Powering Innovation That Drives Human Advancement

Leveraging AI/ML for Engineering Simulation

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Lead Product Manager

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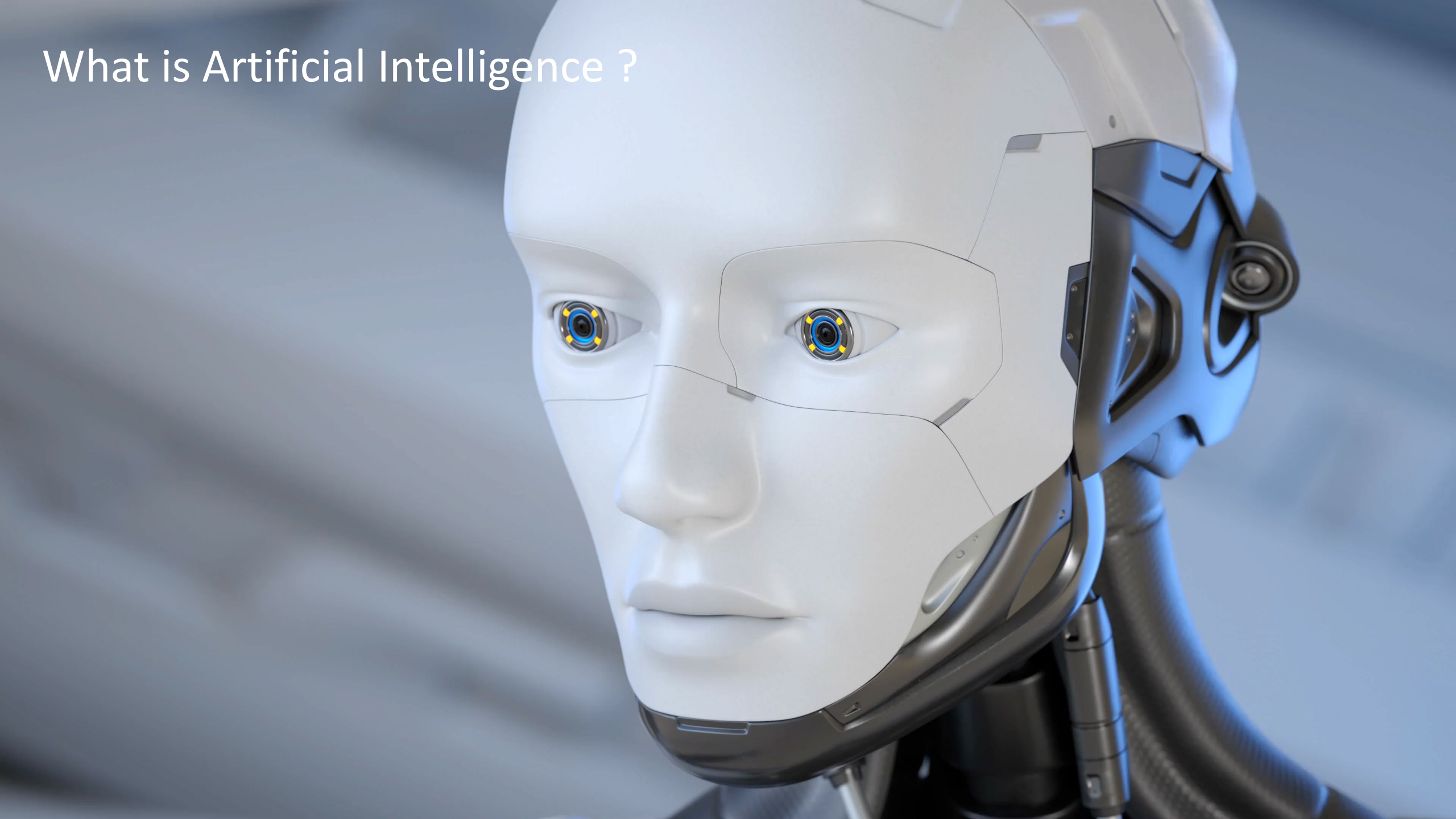
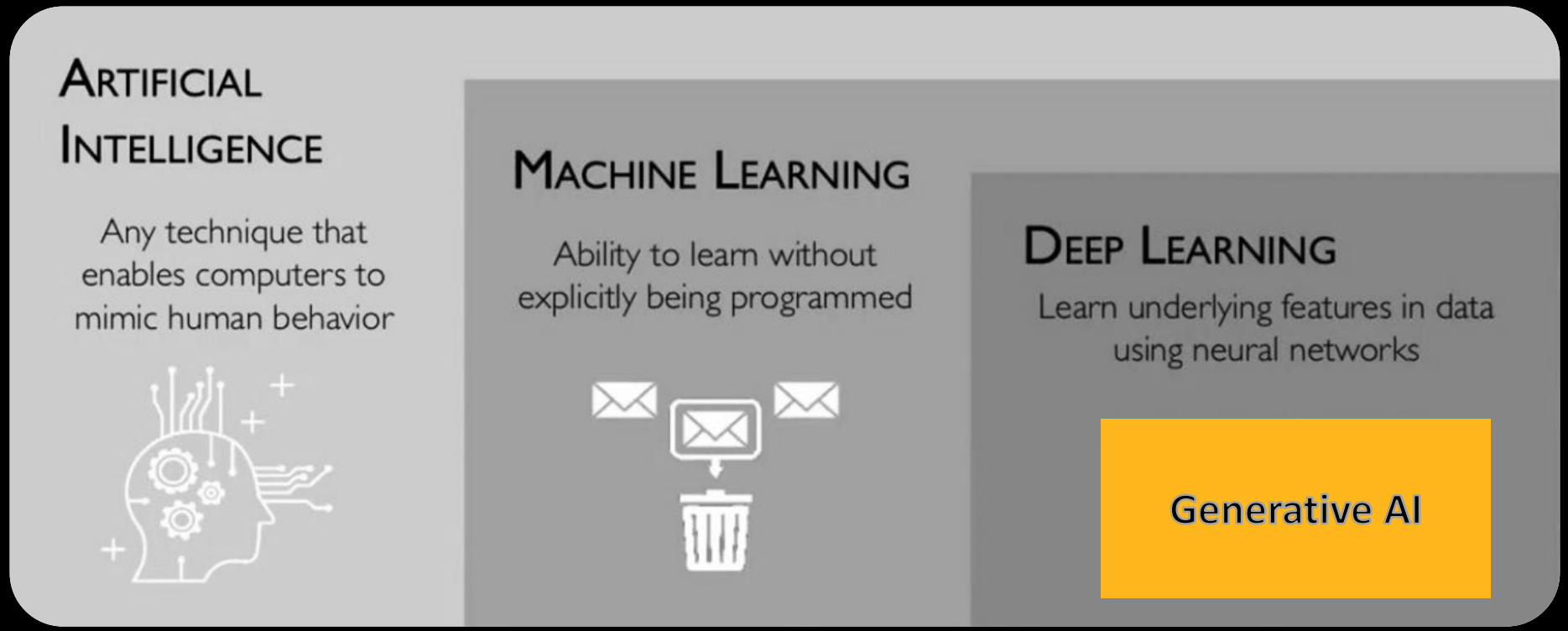
Powering Innovation That Drives Human Advancement

What is Artificial Intelligence?

What is Artificial Intelligence ?



Artificial Intelligence, Machine Learning, Deep Learning, Generative AI



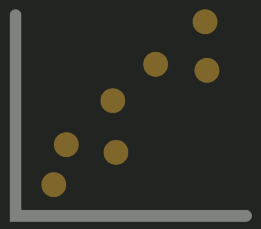
Powering Innovation That Drives Human Advancement

Ansys AI Strategy

Ansys 5 pillars of innovation

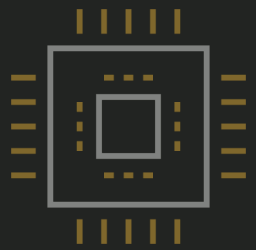
Driving your greatest innovations and solving your toughest challenges

NUMERICS



- Solver methods
- Geometry and meshing
- Shape and topology optimization
- Advanced analysis
- Multiphysics
- Multi-scale

HIGH-PERFORMANCE COMPUTING



- Shared-memory
- Message-passing
- Fine-grained GPUs
- New architectures: FPGAs & AI Hardware
- Quantum computing

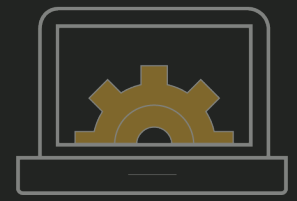
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- Solver acceleration
- Solver settings
- Top-down methods
- Bottom-up methods
- Reduced order models
- Generative AI

CLOUD AND EXPERIENCE

- Cloud Enabled
- Cloud Native
- Platform, Collaboration
- Open APIs and developer ecosystem
- Common user experience

DIGITAL ENGINEERING



- MBSE
- Requirements & architecture connections
- Safety, security & software
- Digital twins
- Simulation process & data management
- Mission Engineering

Ansys AI – Transforming Simulation at the Speed of AI

Ansys AI+

AI Add-ons to Ansys products across portfolio

- OPTISLANG AI+
- CFD AI+
- GRANTA AI+
- SYNMATRIX AI+
- STRUCTURE AI+
- MISSION AI+
- ELECTRONICS AI+

AI Add-ons to various Ansys simulation products that enhance simulation

Various Improvements

AI STANDALONE PRODUCTS

AI platforms for simulation across the physics

Ansys SIM AI

DESIGN

Ansys / TWIN AI

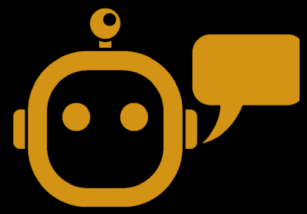
DIGITAL TWIN

Extremely fast and reliable physics predictions which learns from existing data

Faster and Better

Ansys GPT

Virtual assistant to Ansys products



Natural language assistant for documentation, training, support

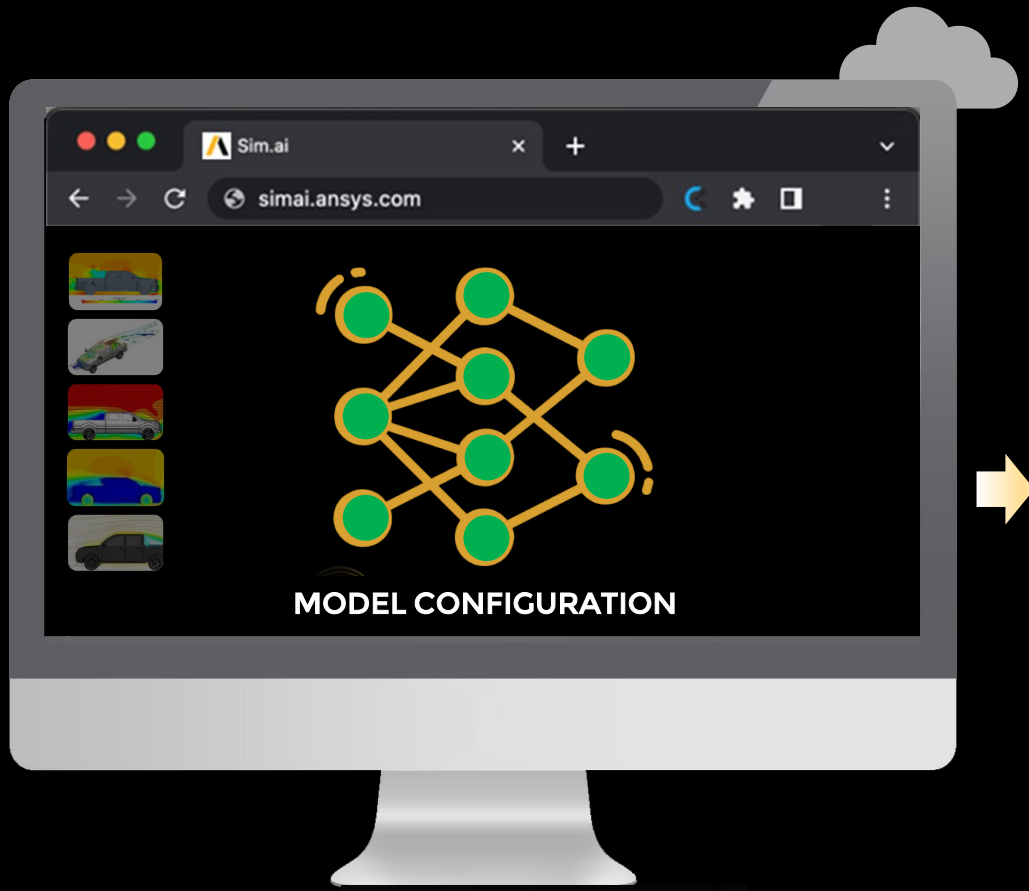
Simple & Natural UX

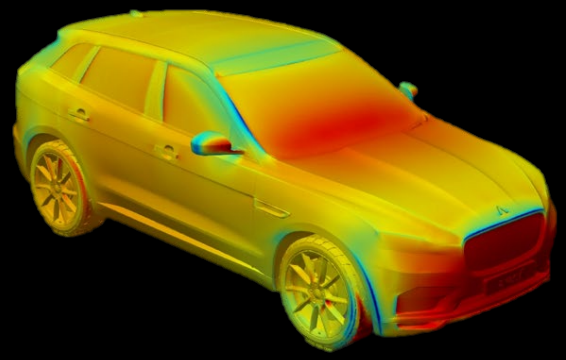
Powering Innovation That Drives Human Advancement

Ansys SimAI:
AI for Engineering Design

Predict at the Speed of AI

New Design





Performance Prediction

Fast. Reliable. Accessible.

1- UPLOAD *Your Past Data*

2- TRAIN *Your AI Model*

3- PREDICT *In Seconds*

Create an ultra fast solver for a specific application using Ansys SimAI

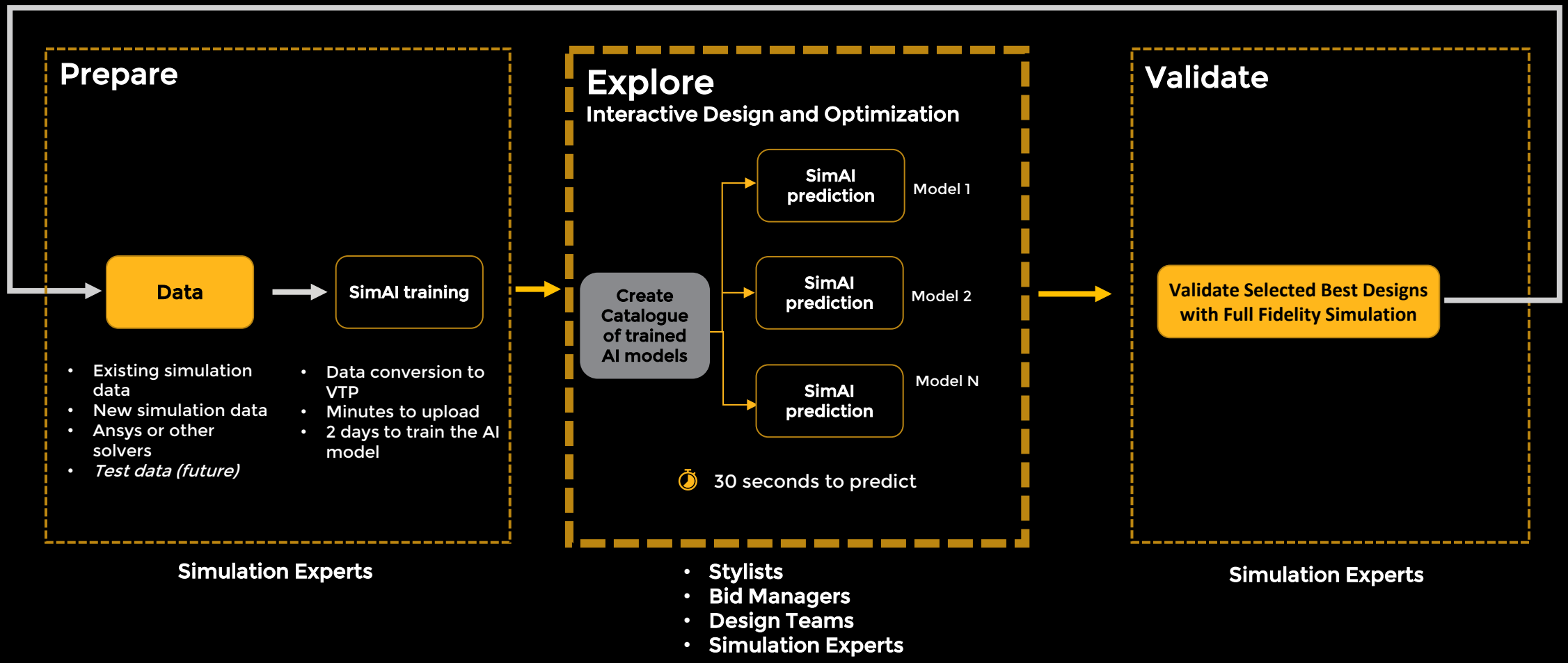
Ansys SimAI is our new cloud-based AI platform for Simulation:

- Train the AI without having to parametrize your geometry
- Predict performance across design changes, even when the geometry structure is inconsistent
- **Leverage previously generated simulation results to train the model**

Ansys SimAI is physics-neutral:

- Any physics – Fluids, Structures, Emag, Optics
- Across all industry segments – Aerospace, Automotive, Semiconductor, etc...
- Works with any 3D simulation data, whether it is Ansys or not

Ansys SimAI – Typical workflow



Bumper Impact Performance

Engineering Goals

Bumper design is driven by several factors: A lightweight design improves range and fuel efficiency. ***Safety regulations*** *for cars require the evaluation for* ***robustness and manufacturing variations****. Performing* ***physical crash tests*** *are* ***very expensive*** *and time consuming.*

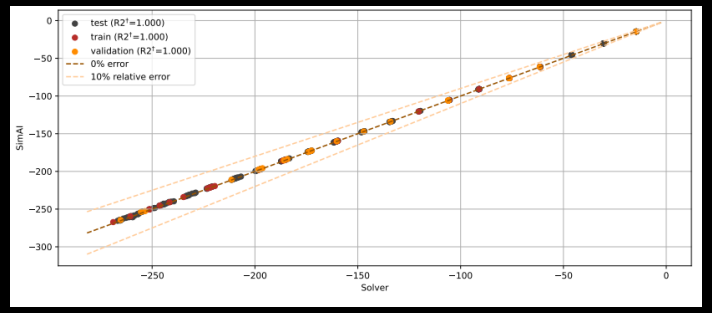
- **A Multi-disciplinary virtual optimization approach** is needed to get the best performance in safety, durability and NVH.

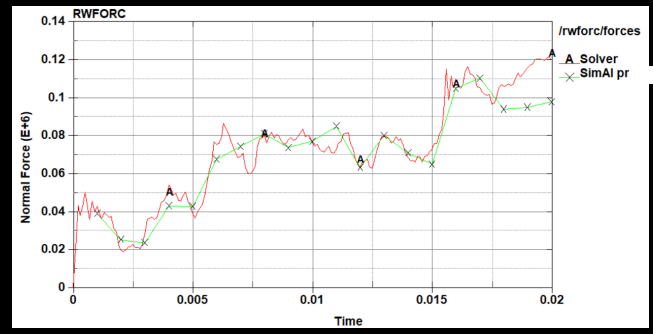
Solution

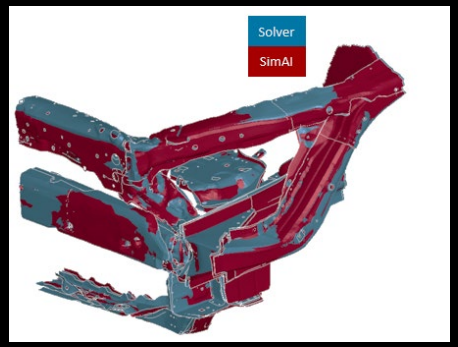
- ~ 50 different crash models with **varying part thicknesses** were evaluated to generate a surrogate AI model for bumper impact. *(SimAI, LS-DYNA)*
- SimAI model accurately **predicts** the bumper deformation and barrier forces as a **transient response**. *(SimAI)*
- **SimAI Prediction on new bumper thickness in less than 1 min.** Overall crush predictions have an error of less that 0.5% and barrier force error is within 10%. *(SimAI)*

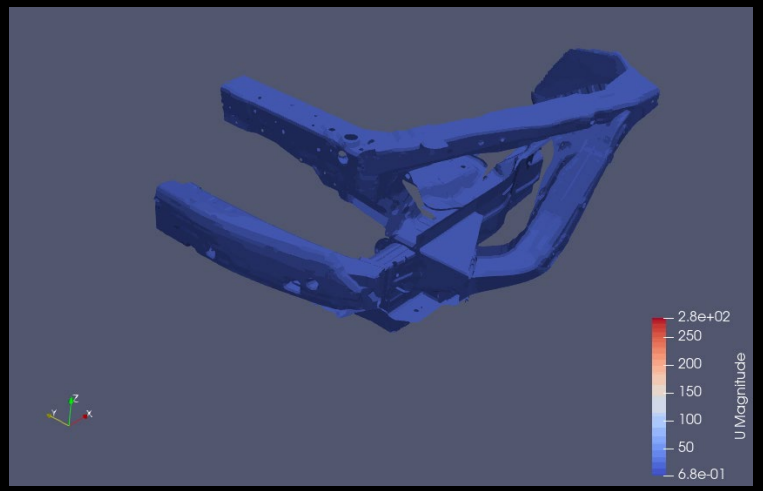
Benefits

- **Assess more car designs: 20x compared to traditional simulation methods** and optimize quicker.
- **Predict consistent safety performance across design changes faster (>50x compared to classical crash simulation)**, even when the geometry structure is inconsistent by leveraging on past crash database (earlier design phase, previous car generations).
- **Shift Left:** Cut-down your design process duration and cost by allowing **designers to use fast and meaningful crash prediction**.









Testimonial – Renault Group

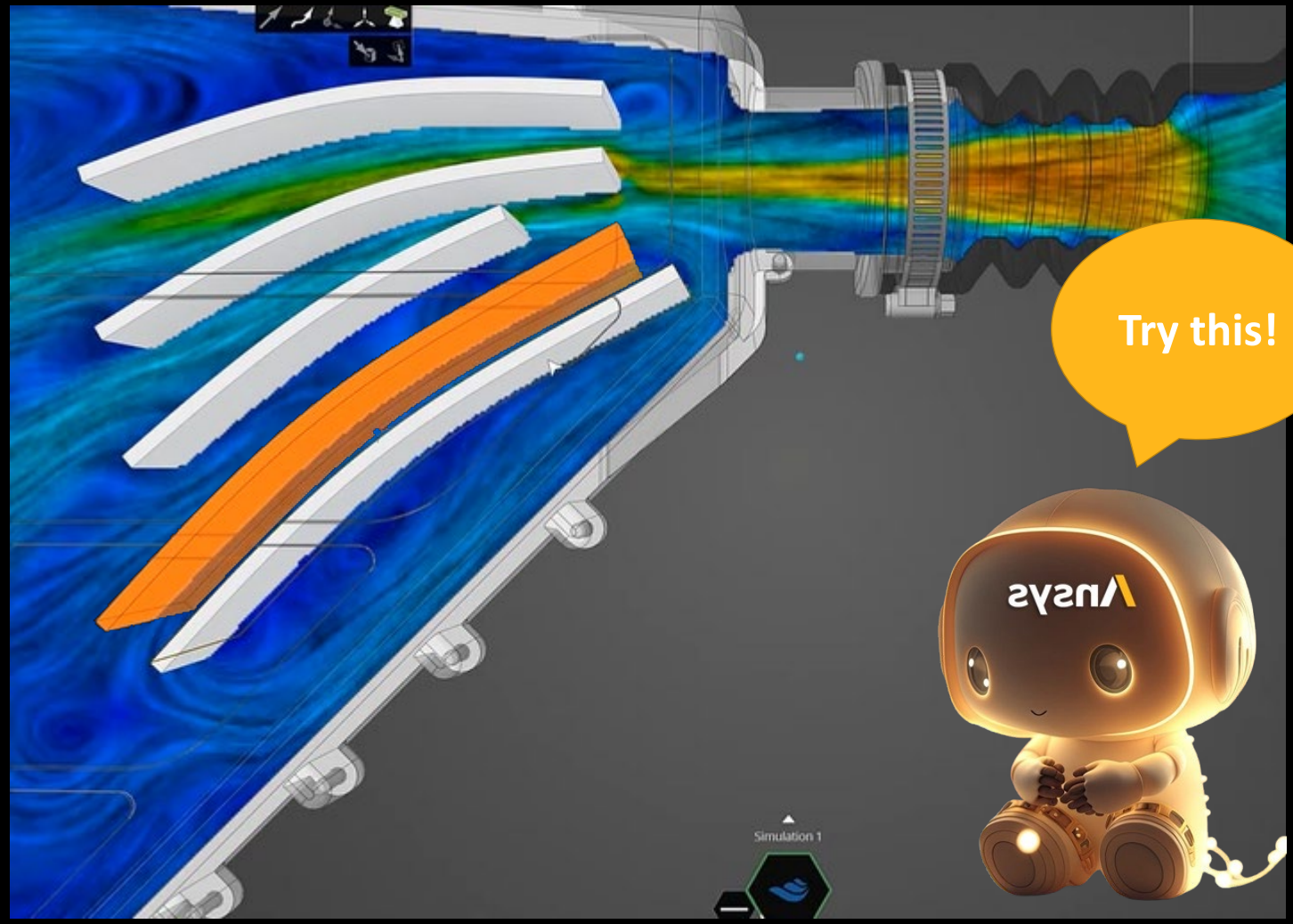
"With Ansys SimAI, we will be able to easily test a design within minutes and rapidly analyze the results, **ultimately redefining our digital engineering workflow** and reshaping our perception of what is possible. By enhancing simulation speed, **we can explore more technical possibilities** during the upstream phase of our projects and reduce the overall time-to-market."

William Becamel
Expert Leader in Numerical Modelling and Simulation | Renault Group

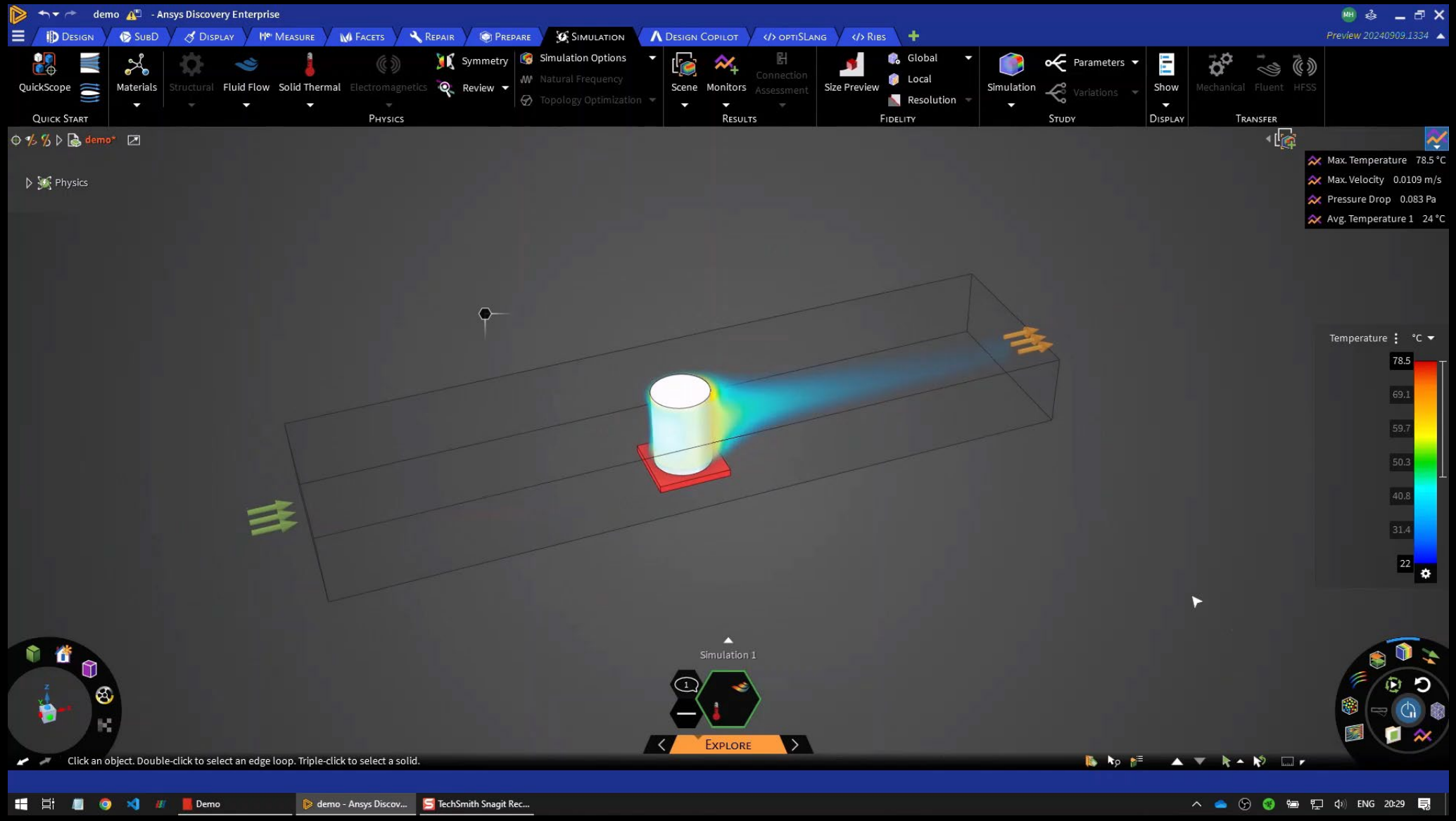
Source: *https://www.ansys.com/news-center/press-releases/1-9-24-ansys-launches-simai*

Generative Design features coming soon (25R2)

- AI observes the user make geometry modifications and execute analysis
- AI makes a suggestion/prediction for an optimal geometry
- User gives feedback to AI on suggestion
- AI improves the suggestion
- User provides ideas to AI for consideration



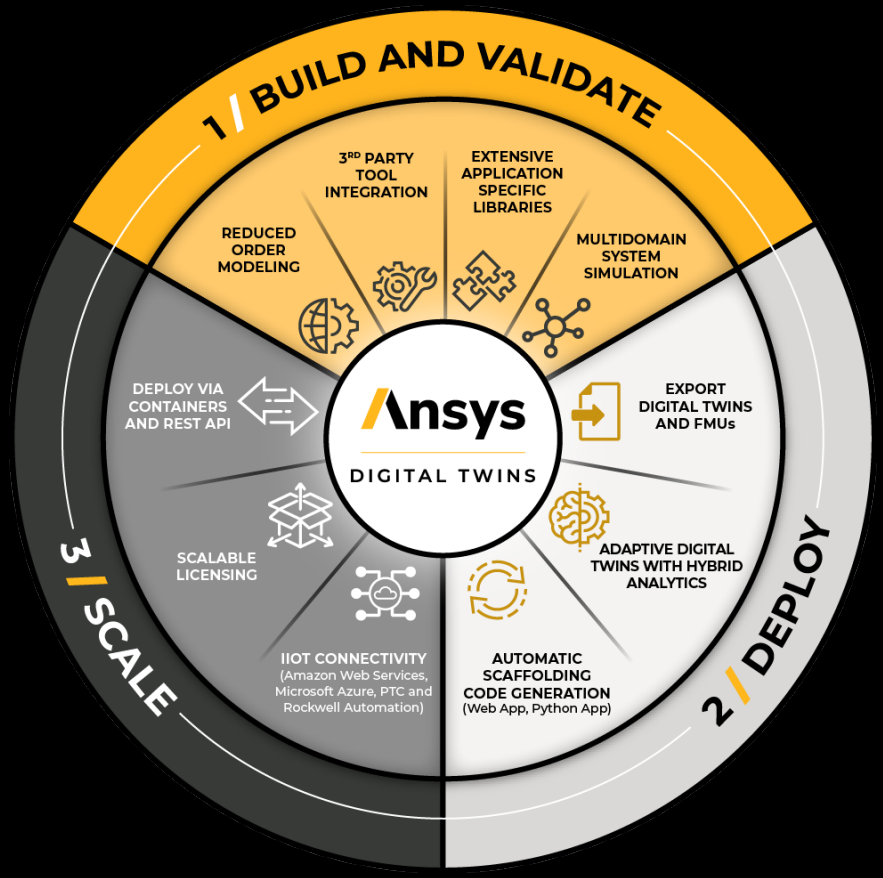
Discovery Design Copilot (patent pending) – first view



Powering Innovation That Drives Human Advancement

Ansys TwinAI:
AI for Digital Twins

Build and Validate, Deploy and Scale AI-Powered Digital Twins



Build & Validate

- Use ROM interfaces to generate accurate, compact models from detailed 2D and 3D physics simulations.
- Visualize 3D fields with the ROM viewer.

Deploy

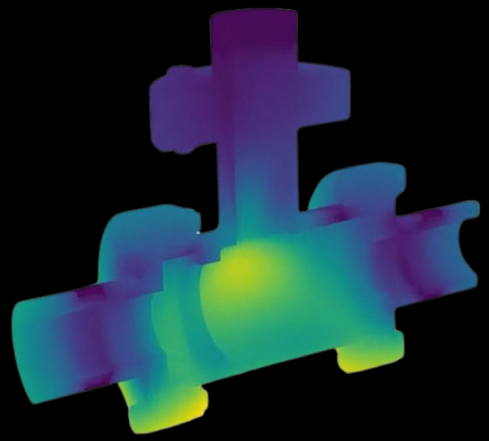
- Export to generate portable Twins that can be deployed on Cloud or Edge.
- Support for the FMI standard for simulation workflows. FMUs can be used in other software and simulation workflows.

Scale

- Easily Scale Deployment with IIoT Platforms
- Scalable Digital Twin licensing offers flexible pricing and configuration options suitable for small and large projects.

Ansys TwinAI Value Proposition

Ansys / TWIN AI

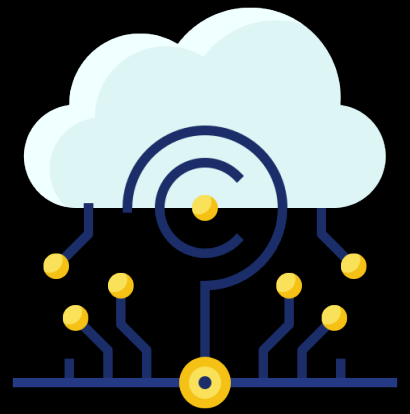


Reduced Order Models

Bring your Physics or Data into TwinAI through ROM

AI/ML & Data

Incorporate sensor data to improve the model through AI/ML



Scaled Deployment

Scaled deployment on the cloud or on the edge.

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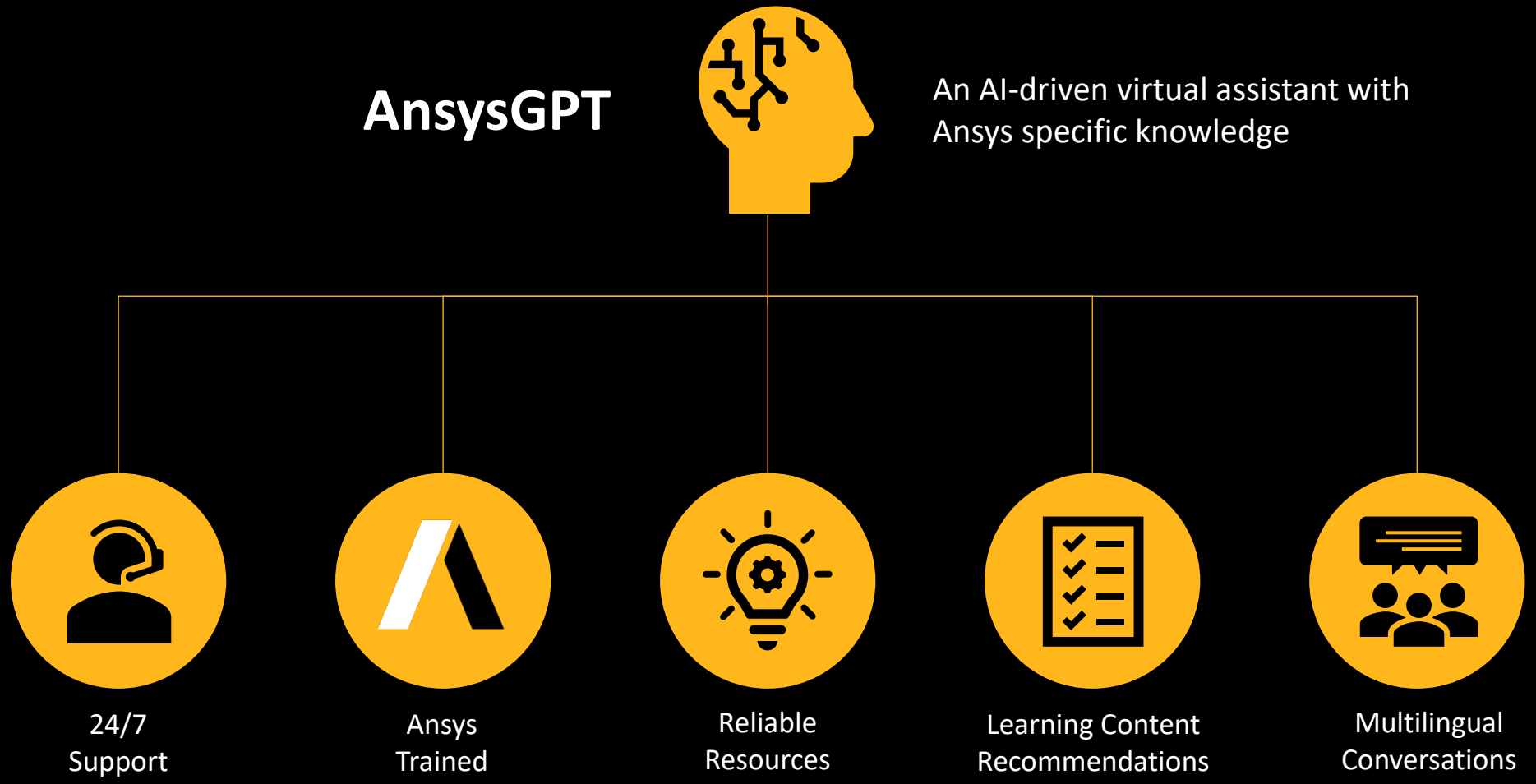
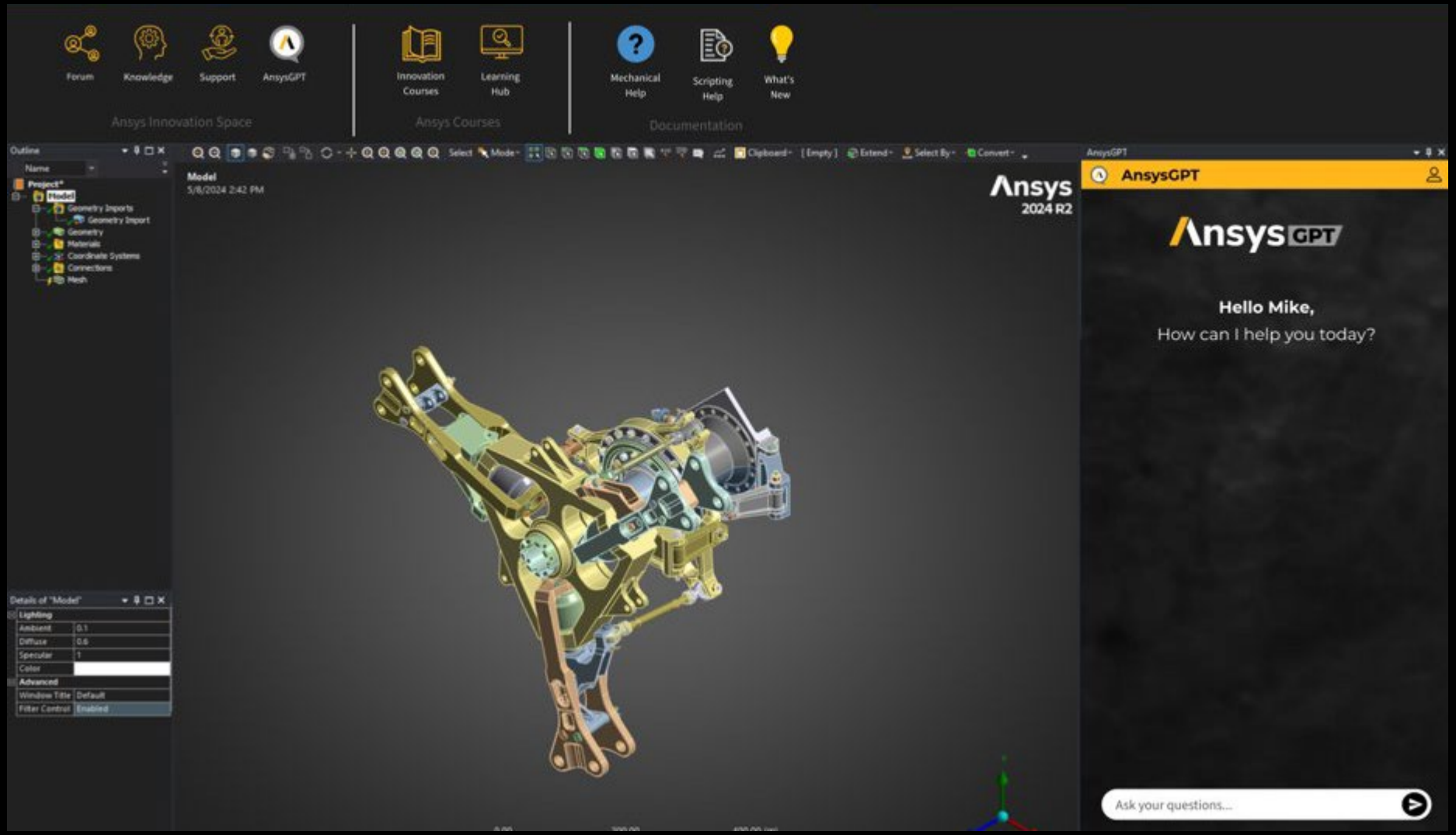
AnsysGPT:
Virtual Assistant for Simulation

AnsysGPT

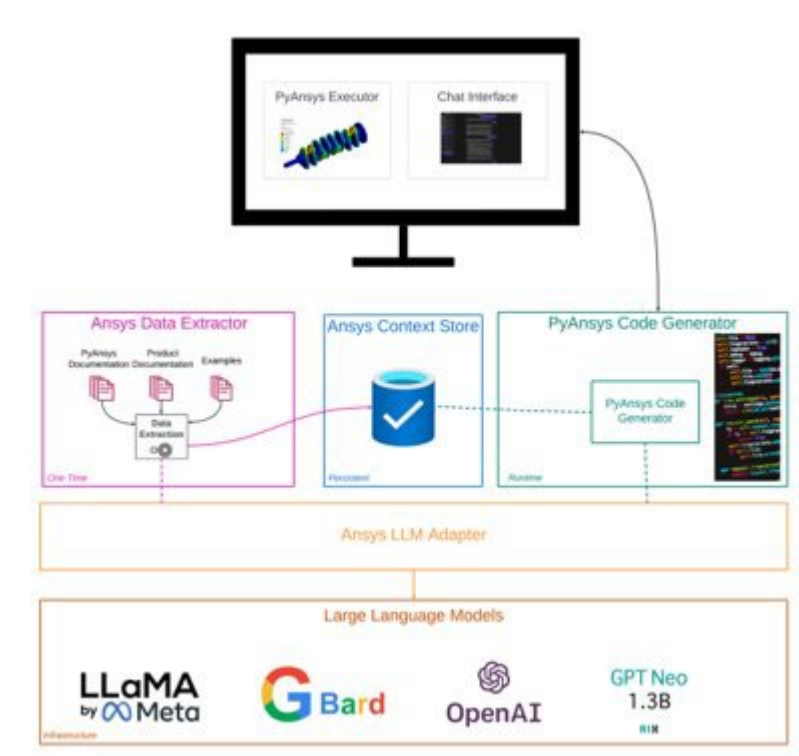
Leveraging AI to unlock the power of Ansys simulation for everyone



AnsysGPT inside coming soon (25R2)



Toward Natural Language Interaction (NLI)




```
Auto-PyMAPDL prompt:
```


```
ALL CURRENT MAPDL DATA WRITTEN TO FILE NAME= _db.db
 FOR POSSIBLE RESUME FROM THIS POINT
```

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Ansys AI+:
Augment Simulation with AI+ Add-Ons

Ansys AI+ : AI features packaged as add-ons modules

Ansys AI+

Already Available

optiSLang AI+

Build prediction models from automated DoEs

2023 R2

Granta MI AI+

Predict process parameters that can achieve material properties goals

2024 R1

CFD AI+

ML tuning of GEKO turbulence model

2024 R1

SynMatrix AI+

Deep-learning-driven RF filter tuning and optimization

2024 R1

Structure AI+

Predict computational resources based on past simulations

2024 R2

Mission AI+

AI/ML providing spacecraft orbit solution assessment

2024 R2

Electronics AI+

Built-in ML-based meshing with decay curve technology for RedHawk

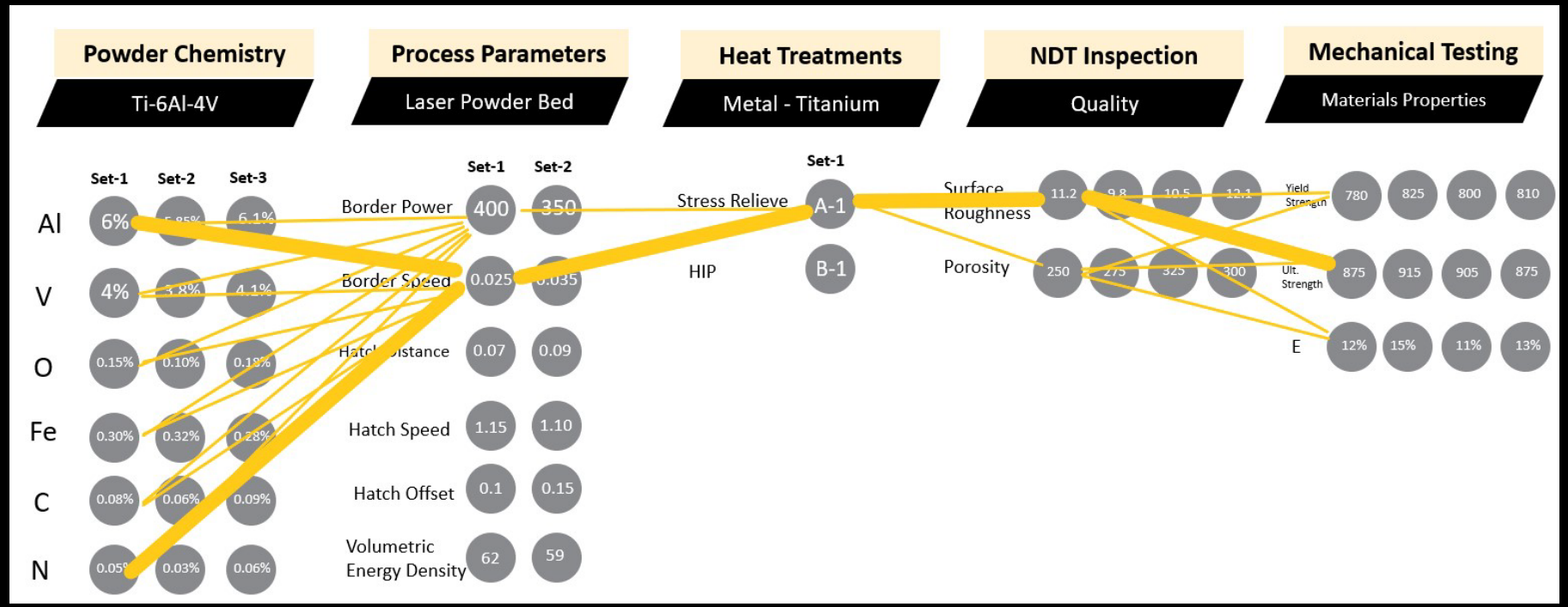
2024 R2

Semiconductor AI+

Built-in ML-based meshing with decay curve technology for RedHawk

TBD

Grant MI AI+ Identifying causal links in YOUR materials data



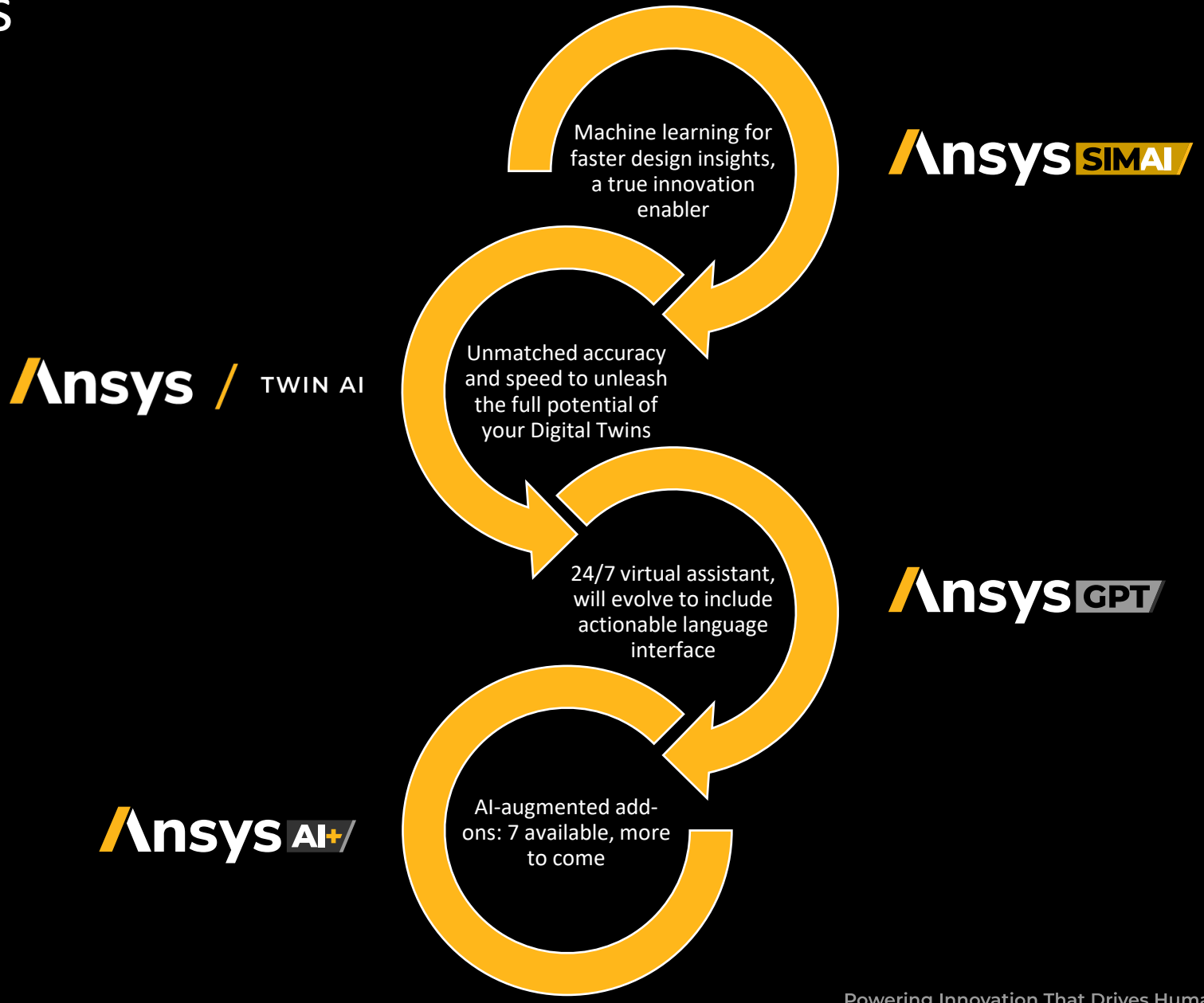
Predict material properties based on input process-parameters

Step 1: create a neural network from YOUR empirical data

Step 2: model the strongest causal links using ML

Determine process-parameters needed for a **targeted material property**

Key Takeaways




Ansys