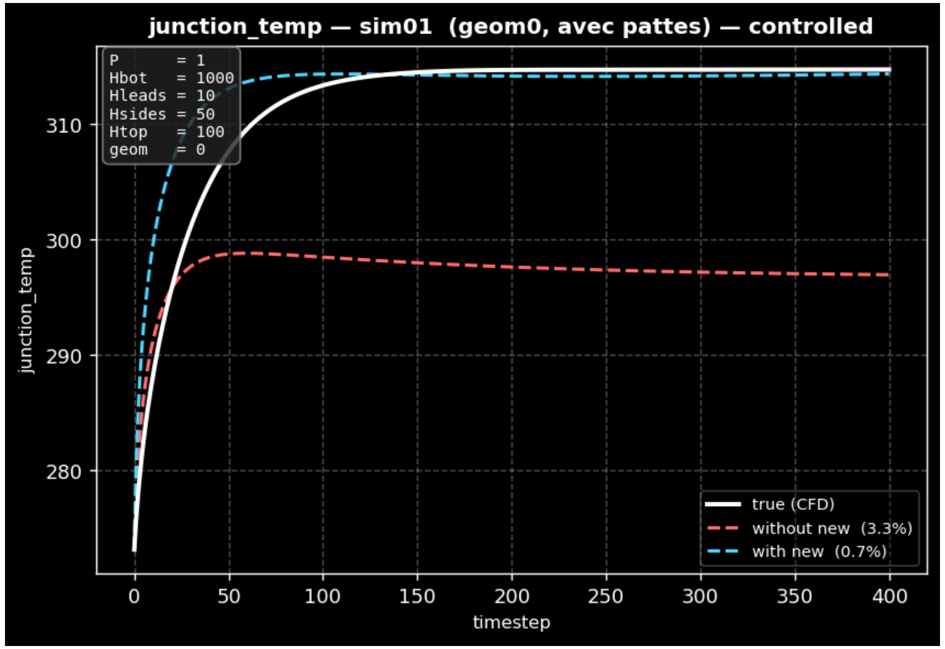
➔ **IT3 = we train on 31 LDB + VDB and predict on 1 LDB + VDB.**

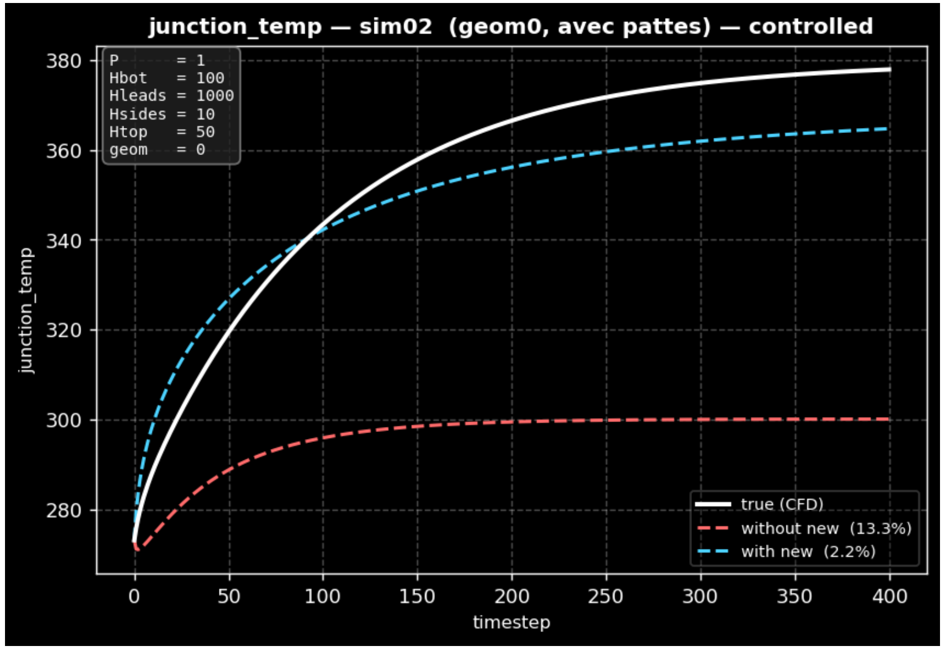
Results

> Metrics

Output	RMSE% IT1	RMSE% IT2	RMSE% IT3
Junction Temp	14.61	8.74	7.57
Top Temp	10.96	10.58	7.40
Bot Temp	15.30	9.31	7.37
Leads Temp	13.67	17.07	10.64

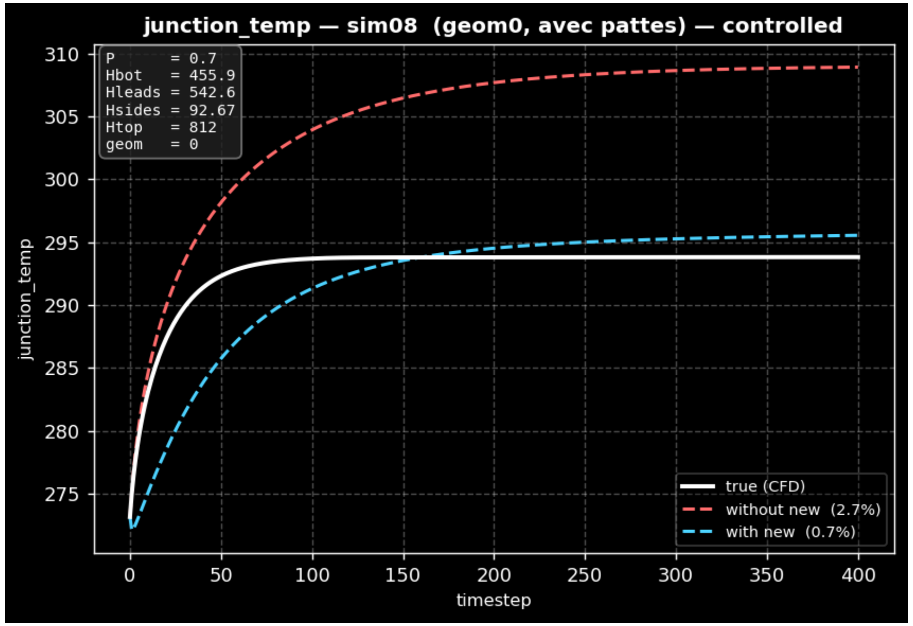
> Probes

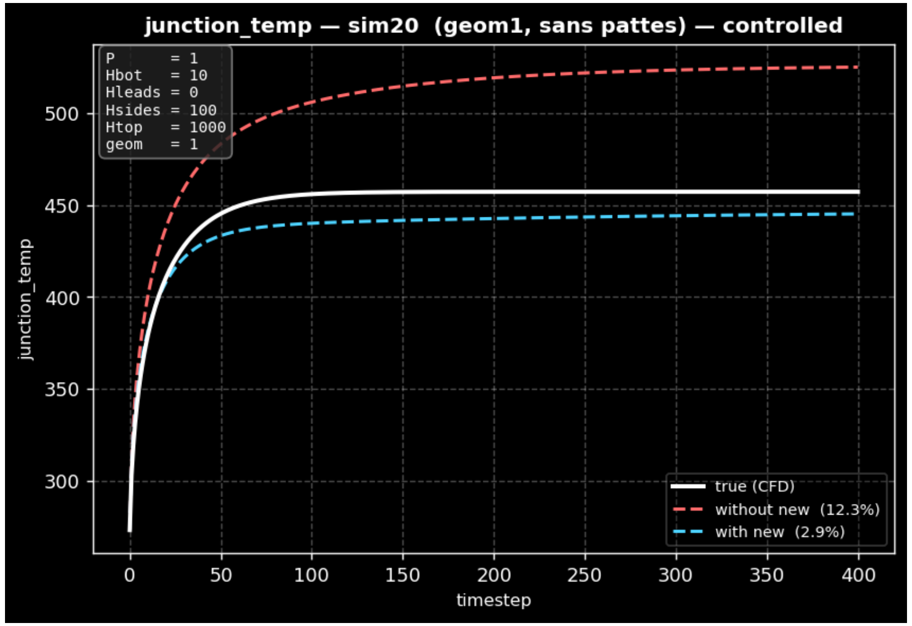


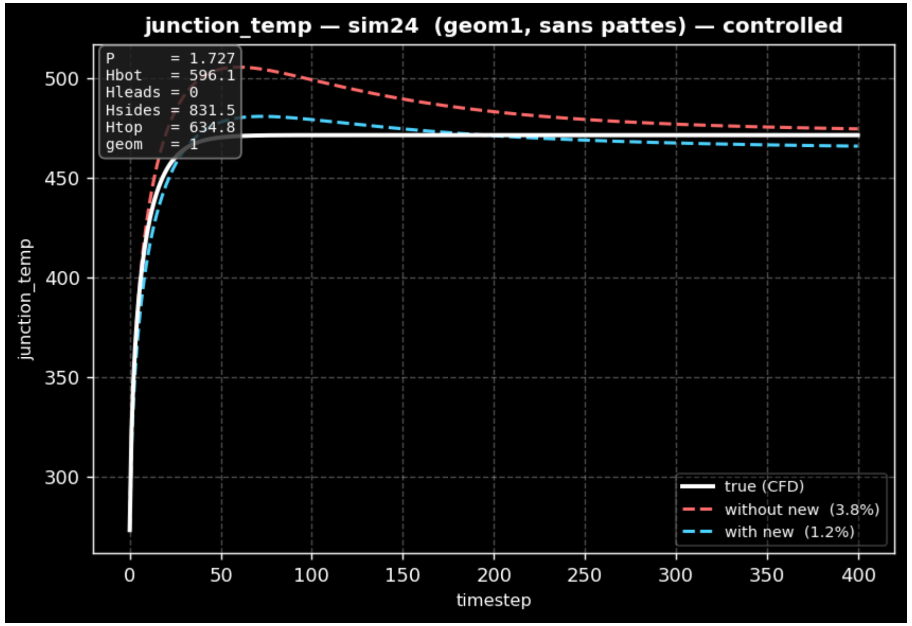


Results

> Probes





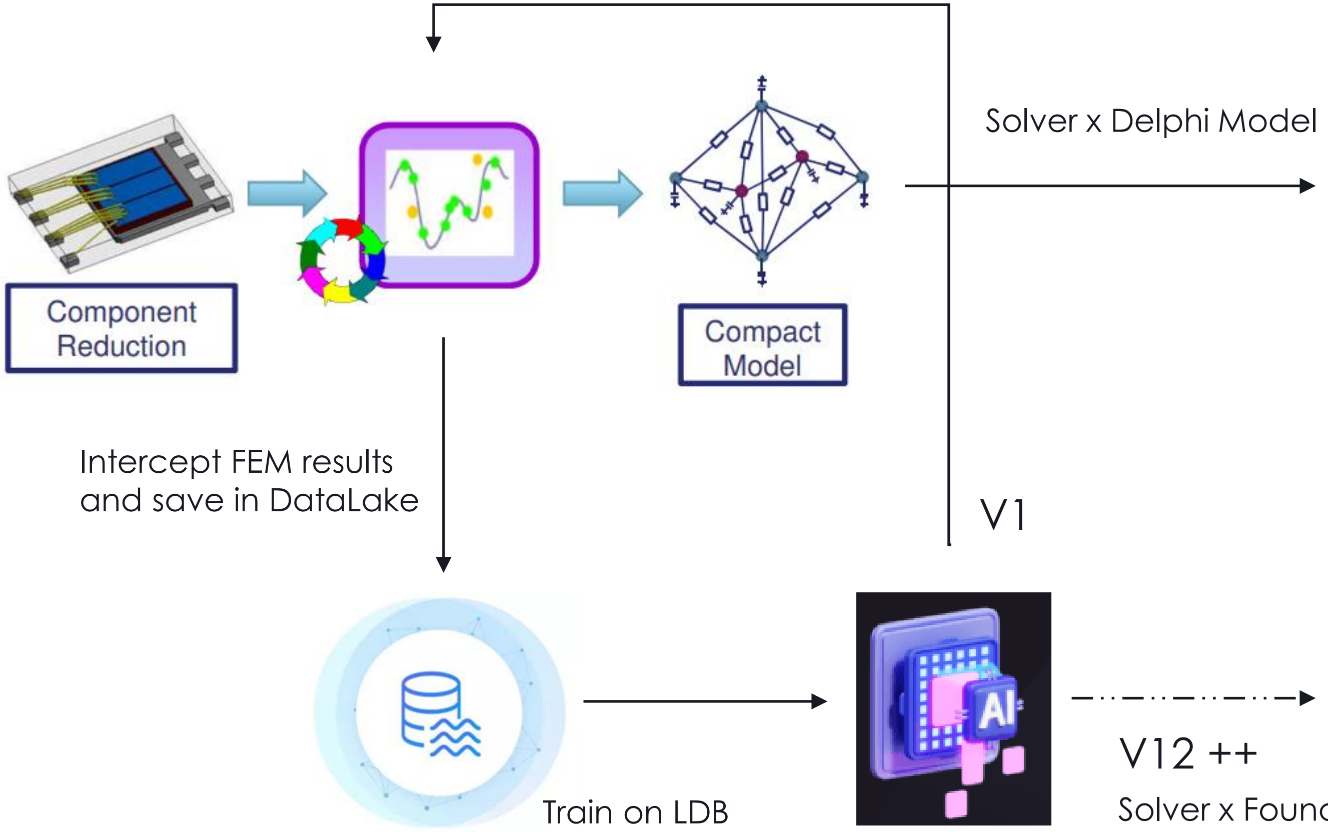


- + Transient dynamics and behavior are qualitatively good !
- + A few samples more in LDB improved a lot the prediction !

- - Adding physics informed feature to the Transformer architecture could help to improve RMSE and prevent physical aberrations.
- - The values obtained are not quantitatively good.

And then …

> Captialize on reduction data to build step by step a foundation model



Use results with > XX% confidence
to reduce FEM solver calls

Component
Reduction

Compact
Model

Solver x Delphi Model coupling

Intercept FEM results
and save in DataLake

V1

Train on LDB
when XX+ new samples

V12 ++

Solver x Foundation Model coupling…

Why could this work @ Thales ?

- ➔ 400+ DELPHI models / year
- ➔ ~20 to 100.000 FEM samples / year

What could be difficult ?

- ➔ Proprietary solver with non standard meshing features & results.

Thank you

Contact

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EQ community

Thermal community

THALES
Building a future we can all trust