rescale

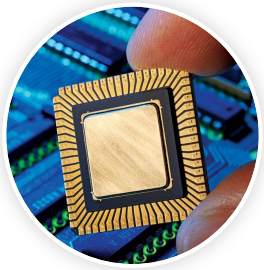
Forum TERATEC 24
Unlock the future

Revolutionising engineering with Rescale

Teratec Forum AT 8 - ***Technologies, applications and uses of the future***

Jeudi 30 mai - 09h35 - 13h00
Parc Floral de Paris

Romain Klein, Senior Technical Director EMEA



Agenda

- Industry Trends
- Rescale Introduction
  - The Challenge - The HPC Stack: Fragmentation and Specialisation
  - The Solution - HPC Agility
- AI is Driving Transformation in Engineering
- Conclusions

Industry Trends in HPC

Topics

- Trends Impacting Engineering Simulation Across Industries
- New Specialised Architectures Drive Performance Gains
- Rescale's Turnkey HPC-as-a-Service Platform

Trends Impacting Engineering Simulation Across Industries

Accelerated Computing

Performance of domain-specific architectures such as GPU and RISC (Arm), is **growing 2x faster** than traditional architectures such as x86 CPUs.

Data Sharing and Collaboration

Collaborative R&D and data sharing is reported at **70% of organizations** globally, often between academia, suppliers, & engineering services organizations.

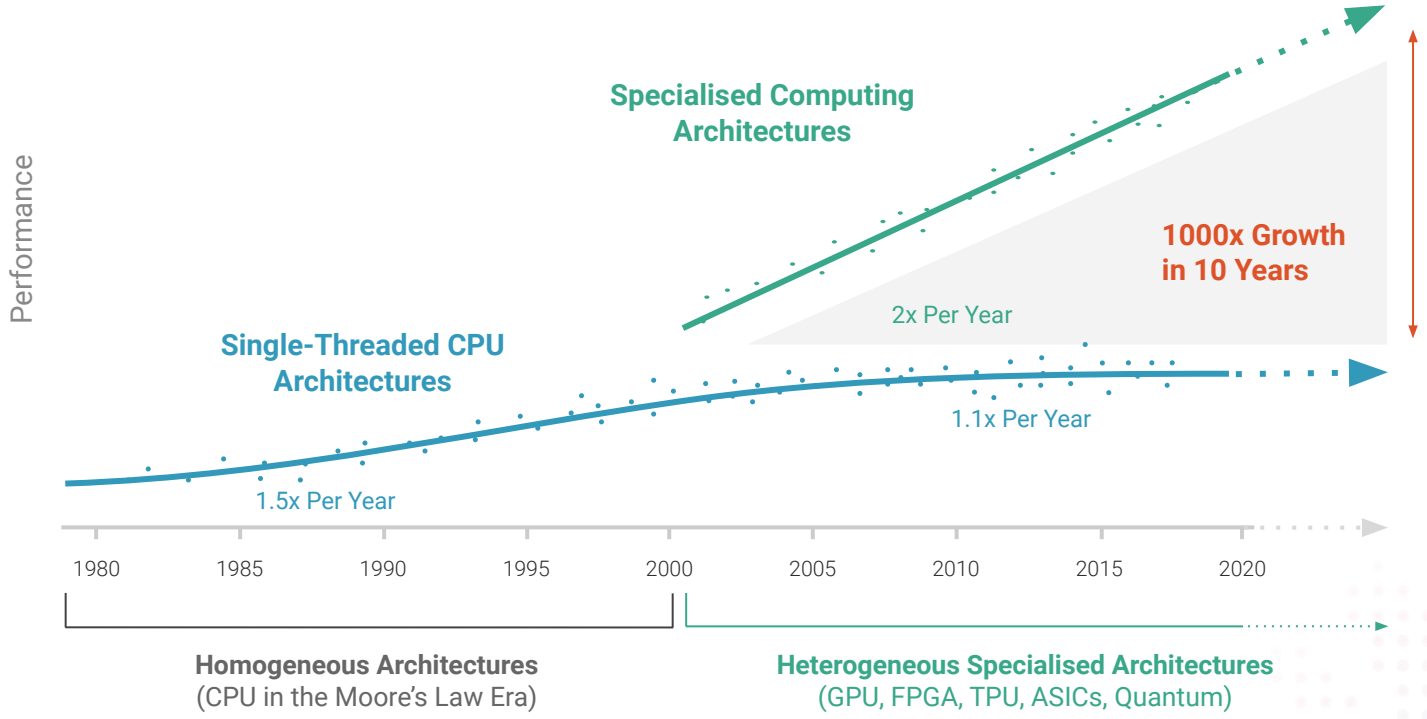
AI-driven R&D

AI/ML enhanced R&D can **reduce product development time by 50%** while accelerating time to market and increasing efficiency.

Sustainable Computing

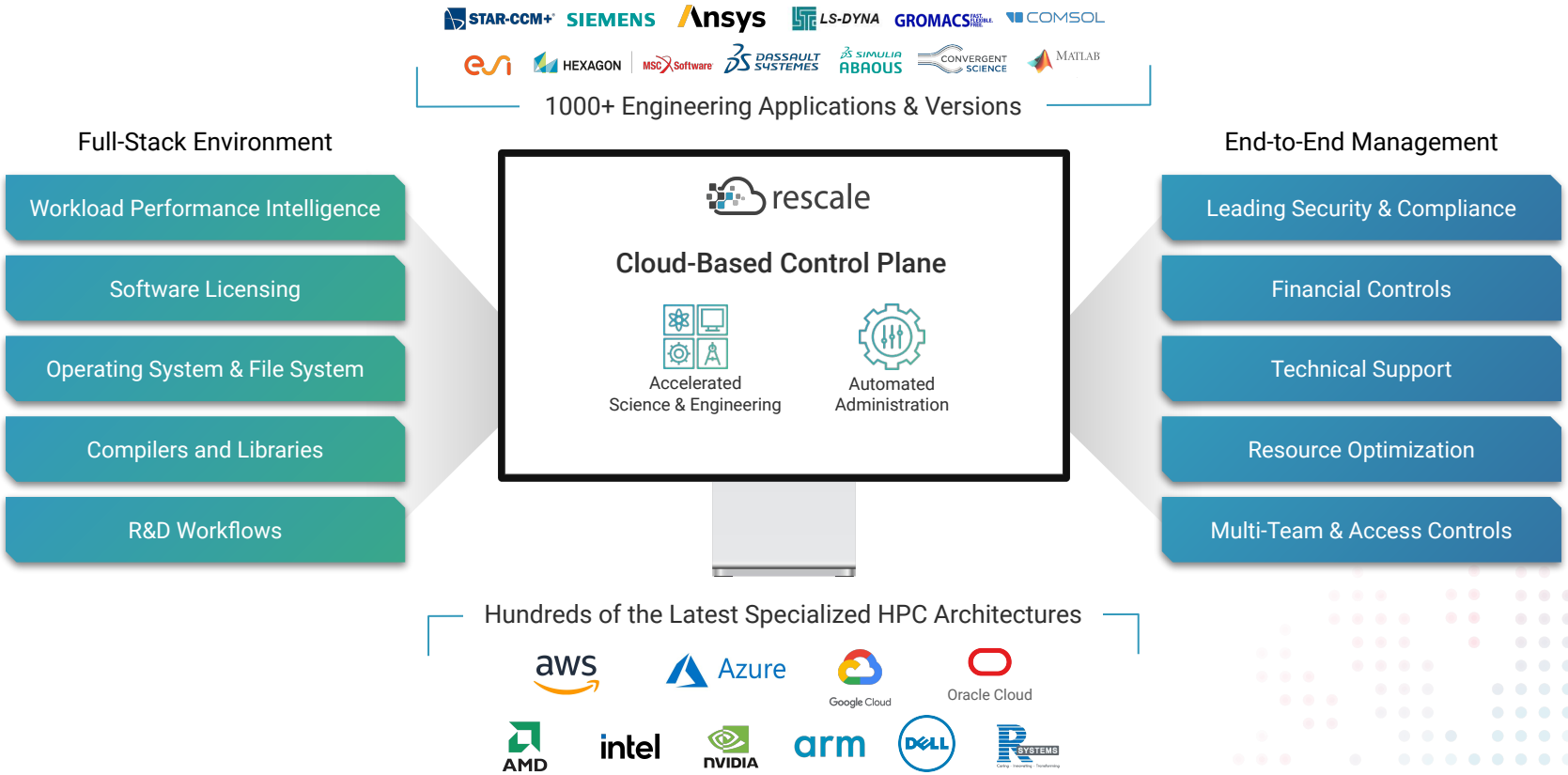
Energy & performance improvements from new architectures in the cloud can be up to **4 times more sustainable** than on-prem.

New Specialised Architectures Drive Performance Gains
Domain-Specific Hardware Accelerators



Source: NVIDIA

Turnkey HPC-as-a-Service for Any Size Organization

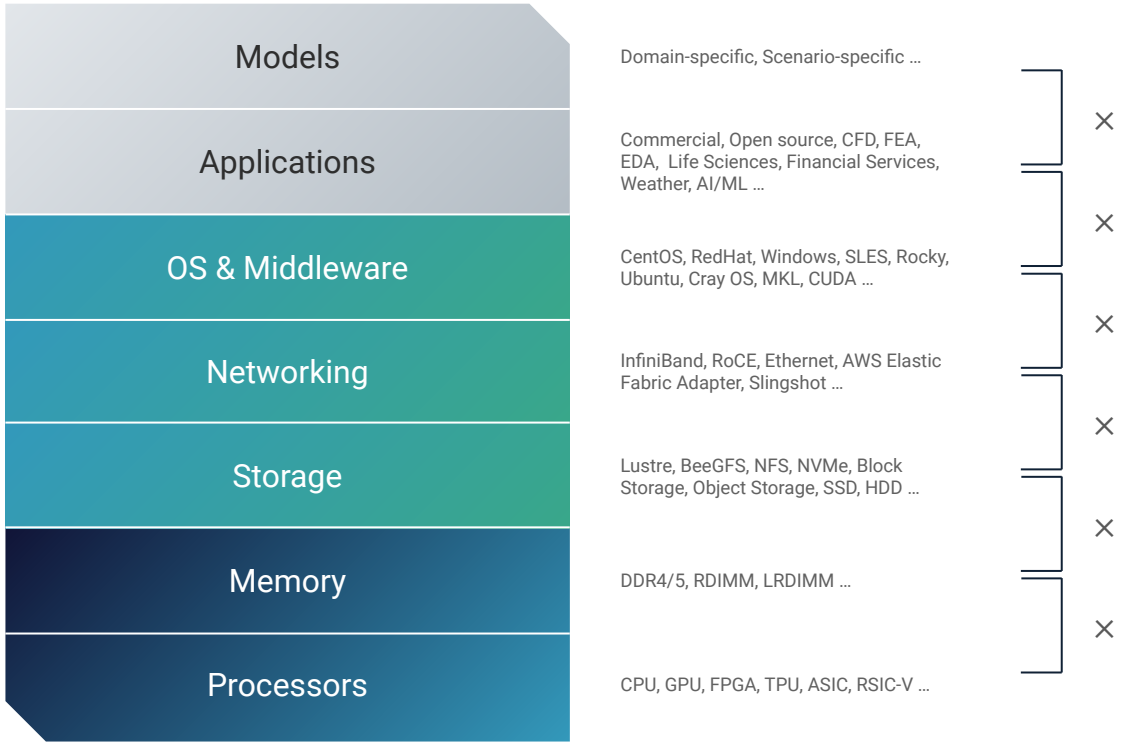


Challenge?

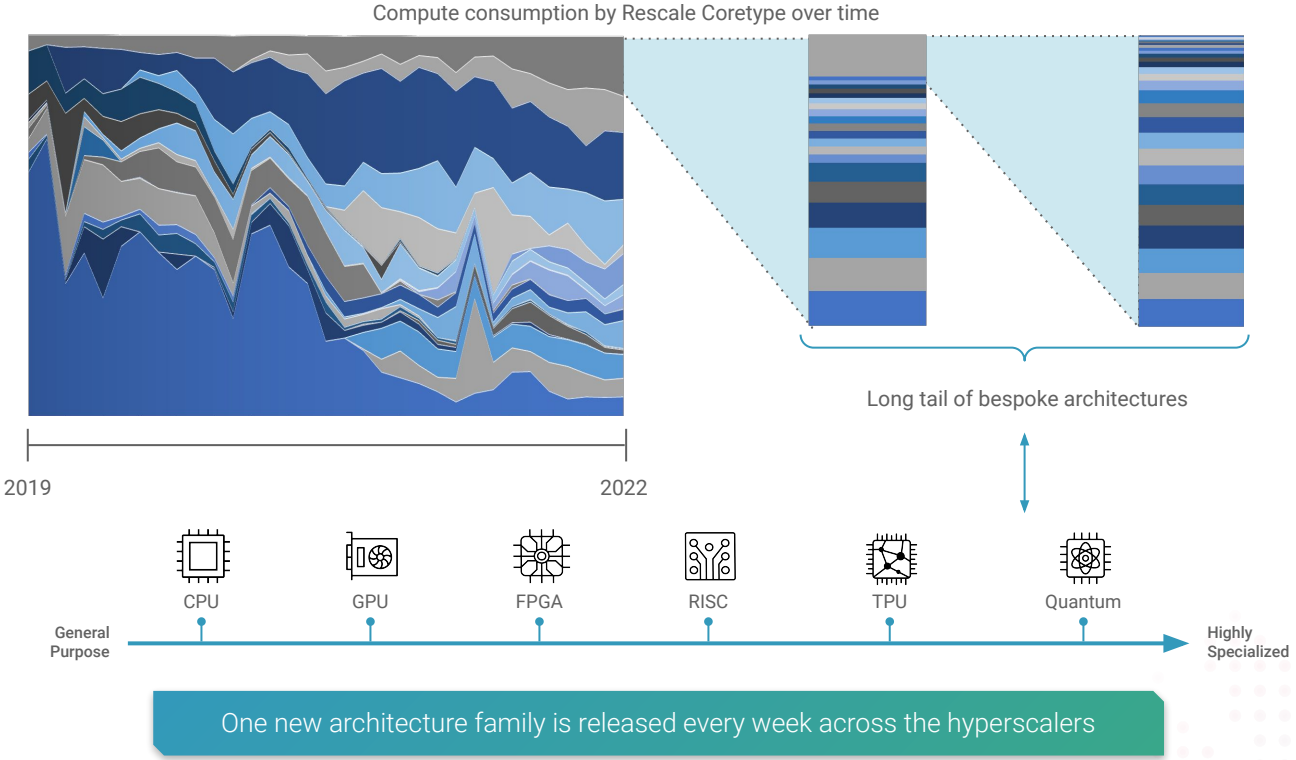
Topics

- The HPC Stack: Fragmentation and Specialisation
- Use Case: Rescale Users Take Advantage of Architectural Proliferation

The HPC Stack: Fragmentation and Specialisation



Rescale Users Take Advantage of Architectural Proliferation



Source: Rescale Platform Intelligence

Solution - HPC Agility

Unified visibility and automated controls across performance, budgets, and security and compliance

Topics

- Rescale Platform Intelligence
- Compute Recommendation Engine (CRE)
- From AI-Driven Insights to Action and Impact

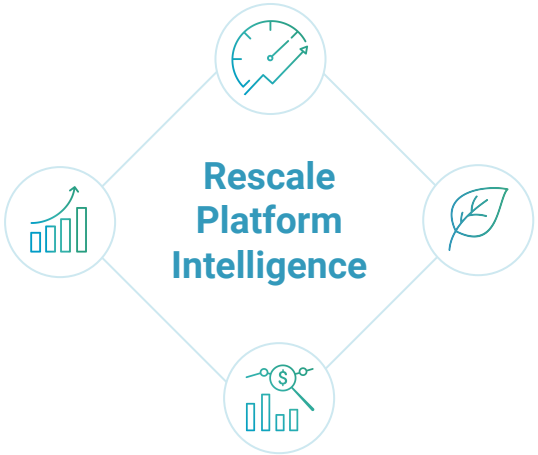
Rescale Platform Intelligence

Performance

Benchmark data on application and hardware performance across CSPs and available hardware types & configurations

Maturity

Infrastructure capacity and reliability data across CSP regions and hardware types



Sustainability

Environmental impact across available global data center infrastructure

Cost

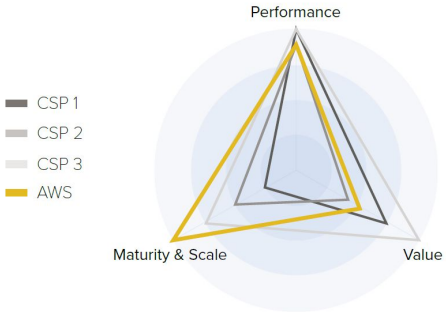
Pricing data across CSPs, hardware types, and service levels

Using Rescale Platform Intelligence - Examples

A data-driven approach to optimizing workloads based on performance, maturity, and cost intelligence.

Example A

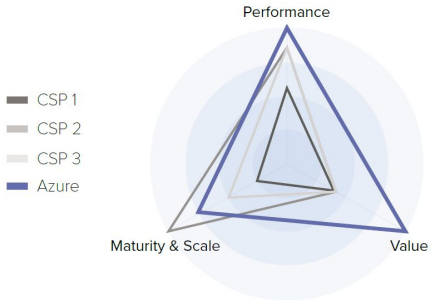
A workload where an AWS coretype provides competitive per-core performance and value, with unmatched capacity



Source: Rescale Cloud HPC Platform Analytics, Using AWS list prices, Workload based on Caravan benchmark on LS-DYNA

Example B

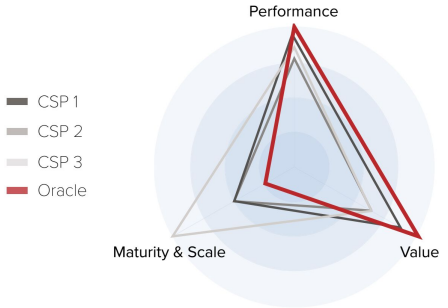
A workload where an Azure coretype delivers best per-core value and per-core performance while offering competitive capacity



Source: Rescale Cloud HPC Platform Analytics, Using Azure list prices, Workload based on Oil Rig benchmark on Ansys Fluent

Example C

A workload where an OCI coretype delivers highest per-core and cost performance



Source: Rescale Cloud HPC Platform Analytics, Using Oracle list prices, Workload based on Molecular Dynamics LJ Liquid 2M on LAMMPS

Compute Recommendation Engine (CRE)

Performance optimization for any workload on any infrastructure

Full Stack Metadata & Telemetry
Across Benchmarks & Jobs

Models
Applications
Operating Software
Networking
Storage
Memory
Processors

X X X X X X

Compute Recommendation Engine

Retrieval Filtering Scoring Ordering

Recommendation
Feedback

User Creates New Job

Compute Optimizer

Optimal Stack
Recommendation

Networking
Storage
Memory
Processors

90%+ accuracy in identifying optimal architectures and optimal scalability

AI is Driving Transformation in Engineering

Topics

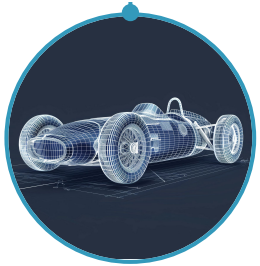
- Surrogate Models
- Generative Design
- Physics-Informed Neural Nets

AI is Driving Transformation in Engineering

Intuition-led Engineering

Data and AI-assisted Engineering

1960



Drawn Wireframe

1980

Computer-Aided Design (CAD)

2015

Computer-Aided Engineering (CAE)

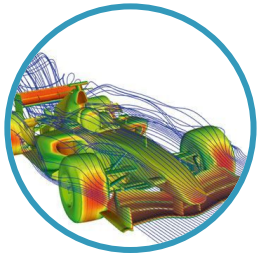
2024

Computational Science & Engineering (CSE)

Deploy Custom AI Models for Continuous Product Improvement

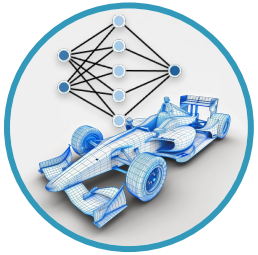
Design Exploration & Optimization Cycle with Simulation + AI

1 Simulation Data Generation



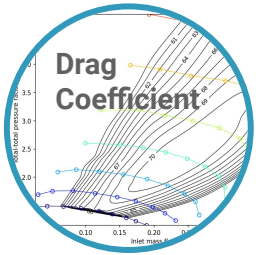
Generate physics-based CFD data, label data & prepare training datasets

2 Model Training & Deployment



Automate workflows for training & deploying custom AI models

3 Inference & Prediction



Run inference to rapidly evaluate one or many designs with AI-driven predictions

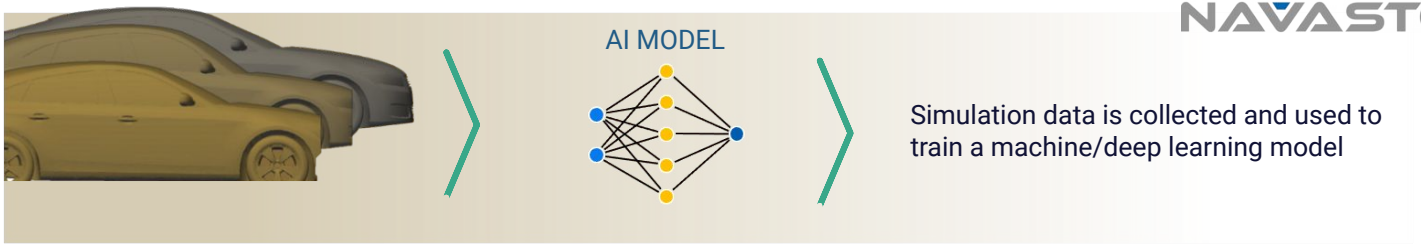
Validation & Tuning

Validate prediction accuracy and improve AI models with additional simulation

AI: Models: Real-time Capable 3D Surrogates for Simulation

Train, Predict, and Validate Designs using Navasto on Rescale

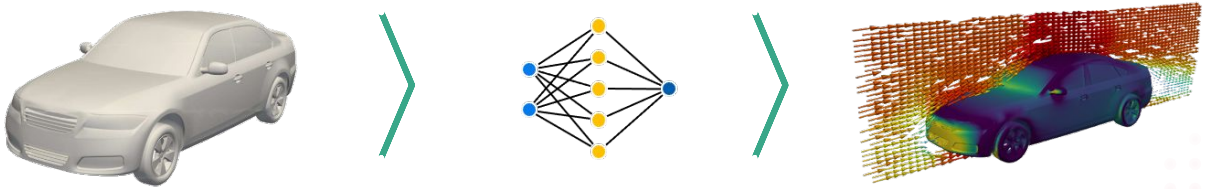
TRAIN



Simulation data is collected and used to train a machine/deep learning model

Geometries and/or Parameters

PREDICT



New Design Candidate

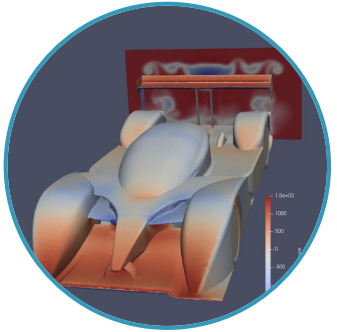
The trained AI model can be queried with new design candidates to **predict the result of a simulation within milliseconds.**

Example: Optimizing Aerodynamics with AI Physics Inference

Description: Le Mans Hypercar Prediction Model Training with CFD data from STAR-CCM+ and Inference Predictions from NAVASTO NAVPACK

rescale + NAVASTO

1,000X
Acceleration of CFD Design Evaluation



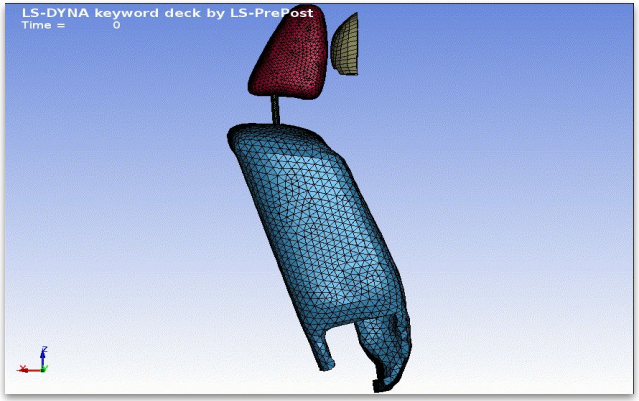
Evaluate a Design in Milliseconds or Thousands of Designs in Minutes

View Full Video Demonstration

Headrest optimization using machine learning

Simplify Simulation Workflow: Use surrogate models to make simulation workflows easier, aiming for lower cost and time compared to traditional methods.
Steps:

- Data Generation: Start with a small part of the initial DOE (Design of Experiments) to create training data.
- Train Surrogate Model: Use the generated data to train the surrogate model.
- Parameter Sweep: Apply the surrogate model to explore the original DOE's parameter space.
- Verification: Check the surrogate model's accuracy against conventional FEA (Finite Element Analysis).

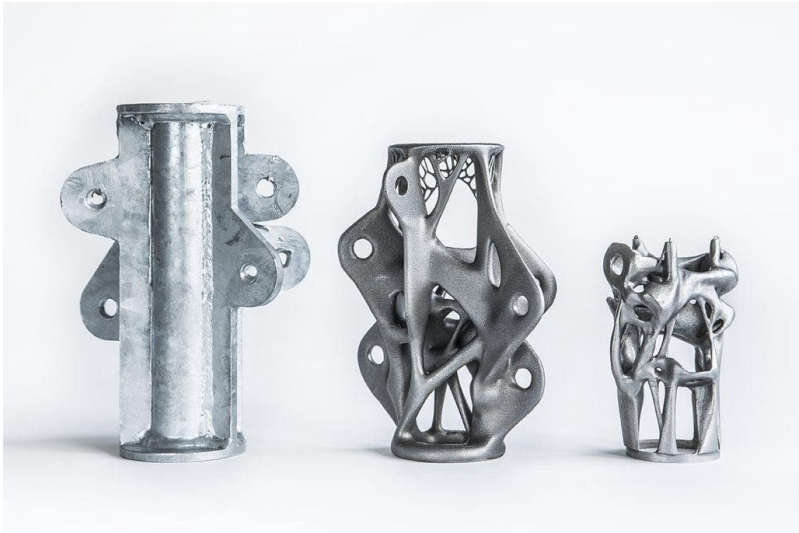


Comparison of cost for 1200 sample runs

Surrogate model based workflow		LS-DYNA
DOE (400 Samples)	33 hours using 1 Node (36 CPU cores)	100 hours using 1 Node (36 CPU cores)
Neural network training	2 mins	
1200 Sample runs	0.15s using 1 CPU core	

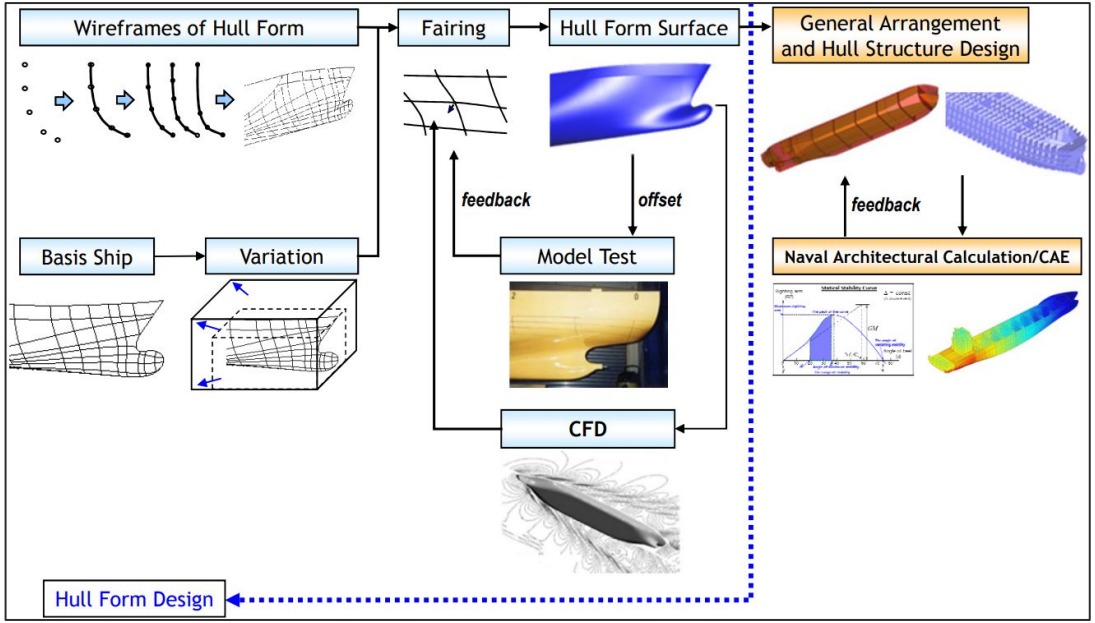
Generative Design Background

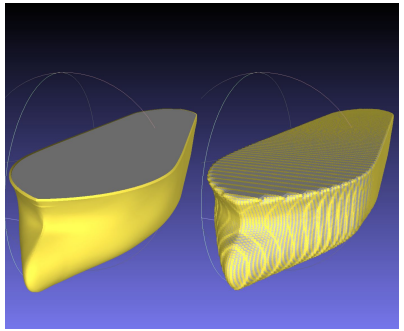
- Generative design is a capability that uses AI to autonomously create optimal designs from a set of system design requirements.
- Engineers can specify requirements, constraints, and goals, the generative design engine will produce innovative designs.
- Similar to transformer models for natural language processing, text-to-image models like Stable Diffusion for image manipulation are being used for generative design.



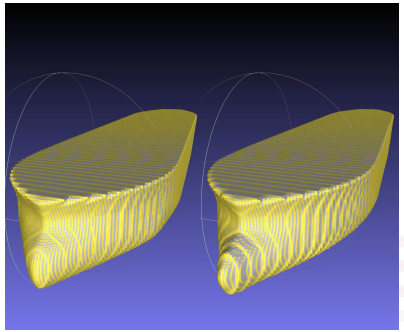
Ship Design Discovery - Problem Statement

- Mission: To enable generative ship hull design using restricted data or metrics (What AI foundation model will do?)
  - **#1: mesh-to-scalar regression ➡️ #2: variational scalar-to-mesh generation**





Original Data



100k model/sample #1

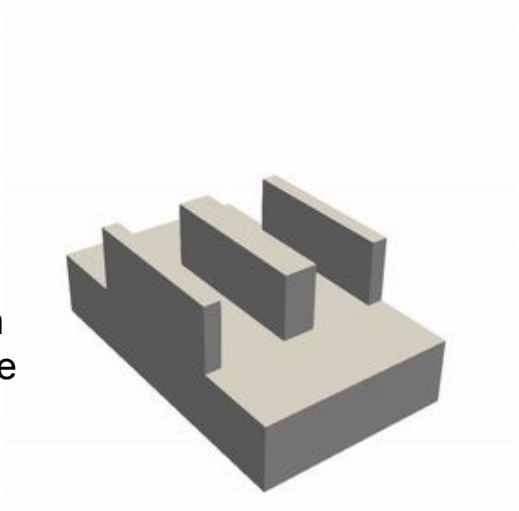
200k model/sample #1

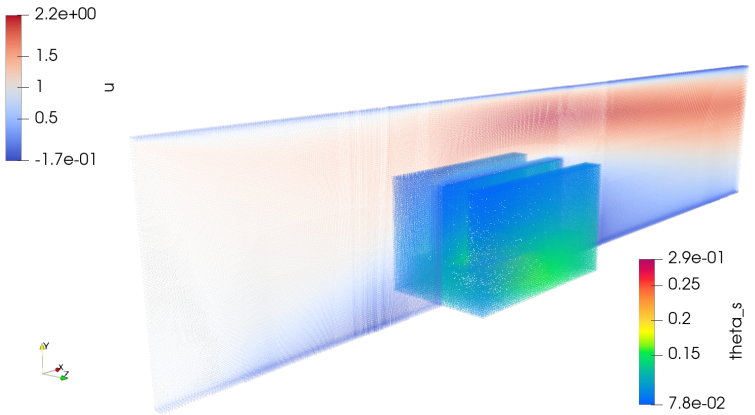
300k model/sample #1

NVIDIA Modulus Run on Rescale

Parameterized 3D Heat Sink

Optimization design space





Velocity in the channel central plane and heat on the sink surface

- Multi-Physics (fluid, heat)
- NN Inputs: x,y,z and design variables

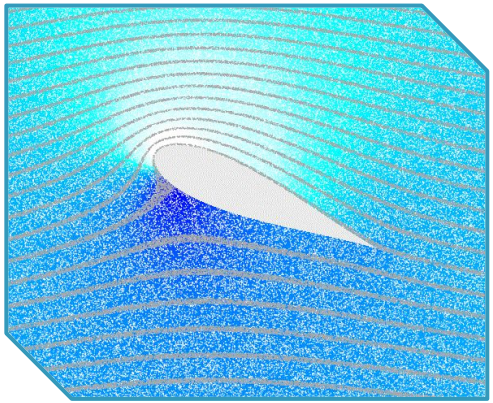
6 design variable and 3 values per design variable

Solver	OpenFOAM	Modulus
Compute Time (hrs)	4099	120

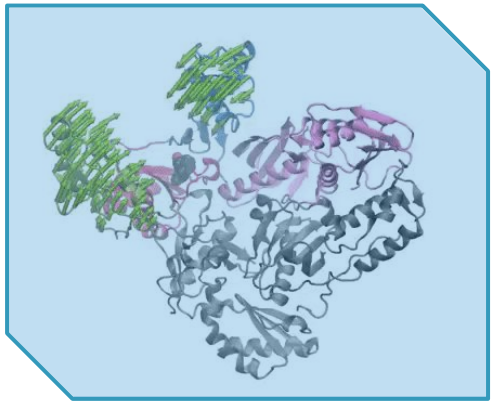
*Referenced from Nvidia Modulus 21.06 User Guide

New Industry Breakthroughs Await

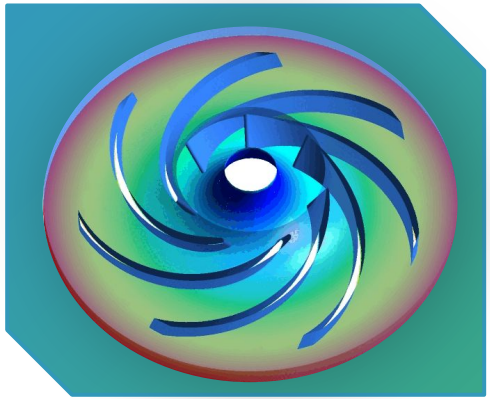
Efficient and Safe Aircraft Airfoil Designs



Precision Medicine and Novel Drug Discoveries



Energy Efficient Power and Propulsion



Variety of AI Physics Use Cases

- External Aerodynamics
- Turbomachinery Flows
- Heat Exchanger Optimization
- Weather Predictions
- Molecular Dynamics
- Biomechanics Simulations
- Cardiovascular CFD

High Performance Computing Built for the Cloud

- Digital Engineering
- Workload Optimization
- Intelligent Automation
- Security & Compliance