rescale

Accelerating CFD Simulations through HPC and AI on Rescale

SPE GCS - Annual Symposium

August, 2024

Company Overview

- Founded in 2011, HQ in San Francisco, locations in Amsterdam, London, Seoul, and Tokyo
- 300+ enterprise customers across all major Fortune 500 and Global 2000 enterprises
- #1 HPC solution for all major cloud providers
- Leading solution for R&D digital transformation

Enterprise HPC category leader

Venture backing
$200M

Ranked
Deloitte Fast 500
Y-Combinator Top 50

HPCwire awards
Readers & Editors Choice Winner

Customers Leading Digital Transformation

Enterprise customers
300+

Top Aerospace Companies
7 of 10

Top Automakers
7 of 10

Broadest Application & Infrastructure Ecosystem

Software marketplace
1000+ Apps

Cloud infrastructure
4 of top 4

Software vendors
80+ ISVs

Investors


Sam Altman


Jeff Bezos


Richard Branson


Paul Graham


Peter Thiel


Ben Verwaaye

TRANSLINK CAPITAL · Microsoft · Data Collective
JumpCapital · ITV · SAMSUNG
initialized() · KEEN · SINEWAVE VENTURES
HITACHI · Y Combinator · NVIDIA

Industries


Aerospace


Automotive


Energy


Higher Ed


Life Science


Manufacturing


Government


Semiconductor

Analyst Recognition

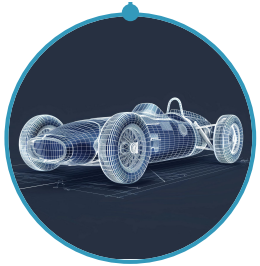
Gartner · IDC Analyze the Future · HYPERION · HPC Wire · Goldman Sachs · McKinsey&Company

AI is Driving Transformation in Engineering

Intuition-led Engineering

Data and AI-augmented Engineering

1960



Drawn Wireframe

1980

Computer-Aided Design (CAD)

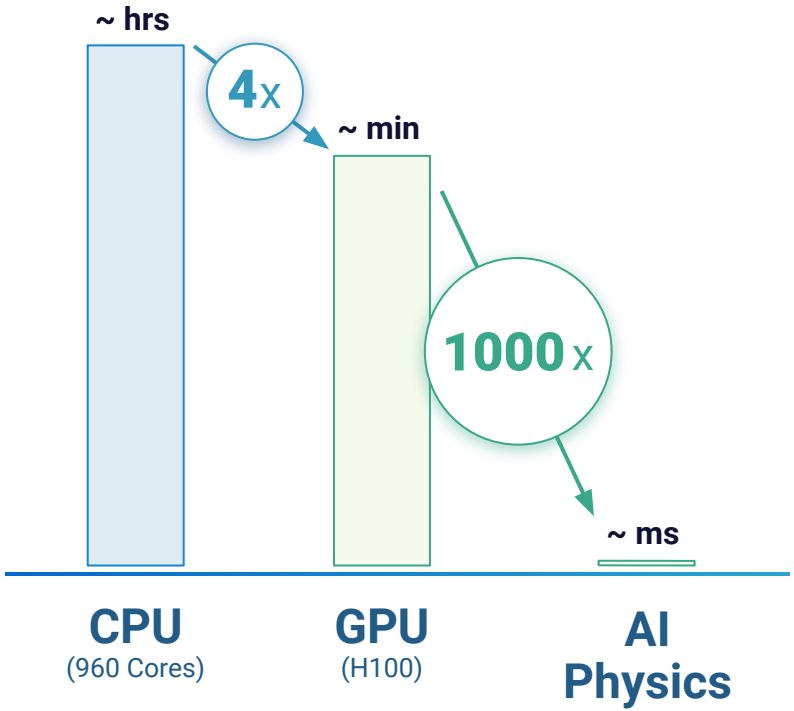
2015

Computer-Aided Engineering (CAE)

2024

Computational Science & Engineering (CSE)

AI and Accelerated Computing Enable AI Physics Breakthroughs



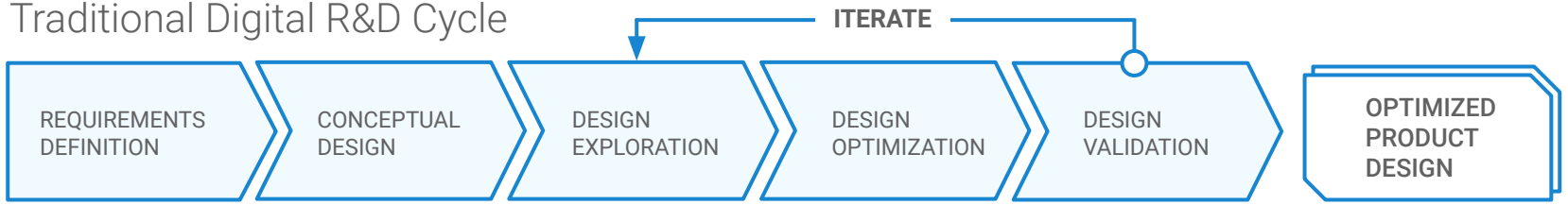
Recent Advancements / Enablers of Business Outcomes

- Computational reducibility unlocks accurate predictive physics
- Breakthroughs in AI frameworks, and neural network development
- Accelerated computing further fuels accelerated algorithms
- Pre-trained physics models can provide compounding advantages

Rescale CFD Benchmarks

Modern Engineering Teams Harness AI to Accelerate R&D Cycles

Traditional Digital R&D Cycle



DAYS OR WEEKS

AI-Augmented Digital R&D Cycle

MINUTES OR HOURS

1000X+ Accelerated Results for Design Evaluation

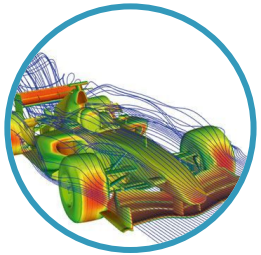
99%+ Accuracy Compared to Traditional CFD Simulation

85% Improvement in Computing Resource Efficiency

Deploy Custom AI Models for Continuous Product Improvement

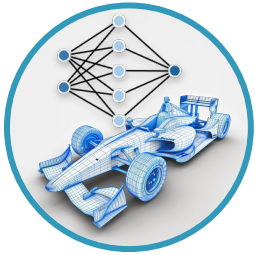
Design Exploration & Optimization Cycle with Simulation + AI

1 Simulation Data Generation



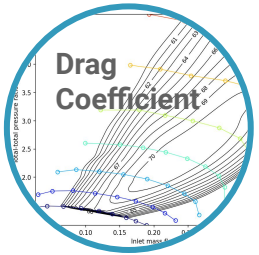
Generate physics-based CFD data, label data & prepare training datasets

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

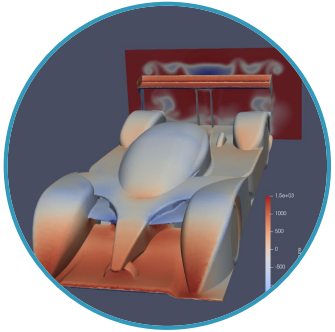
Example: Optimizing Aerodynamics with AI Physics Inference

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

View Full Video Demonstration



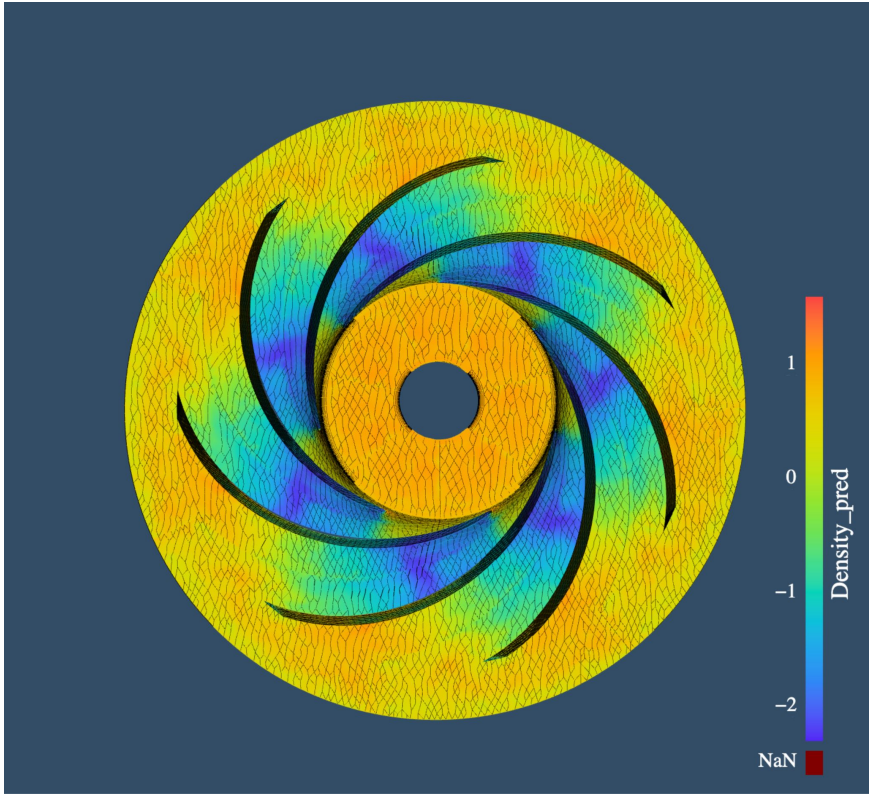
Evaluate a Design in Milliseconds or Thousands of Designs in Minutes

Turbomachinery Flow

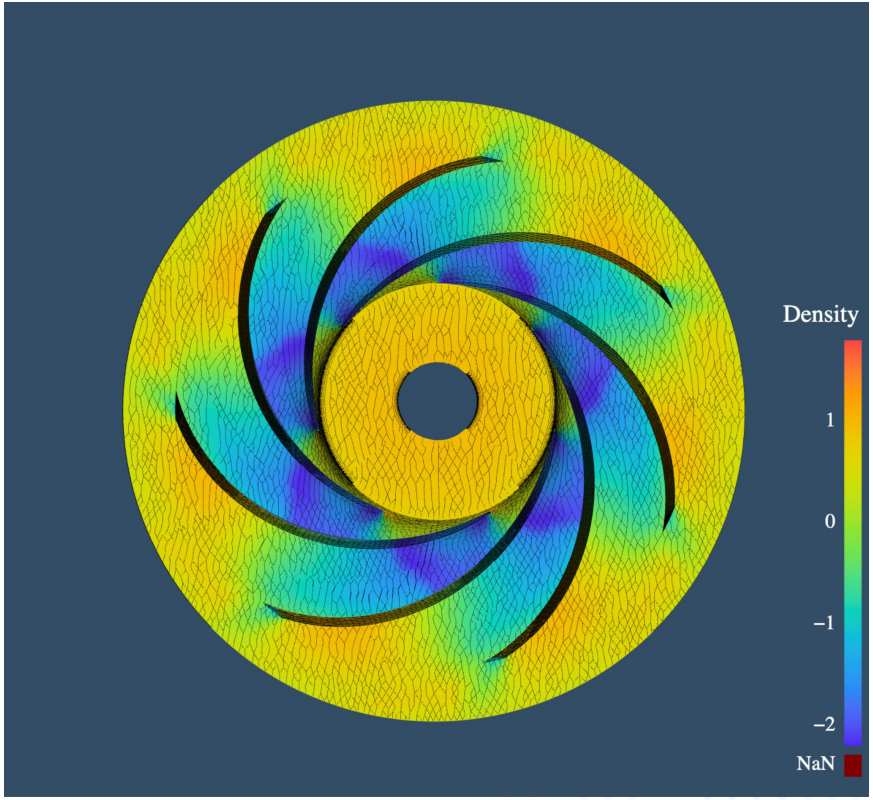
Feature [unit]	Value range		
	min	baseline	max
r1: inner radius [mm]	20	21.5	23
r2: outer radius [mm]	55	57.5	60
β1: at inlet [∘]	20	23	26
β2: at outlet [∘]	17	20	23
b2: at outlet [mm]	15	18	21
ω [rpm]	28000	30000	32000
p [kPa]	110	120	130

- 2,000 design & operational condition variation
- 5 mins on 4 cores per run to generate dataset
- Network training - 31000 epochs, 3 mins on a V100 GPU

Turbomachinery Flow

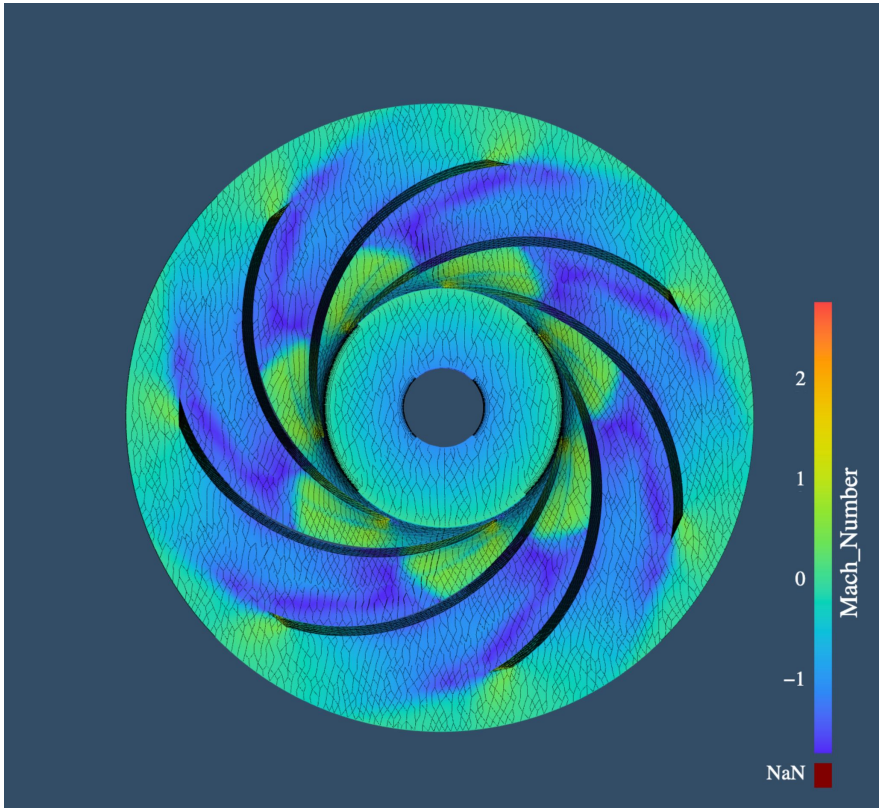


Predicted

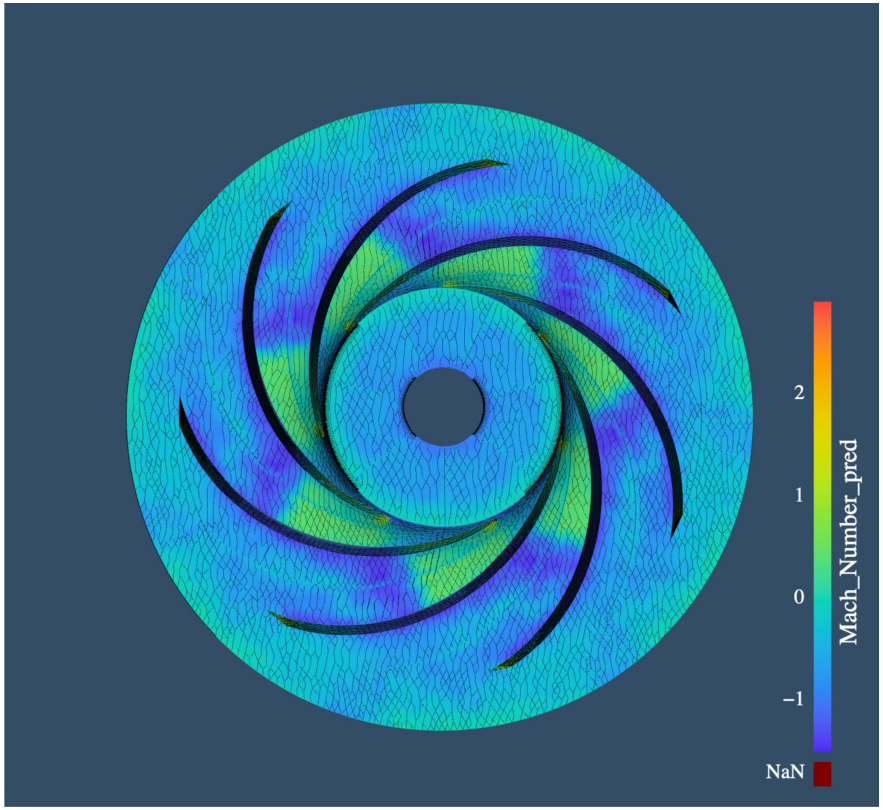


CFD

Mach number comparison

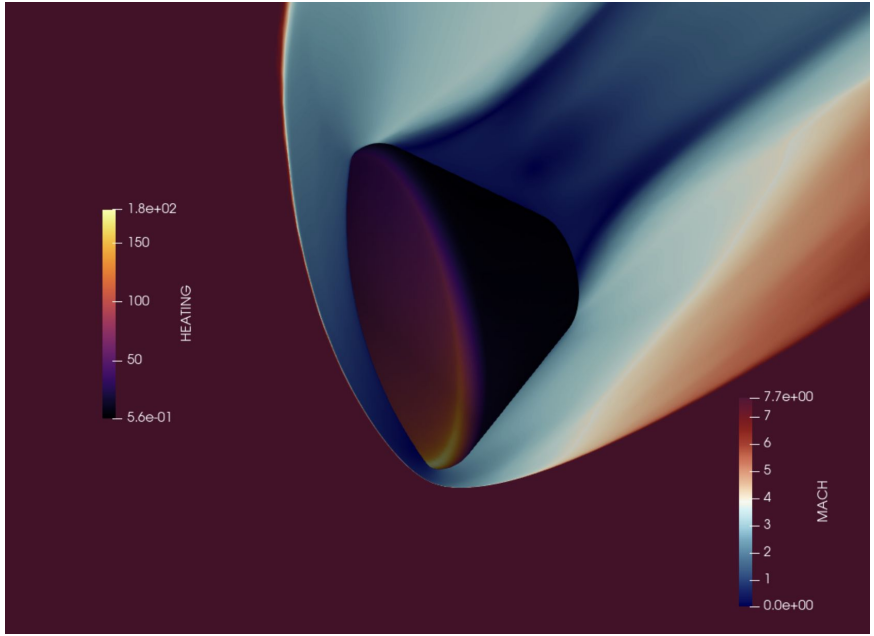


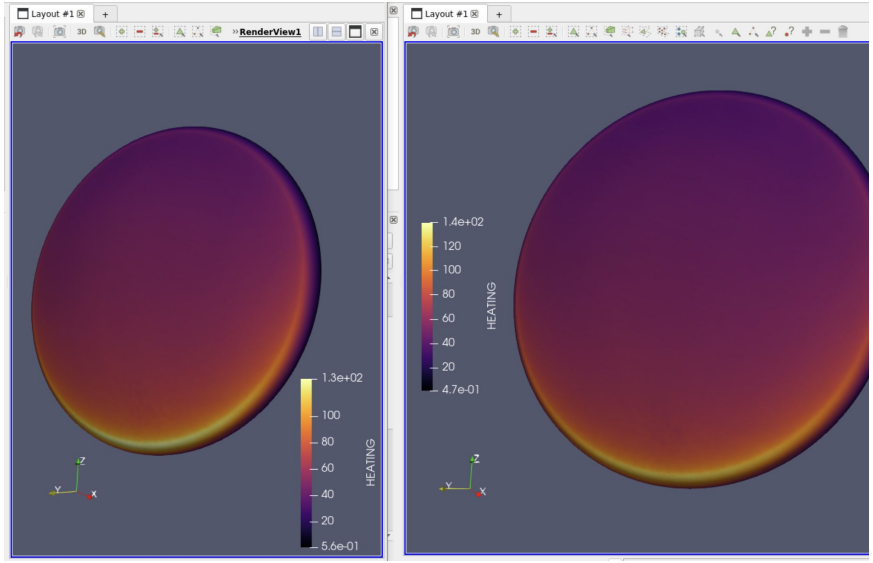
CFD



Prediction

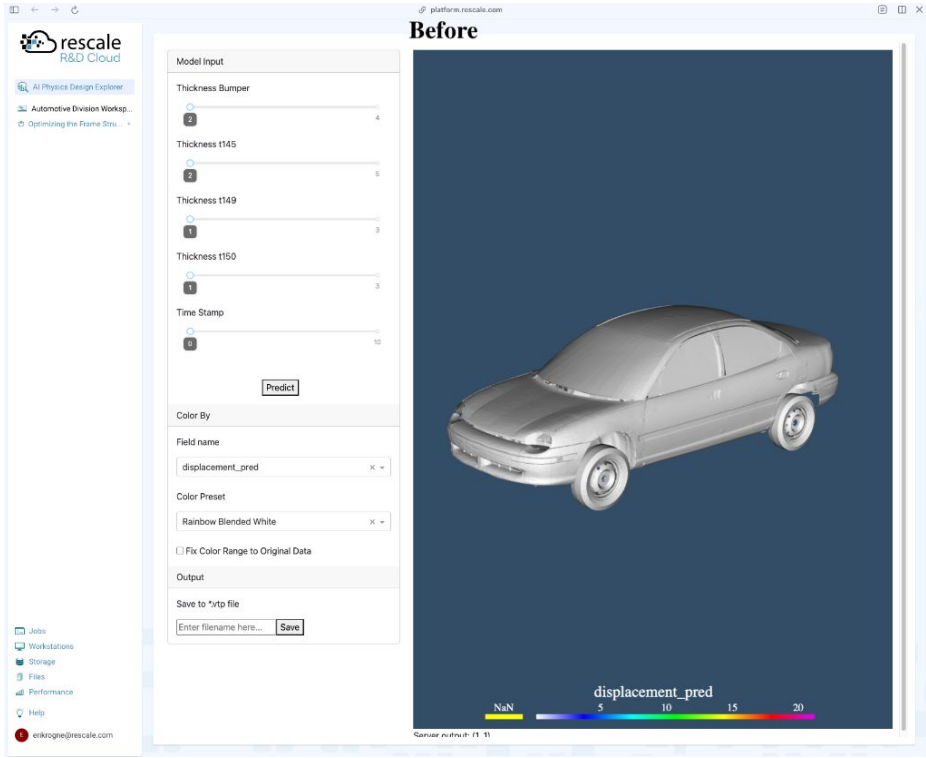
Flow over a reentry capsule

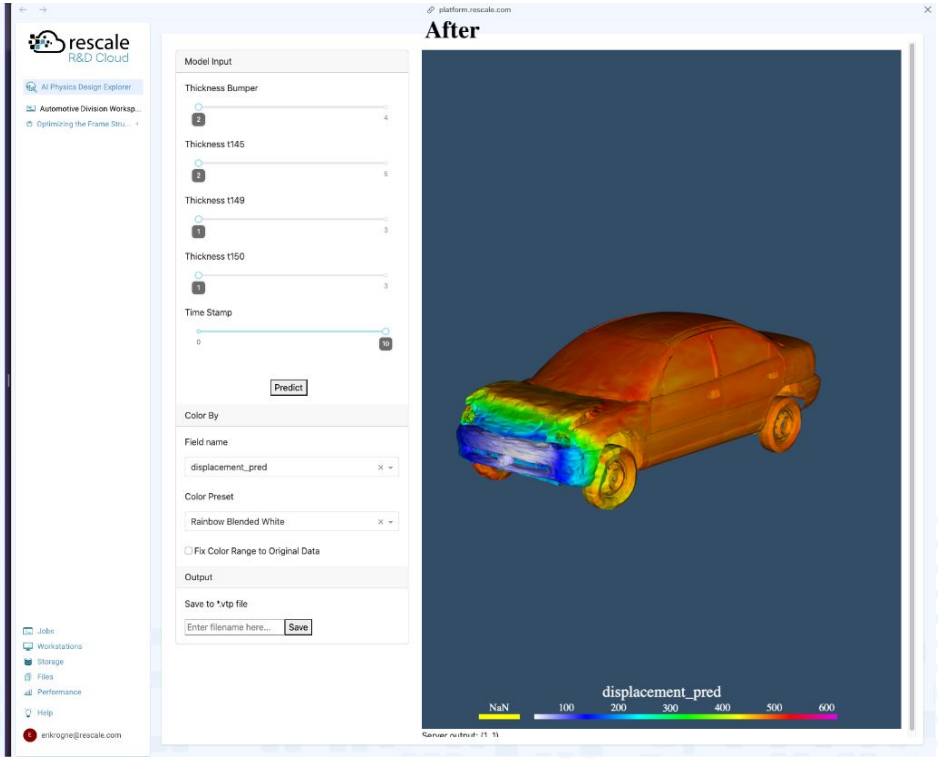




Predicted (left) vs. FUN3D (right)

Crash simulation





AI Physics Powered by NVIDIA

NVIDIA AI Enterprise

Full-Stack Data Science & AI/ML

50+ AI developer tools and AI accelerated hardware

Frameworks & Pre-Trained Models
Modulus, NeMo, Clara, and more

Data Prep, Training, Optimization, Deploy
TAO, RAPIDS, Triton, CUDA and more

Multi-Cloud Infrastructure
A100, H100, H200, GH200

Learn more about NVIDIA AI Enterprise

+

Rescale HPC Built for the Cloud

Fully-Automated R&D & IT Computing

1,200+ R&D applications and Full-stack HPC+AI Automation

AI Application Marketplace
NAVASTO, Neural Concept, Physics X, Navier AI, Monolith AI, and more...

AI Workflows
Training Pipelines
Data Labeling
Inference Prediction
Results Visualization
Simulation Validation

rescale

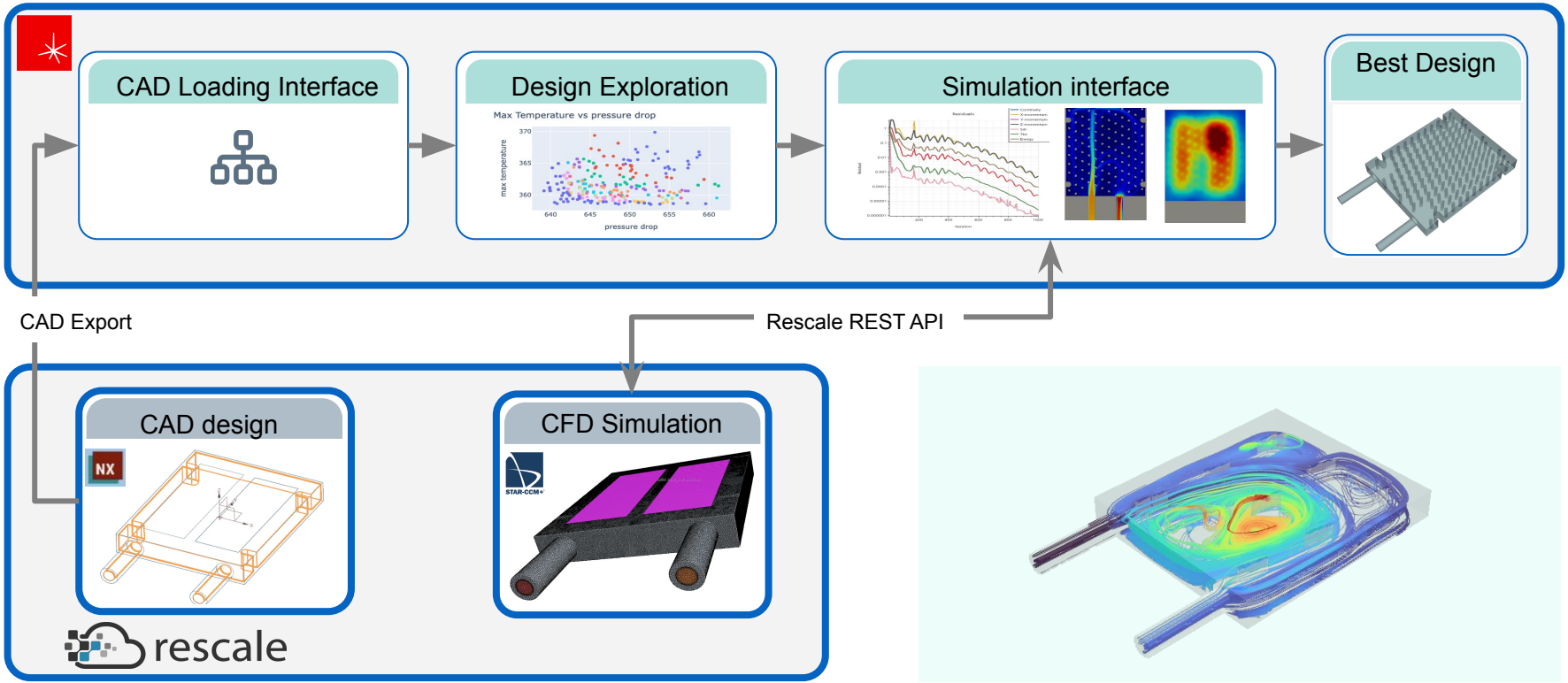
Cloud Platform for Engineering Computing

PERFORMANCE | AUTOMATION | GOVERNANCE

NC + Rescale

A FULLY PACKAGED, REPLICABLE AND SCALABLE END-TO-END WORKFLOW

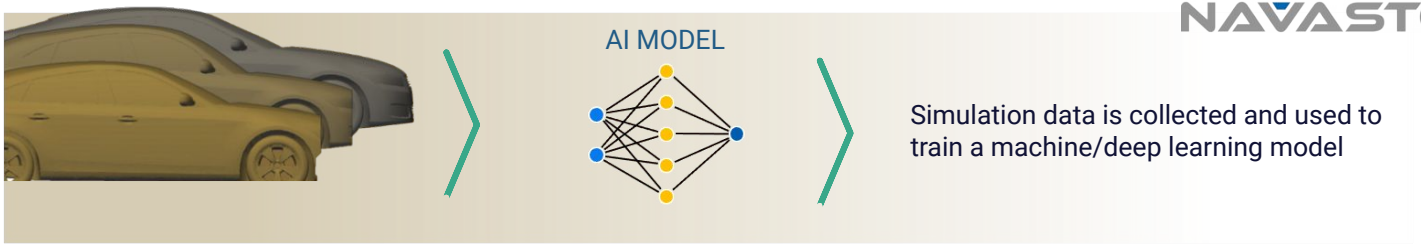
REQUIREMENTS — EXPLORATION — VALIDATION — EXTRACTION



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

Train, Predict, and Validate Designs using Navasto on Rescale

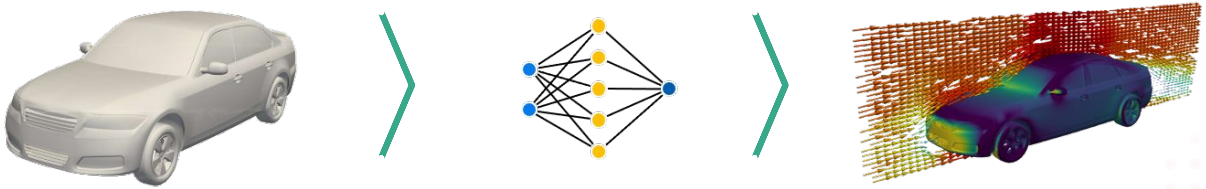
TRAIN



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.**

Built for Seamless Integration for Any Enterprise

AI-ENABLED ENGINEERING

NVIDIA Modulus · NAVASTO · NEURAL CONCEPT · PHYSICSX · Navier AI

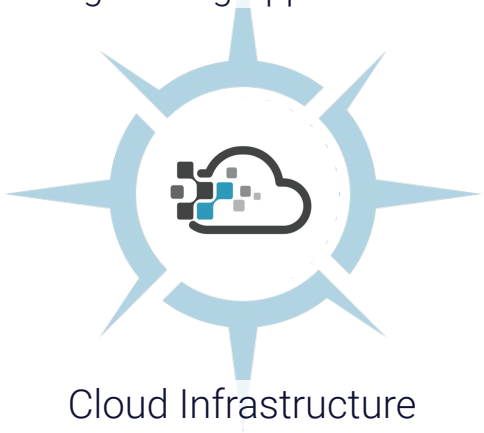
COMPUTER-AIDED ENGINEERING

Ansys · cadence · HEXAGON · DASSAULT SYSTEMES · SIEMENS

Engineering Applications

3DEXPERIENCE · TEAMCENTER · aras

Product Knowledge and Process Orchestration



Storage Services and Data Management

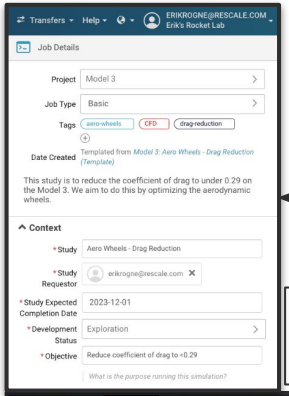
·l·u·s·t·r·e· · NetApp · WEKA

Cloud Infrastructure

aws · Microsoft Azure · Oracle Cloud · IBM Cloud | NVIDIA DGX Cloud | RESPONSIBLE COMPUTE · CoreWeave · VULTR · NAVER CLOUD PLATFORM

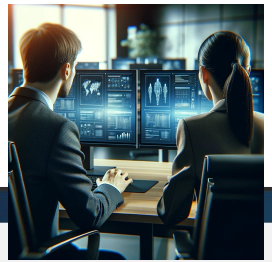
HYPERSCALE CLOUDS **SPECIALTY CLOUDS**

Rescale Metadata Management

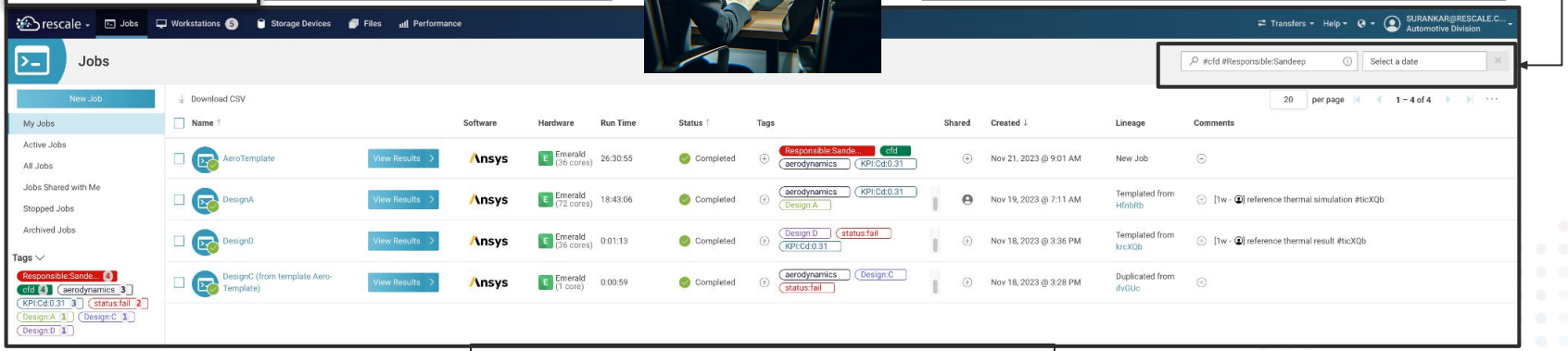


User-Centric Experience
Flexible, Seamless and Automated

Simulation Governance
Consistent Data Capture

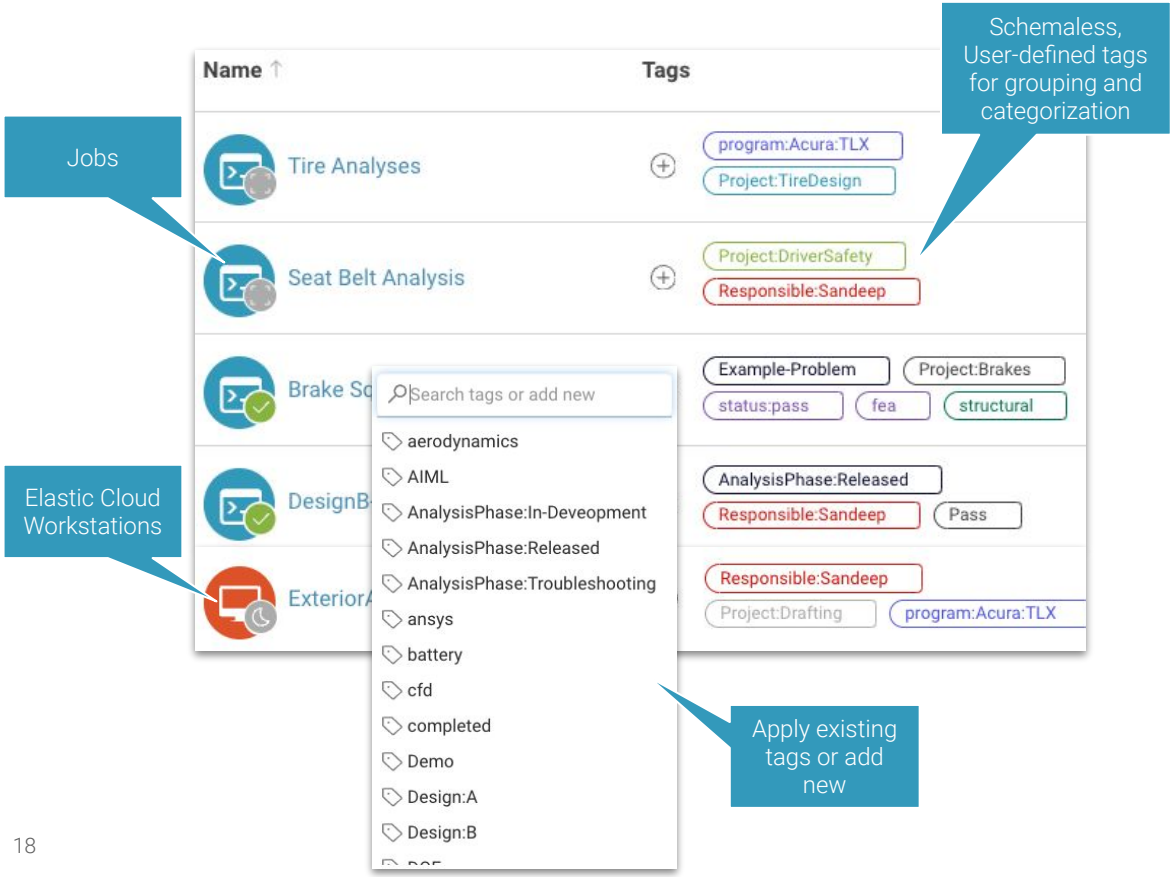


Simulation Traceability
Search and Find Simulation Jobs, Files, and Decisions



Model-Based Collaboration
Share Simulation Models and Insights

Resource Tags: Share Simulation Context Fast and Flexibly



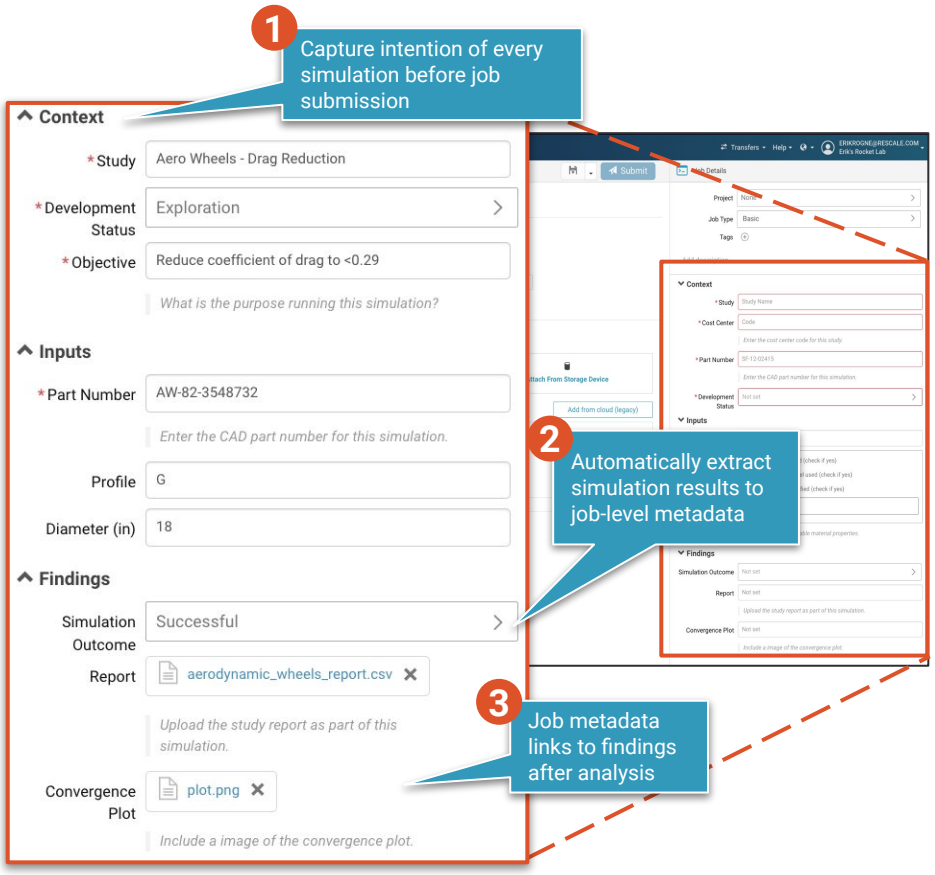
Features

- Schemaless tagging for flexible categorization
- Apply tags to Jobs, Elastic Cloud Workstations, and Files

Benefits

- Shared context on computing activities across projects and teams e.g. related studies, goal, outcome, stage
- Efficient organization of most important resources for increased visibility via search, sorting, and filtering
- Flexible schema-less format for customization and extensibility

Custom Fields: Capture Complete Details on Every Simulation



Features

- **Admin-Enforced Fields**: Ensure data consistency and governance with mandatory fields.
- **User-Defined Fields**: Enrich jobs with custom simulation parameters and results.

Benefits

- **Governance**: enforce process compliance with mandatory fields
- **Traceability**: revisit findings and decisions for audits, error detection, and revisions
- **Organization**: search by context rather than HPC data
- **Analytics**: connect various jobs and resources into a digital thread for enhanced collaboration and insight extraction

Let’s Get Started!

- Contact Rescale team
- Arrange discovery calls
- Scope out a pilot program
- Set a routine customer meeting
- Celebrate the successful pilot
- Launch it in production

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