

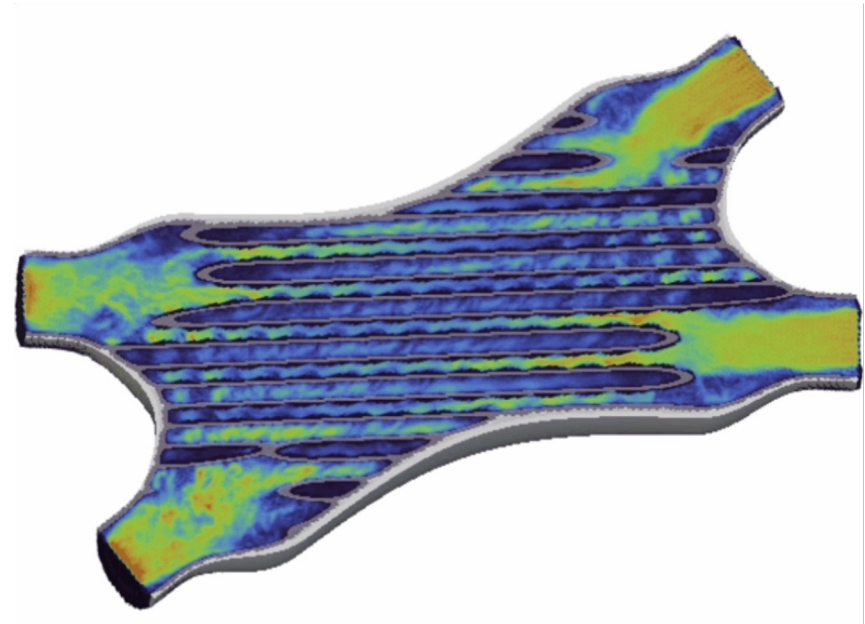


# AI-Accelerated Design & Simulation for AM

FIIF, 2025

The Future of Manufacturing: AI-Driven Design and AM Innovation

Hans Gruber, Senior Account Executive



# Who are we?



<p><b>Founded</b></p> <p>2015</p>	<p><b>Funding</b></p> <p>~\$150M</p>	<p><b>Products</b></p> <p>nTop, Automate, Core, PLM Connector</p>	<p><b>EDU</b></p> <p>&gt;1K references in academic papers since 2023</p>
<p><b>World Class Team</b></p> <p>Expertise in geometry, graphics, GPU programming</p>	<p><b>What we do</b></p> <p>We build computational design software that allows for real-time parametric modeling</p> <p><b>nTop removes barriers to optimization, lowers the cost of revision, and increases the speed of design iteration</b></p>		<p><b>Where we fit</b></p> <p>For highly-engineered designs that benefit from more iteration</p> <p>Concept through detailed design</p> <p>Complement traditional CAD/CAE systems</p>



# The pressure to deliver products to market faster has never been greater



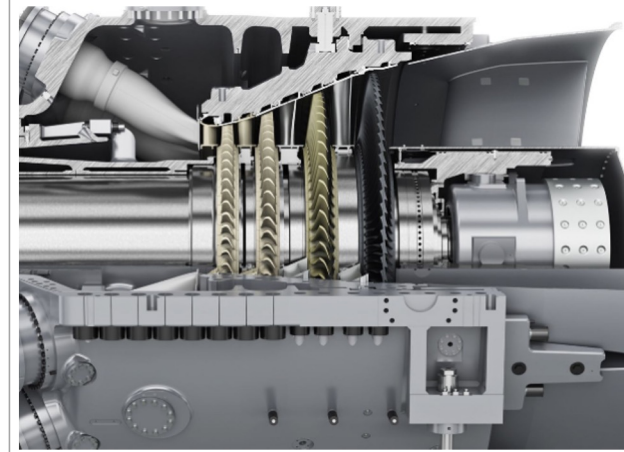
**Aero/Def**



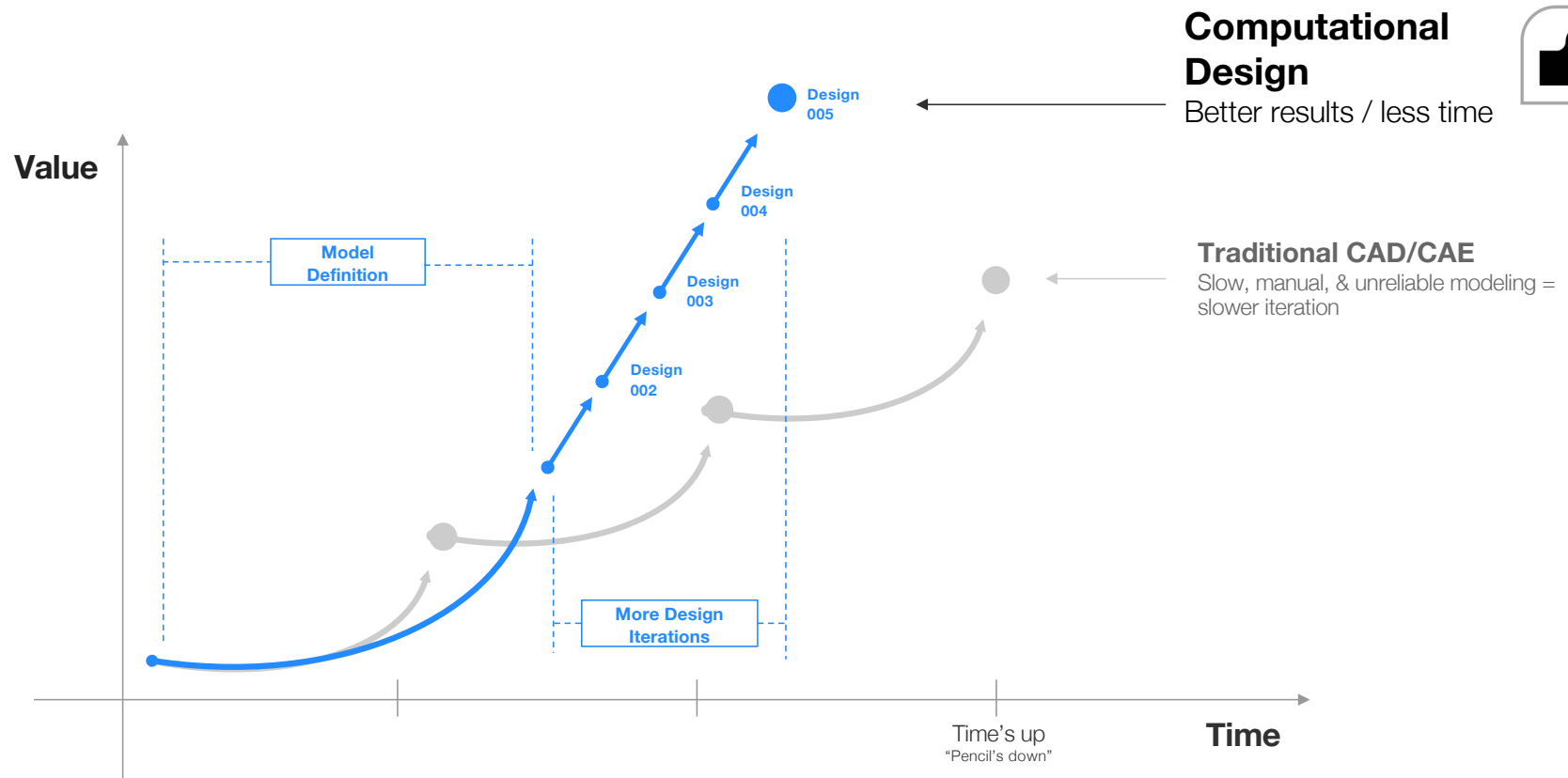
**Automotive**



**Industrial**



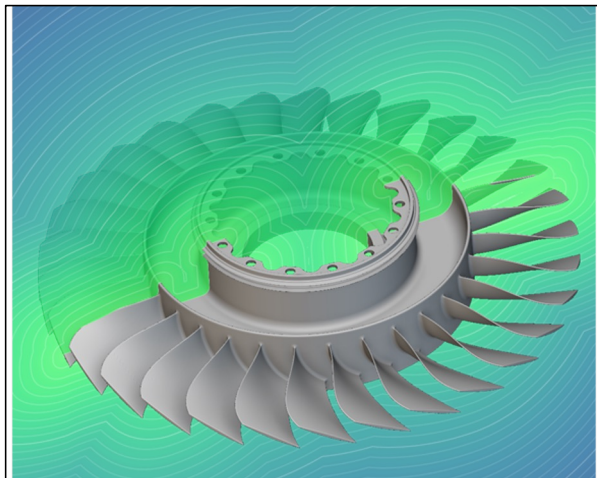
# The bottleneck: Design iteration is too slow



# nTop enabling technology

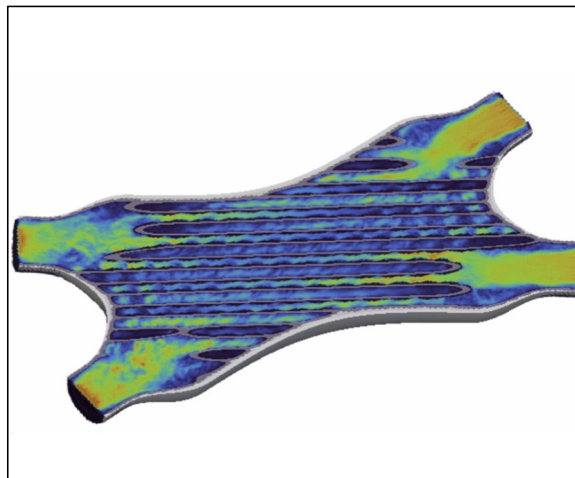


## Implicit Modeling



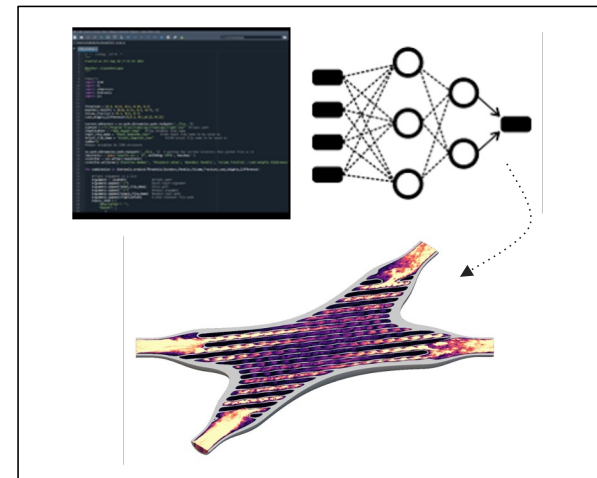
- New approach using “signed-distance fields” (not traditional B-Rep tech)
- Fast and reliable modeling, more flexible “field-driven” parameterizations
- Leverages modern compute hardware (multiprocessing and GPU)

## Accelerated Compute



- GPU / cloud / HPC hardware
- GPU-native algorithms (e.g., Lattice Boltzmann CFD)
- Scalable design space exploration and economical data generation for AI/ML

## Machine Learning

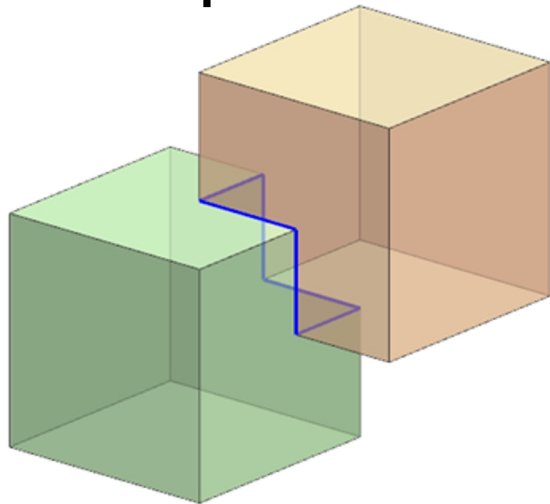


- Physics-acceleration (e.g., PINN's)
- Real-time predictions
- Differentiable (for inverse design)



# B-rep vs. implicit geometry

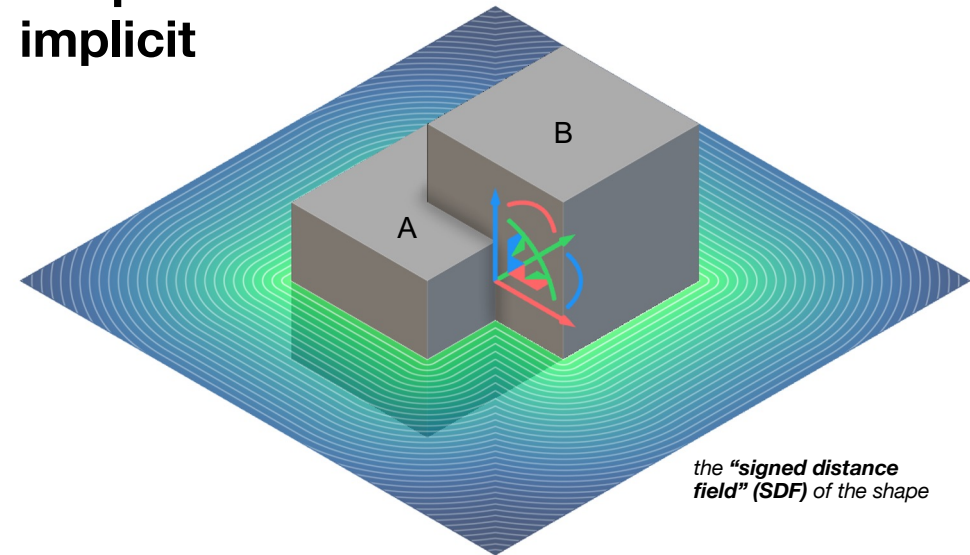
## CAD B-rep



### Union with B-rep:

- ✗ Error-prone surface-surface intersections
- ✗ Slow & fragile, explicit topology
- ✗ Not GPU friendly

## nTop implicit



the “signed distance field” (SDF) of the shape

### Union with implicit:

- ✓ union =  $\min(A, B)$  – fast and 100% reliable
- ✓ Reliable blends, offsets, etc.
- ✓ Easily parallelizable



# nTop integrated CFD

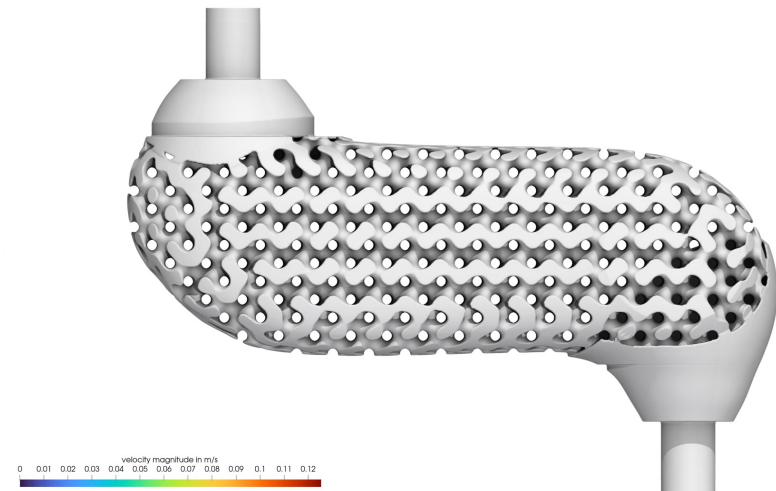
Lattice Boltzmann offers several advantages over traditional CFD solutions

**No Conformal Meshing** - Voxel meshing is used instead, which is faster and more automatable for complex geometries. Removes the meshing bottleneck.

**Highly Parallelizable** - LBM benefits from a simpler algorithmic structure that scales well on modern computing architectures, i.e. GPUs

**Superior for Transient Flows** - LBM naturally handles unsteady flows more efficiently than traditional CFD. This is particularly beneficial for flow instabilities and aeroacoustics.

**Turbulence Modeling** - Traditional CFD uses empirical turbulence models, which fail for complex turbulent flows. LBM naturally simulates low-to-moderate turbulence via Large Eddy Simulation (LES).

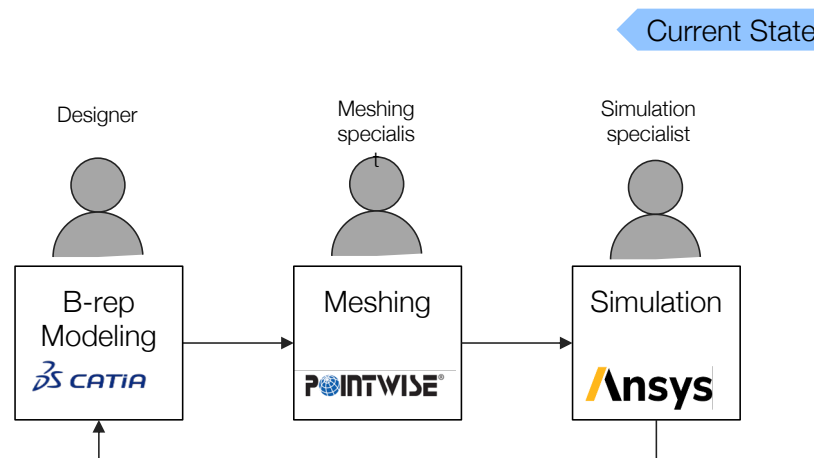






# Removing simulation bottlenecks

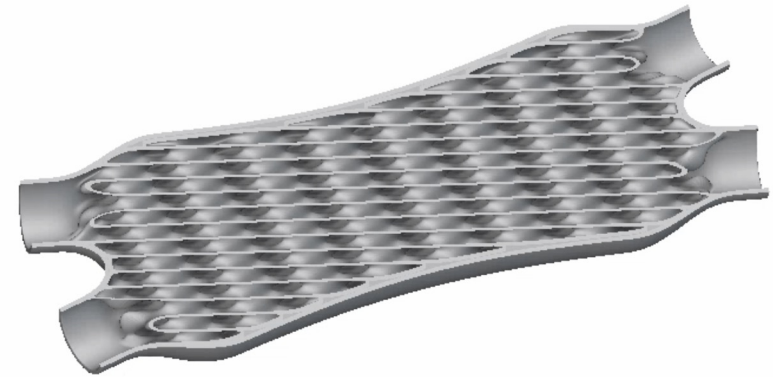
Meshing and traditional sim tools are too slow for rapid design iterations



- ✗ Manual CAD updates & b-rep failures
- ✗ Meshing failures
- ✗ Long solve times
- ✗ 3 separate apps, experts, and data transfers

**One design iteration = 2 - 4 weeks**

Future



- Real-time, geometry updates
- No meshing
- GPU accelerated fluids solver
- 1 application

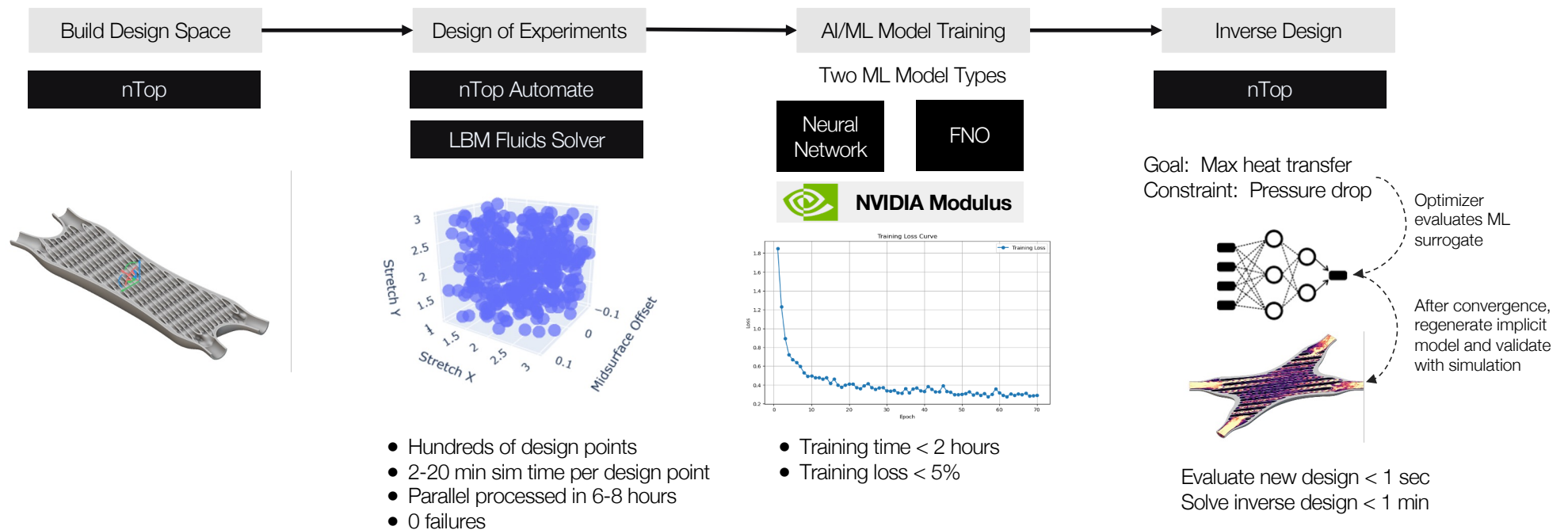
**One design iteration = 1 - 30 minutes**





# Accelerating design with AI/ML

Proven success with nTop solutions & managed services

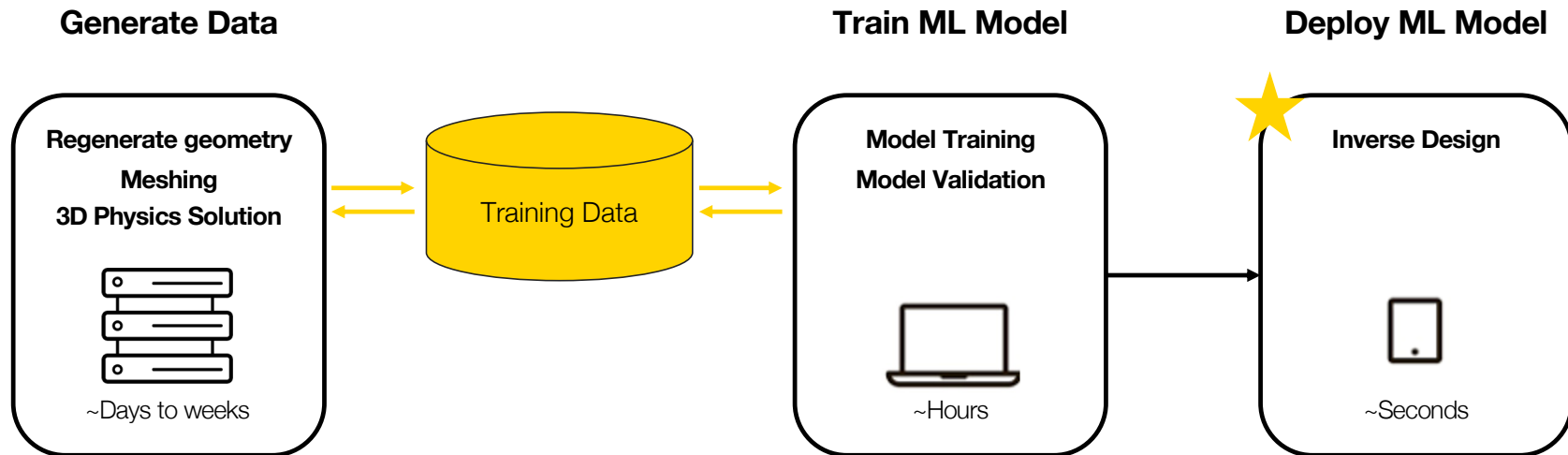






# The overlooked economics of ML

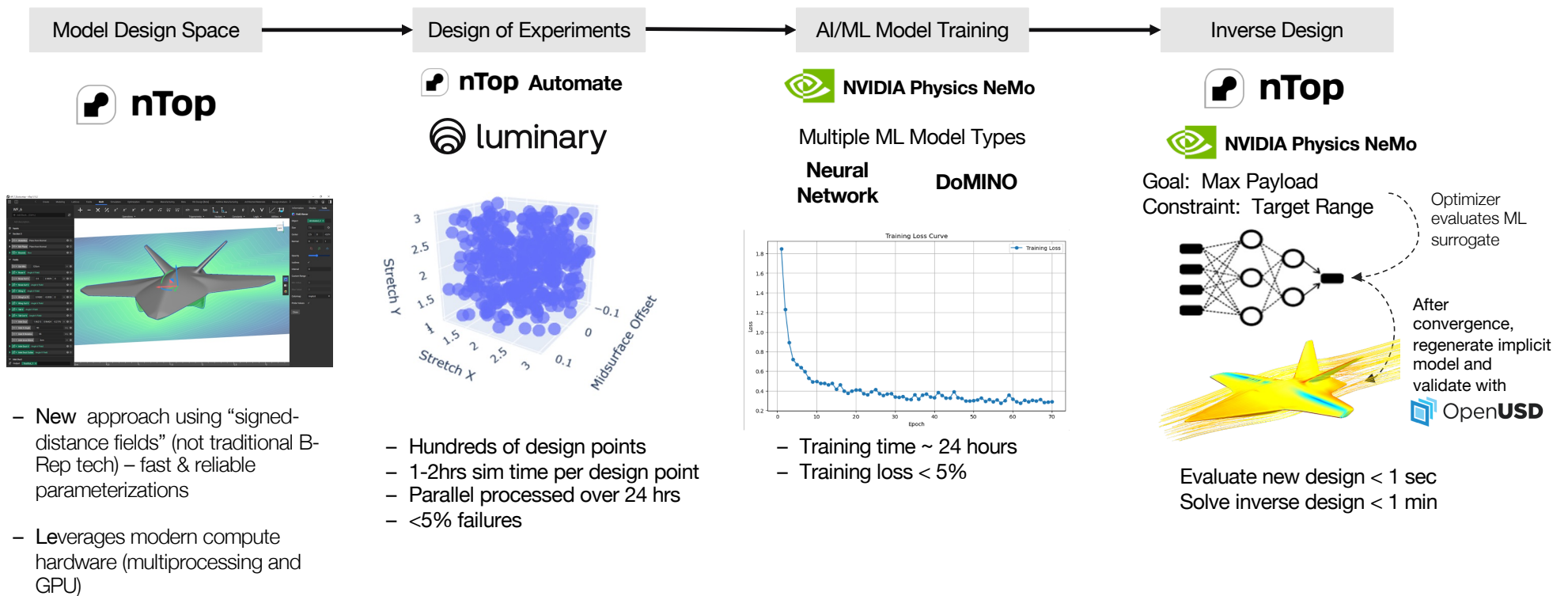
The adoption of ML to accelerate design hinges on reducing the cost of training data—an issue nTop is uniquely equipped to solve.



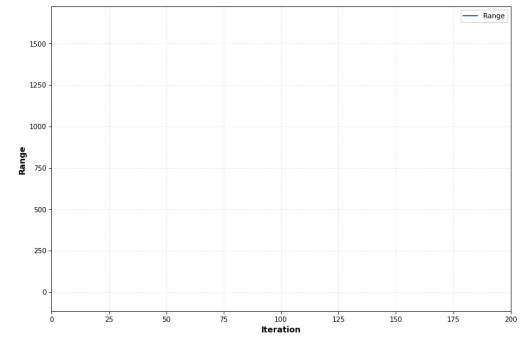
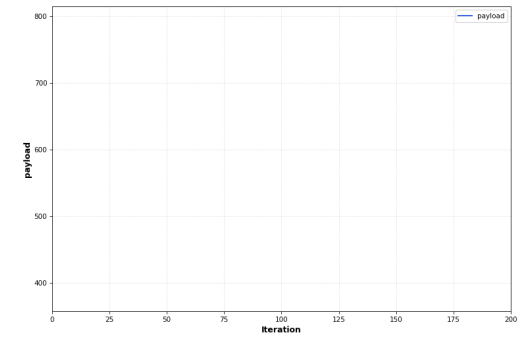
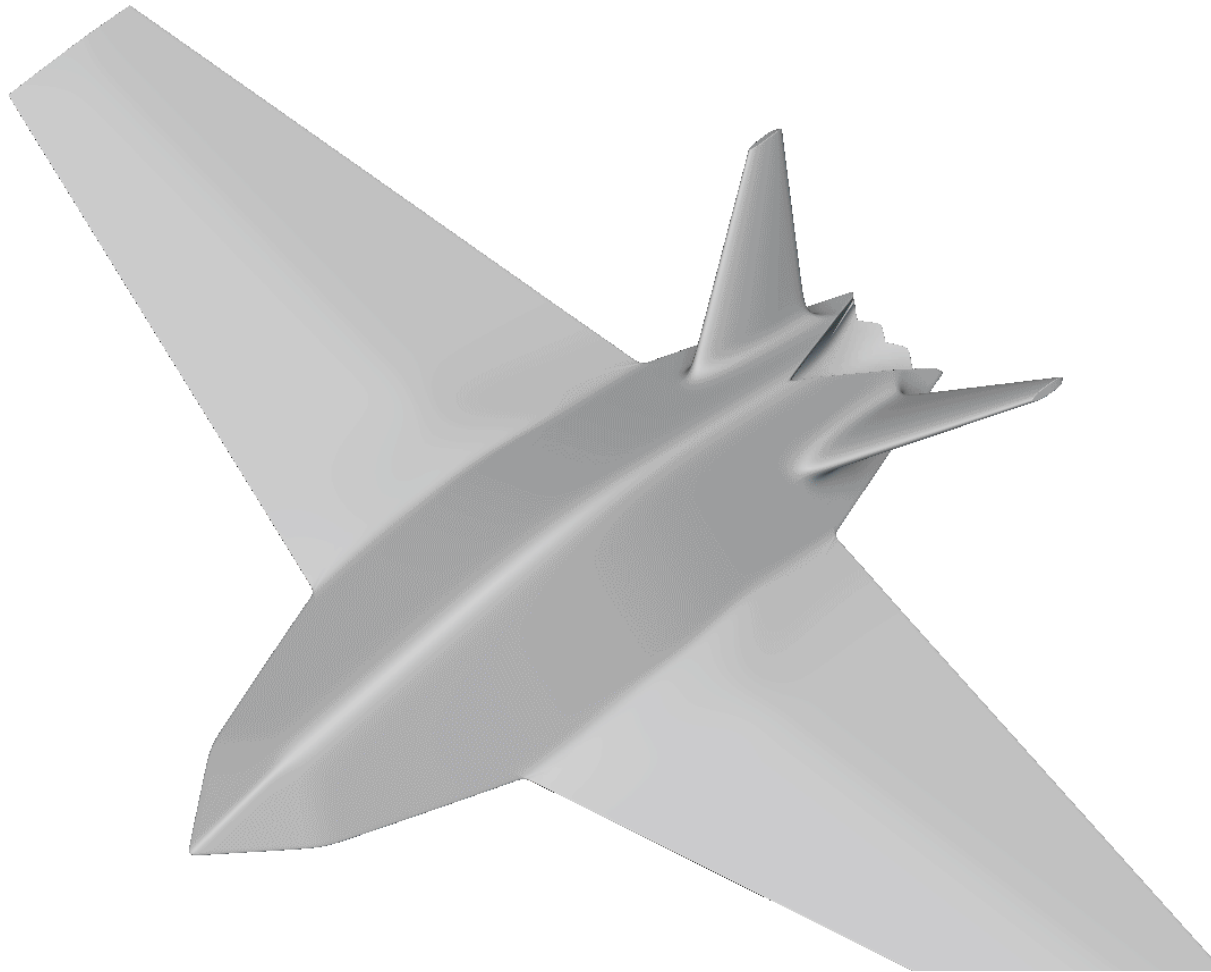
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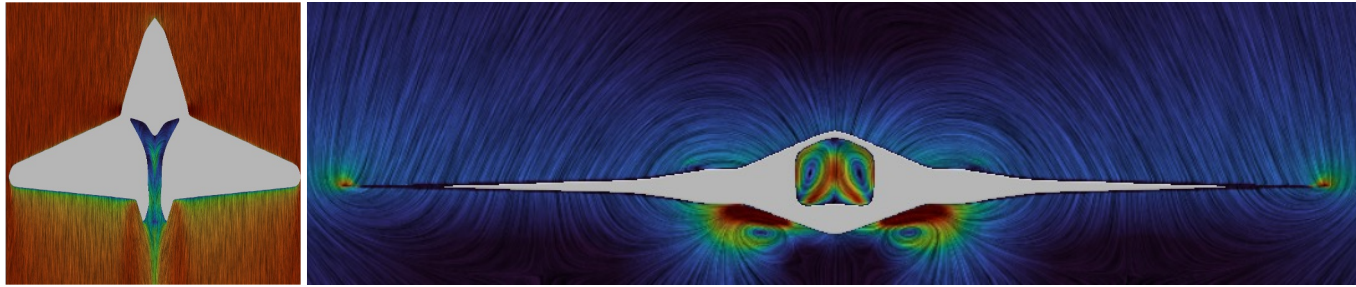
The technology used to generate simulation training data is slow, lacks robustness, and runs on compute architectures that have tapped out Moore's Law and not getting faster.

# nTop / Luminary / NVIDIA AI-accelerated design



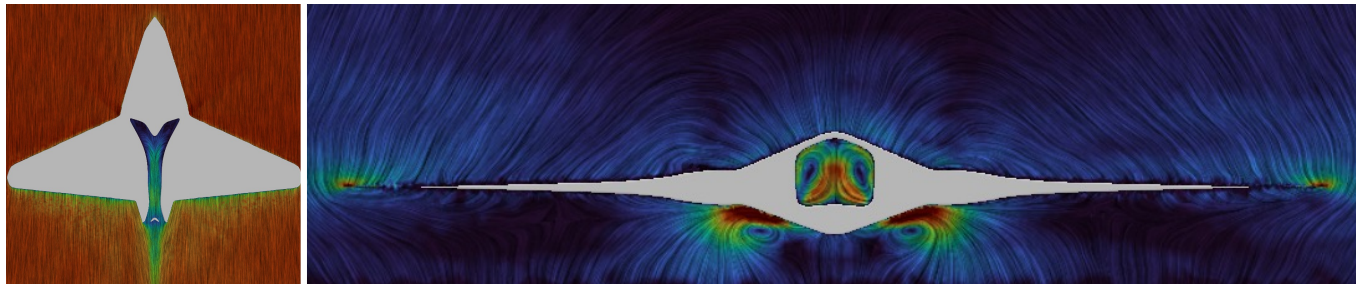
# Near real-time design optimization





 nTop +  luminary 




**~1.5hr**



 nTop +   
 NVIDIA Physics NeMo

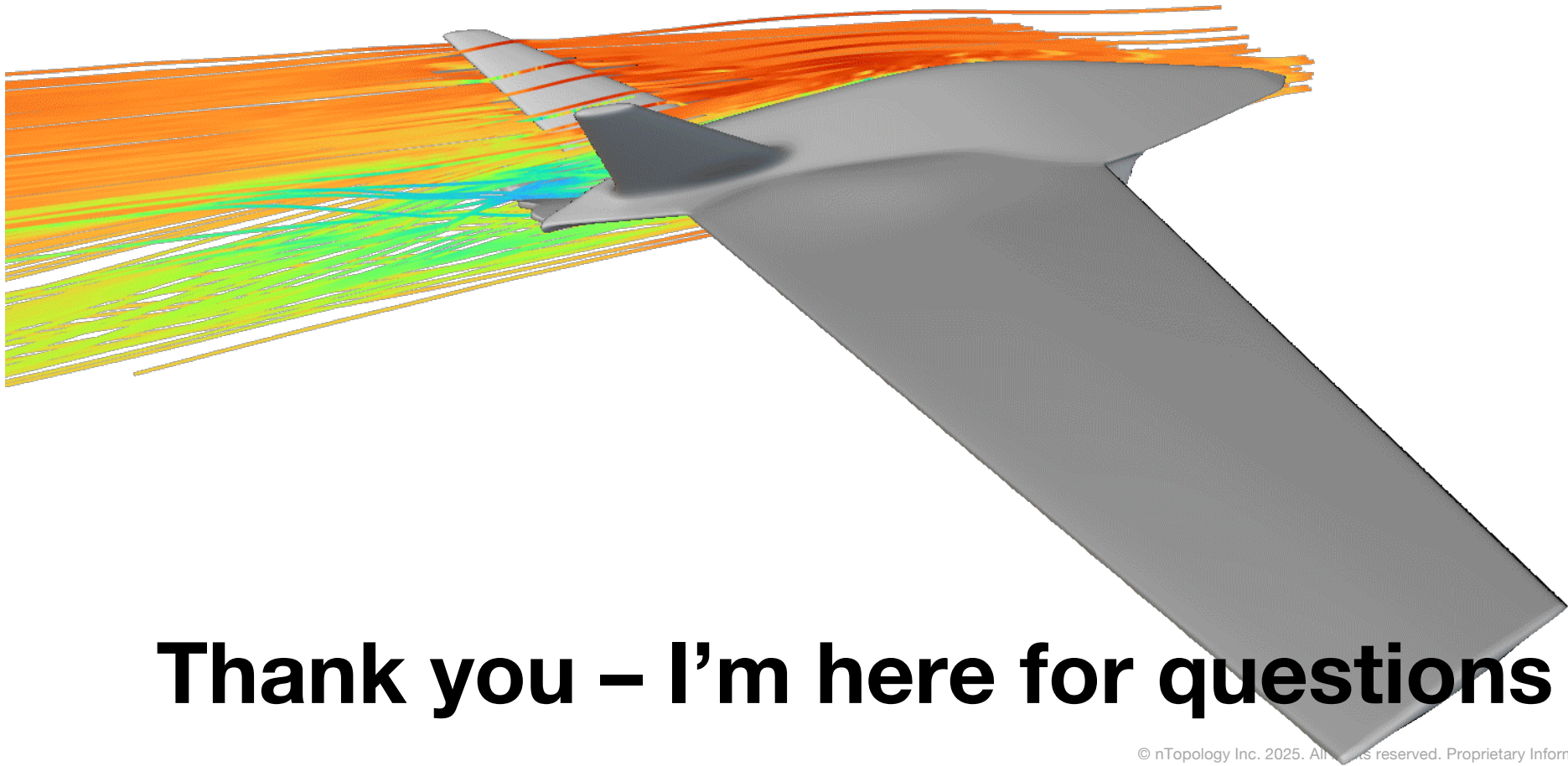
**~3 min**



 nTop +   
 NVIDIA Physics NeMo

**~5%  $\Delta$**





**Thank you – I'm here for questions**