

Engineering Design Synthesis

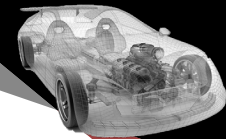
OmniQuest™ Genesis® and LIAD™ Introductions



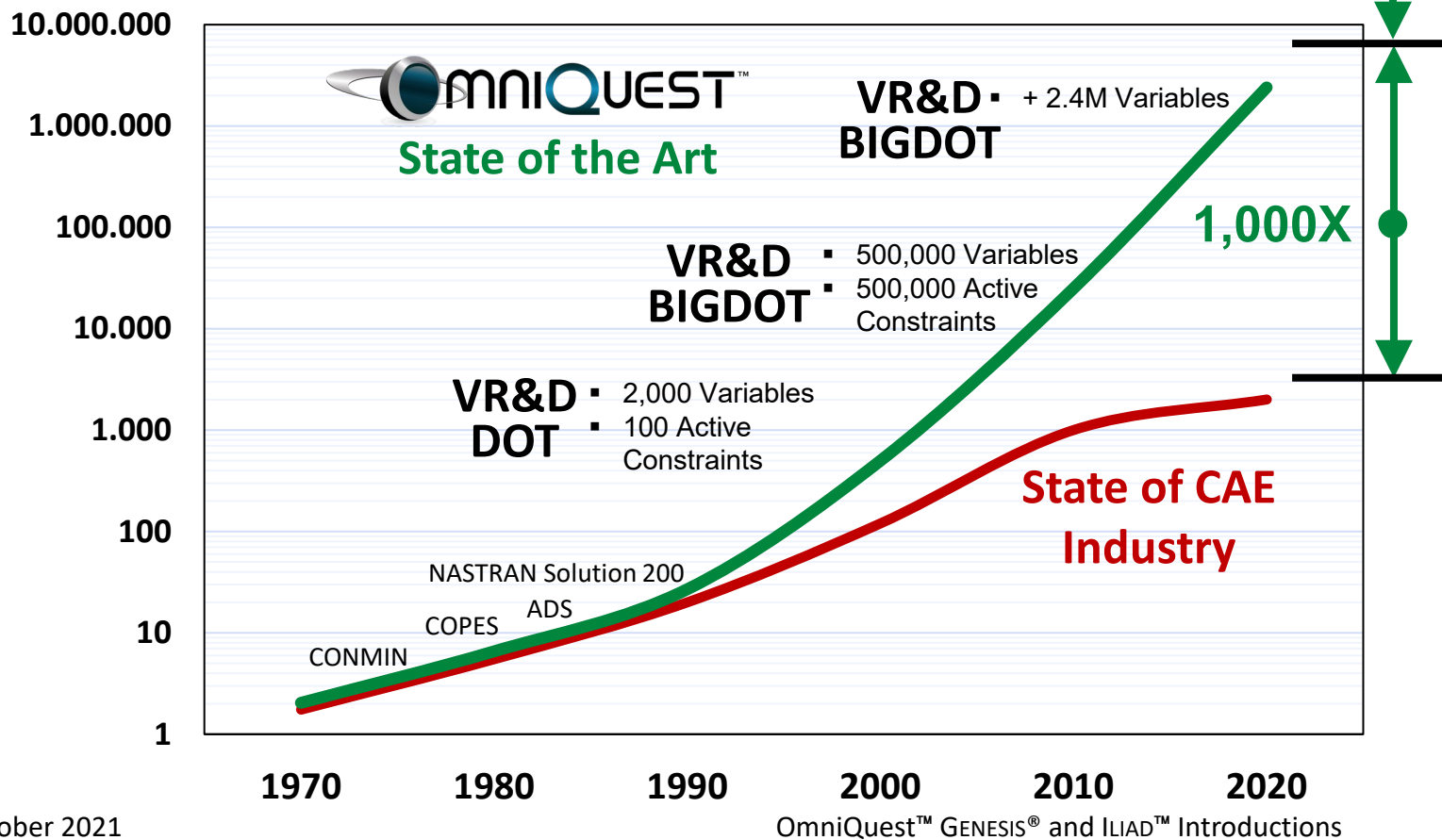
Stewart Skomra
CEO OmniQuest™
stewart.a.skomra@omniquest.world



Optimization Engine Breakthroughs



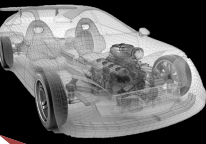
- Over **1,000 X** performance of alternatives
- Scales with advancement of Moore's Law



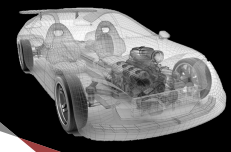
Dr. Garret N. Vanderplaats
OmniQuest Chairman & Founder

- Protégé of Dr. Lucian Schmit the Father of Structural Design Synthesis
- Pioneer in Developing & Commercializing Optimization and Extending to Multiple Fields & Domains

Dr. Vanderplaats is a Fellow of American Institute of Aeronautics & Astronautics (AIAA) and Recipient of AIAA Lifetime Achievement Award for Multidiscipline Design Optimization

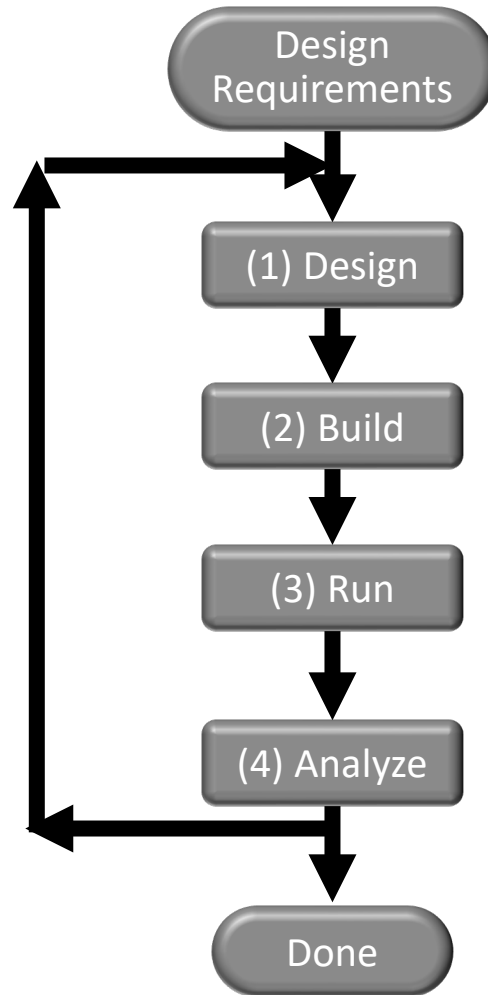


*We help engineers improve
design where complexity is
beyond human intuition*

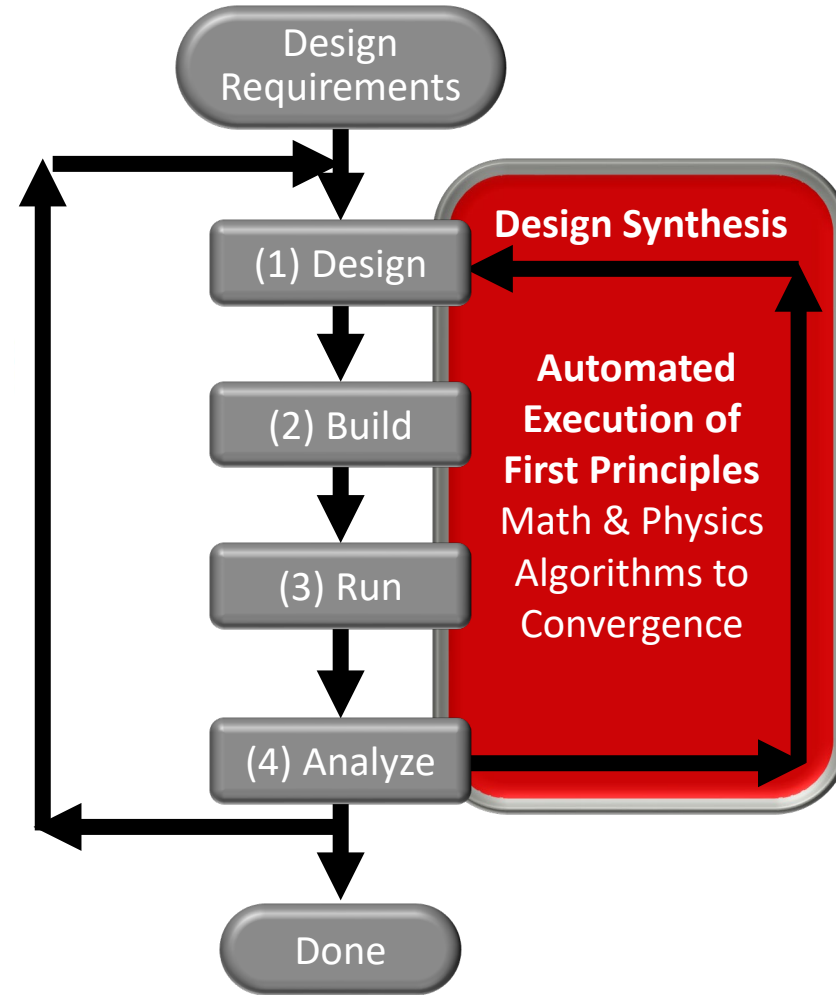


Improvement: Old vs New

Computer Aided Engineering



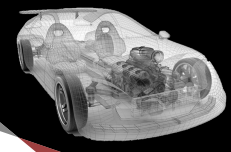
Design Synthesized Engineering



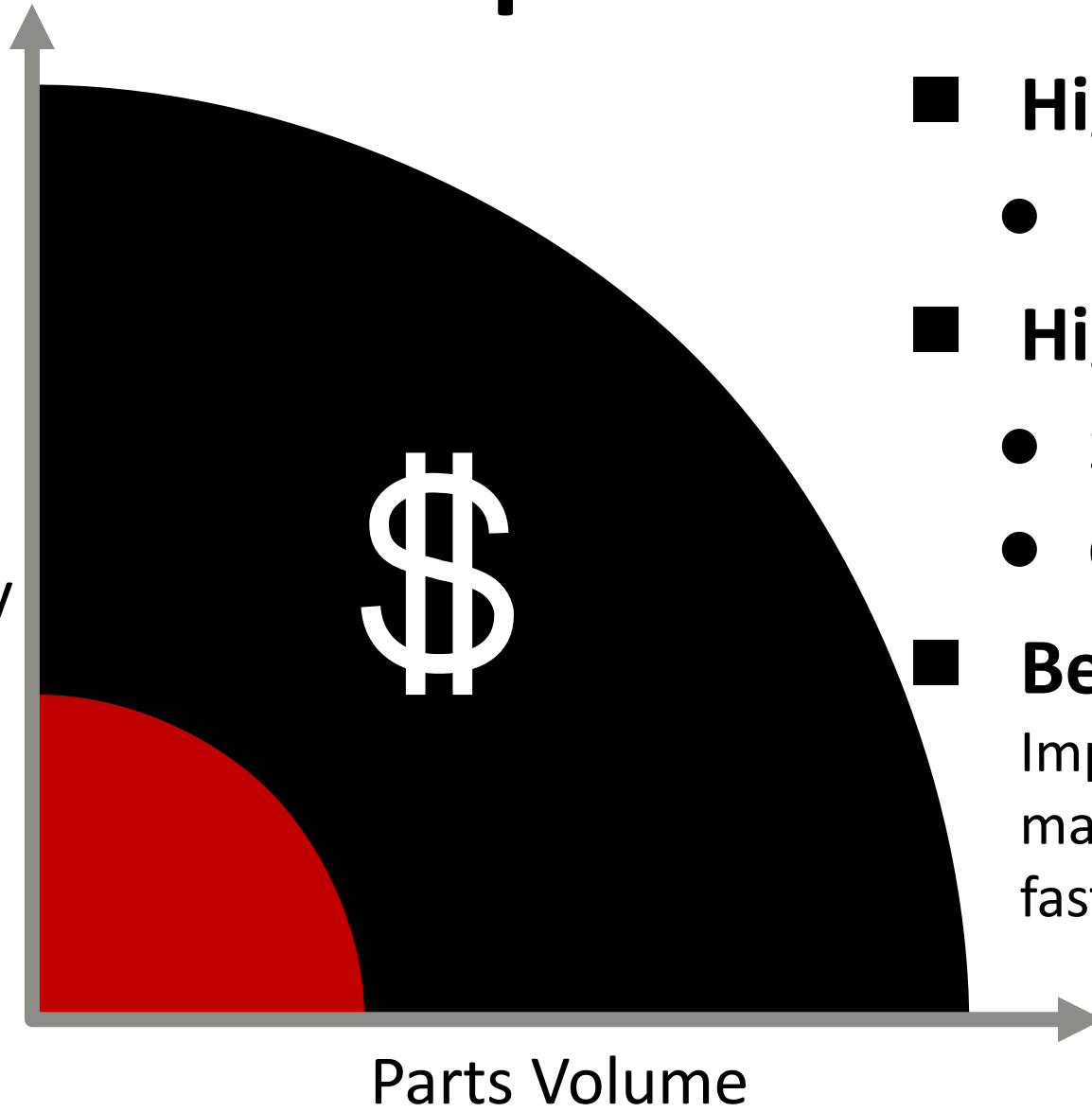
Automatically:

- Apply learning to evolve models used in running experiments
 - Test model in simulated use
 - Analyze findings from previous step and learn
- Put computer to work on tedious repetitive processes to simplify complexity

Engineers can now focus on Design Innovation!



What problem do we solve?



- **High part volume:**
 - Best at reducing cost

- **High part complexity:**
 - 26 Million Variables+
 - Optimize all modes in a single model

- **Best Results:**

Improve performance, reduce materials, maintenance cost and time, iterating faster/decreasing time to final design

Automotive Customers:



TOYOTA



TOYOTA



Transforming what's possible.



Cross-Industry, Research & Education:



Innovation by Chemistry



石川県工業試験場
Industrial Research Institute of Ishikawa



October 2021

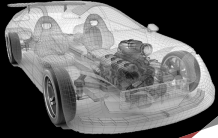
OmniQuest™ GENESIS® and ILIAD™ Introductions

Page 7

OmniQuest offerings

AUTOMATION

GENESIS®
Version 2022



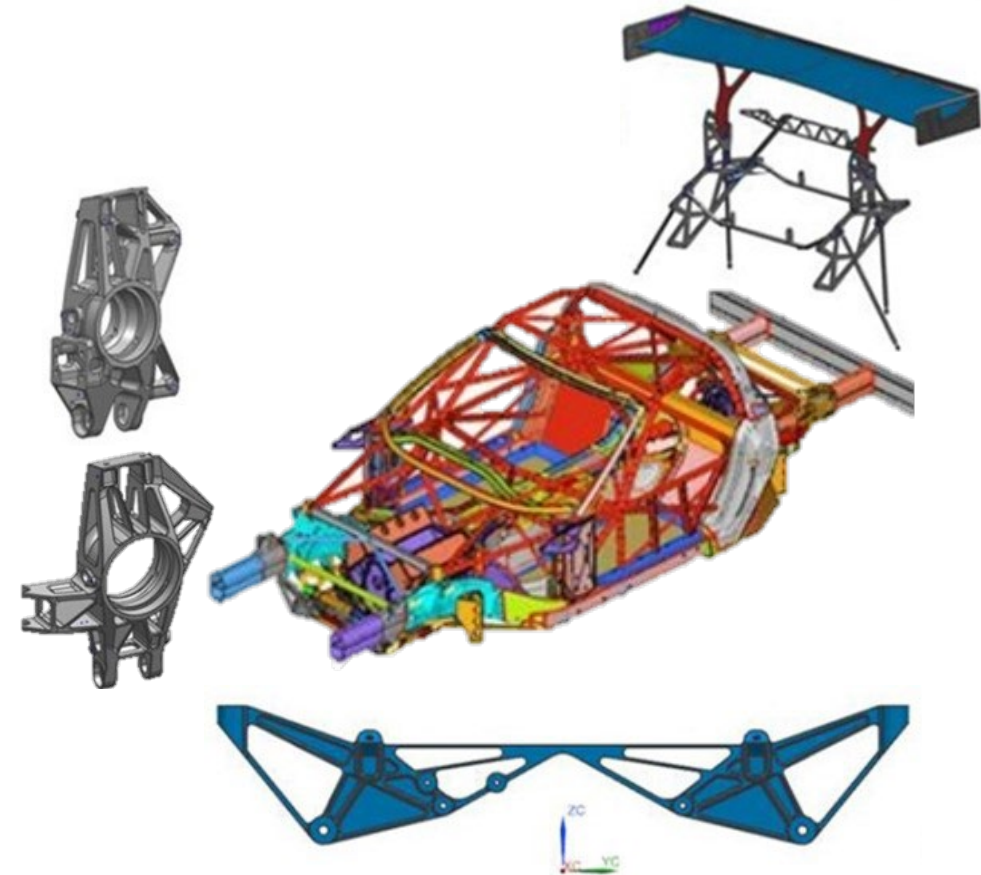
Results: Pratt Miller Corvette Racing



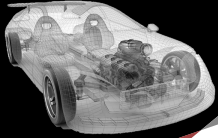
Transforming what's possible.

■ OmniQuest™ C7 Outcomes:

- Torsional Rigidity = +50%
- Full Car Weight \approx - 65 pounds
 - ✓ Front Suspension \approx -10 pounds
 - ✓ Rear Suspension \approx - 6 pounds
 - ✓ Structural Chassis \approx - 50 pounds

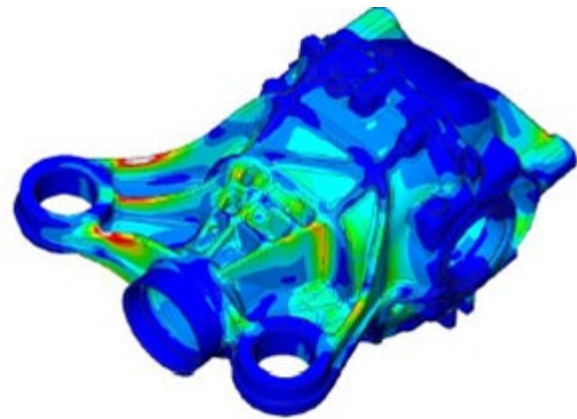


5 x Win = Stronger + Lighter + Safer + Faster + Sooner!



Results: Jaguar Land Rover

Bearing Reaction Loads



Optimized Mass



Ultra Light-Weight



Final Design



Weight Reduction

32%

Mass Reduced By

1.5kg

Load Conditions

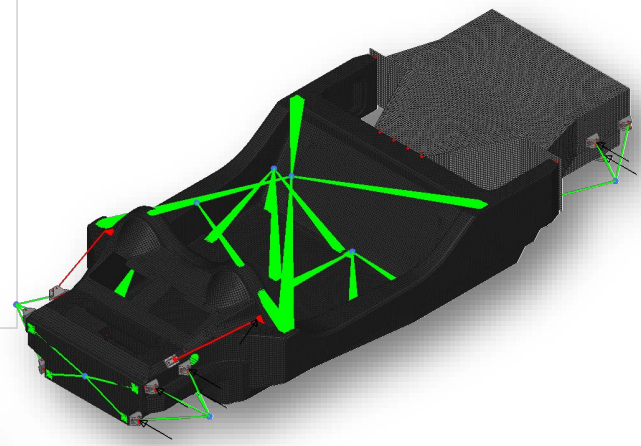
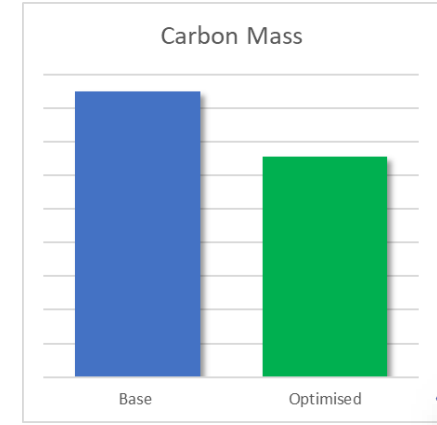
15



Results: Italian HyperCar

Composite Monocoque Laminate Development through Optimisation

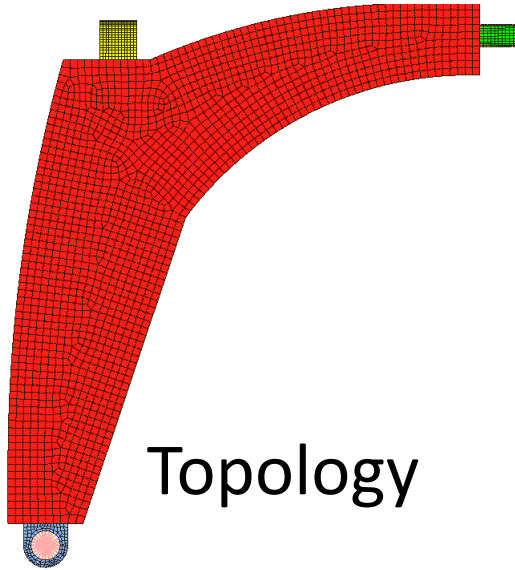
- Existing Genesis OEM customer
- Engaged workflow of:
 - Free Topometry to understand optimal material layouts
 - User-Topometry to incorporate manufacturing rules for their specific composite manufacturing processes
- Primary objective to deliver mass saving whilst meeting performance targets



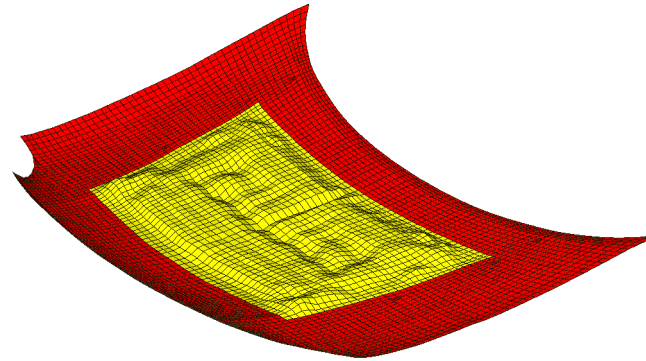
Composite material mass saving of 39kg achieved (23%)



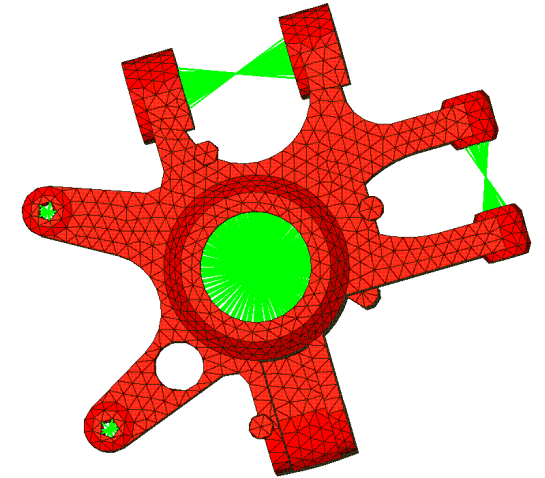
GENESIS Structural Optimization Types



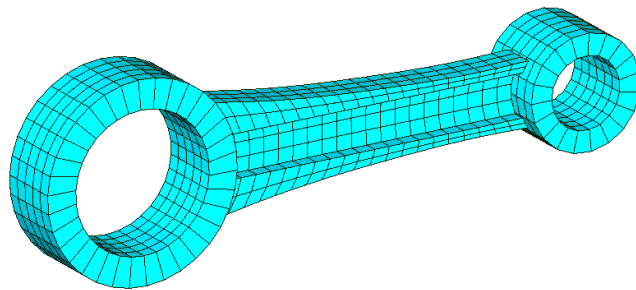
Topology



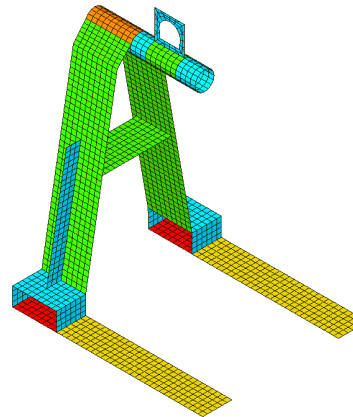
Topography



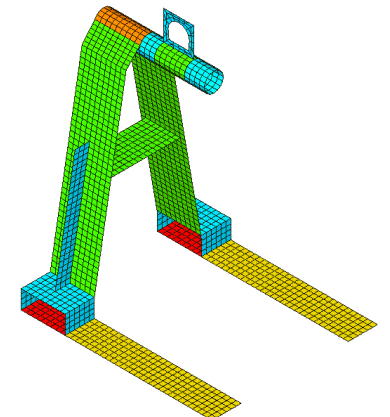
Shape



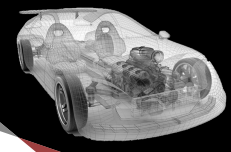
Freeform



Sizing

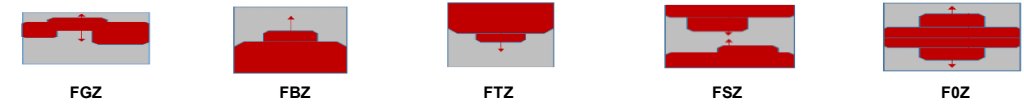


Topometry

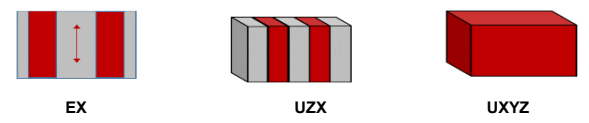


Manufacturing Constraints

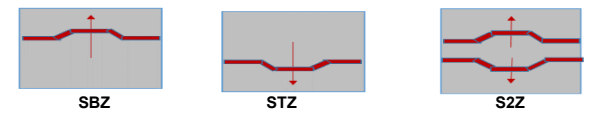
Casting



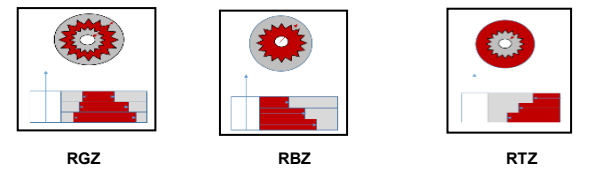
Extrusion (Uniforms)



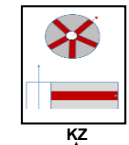
Stamping



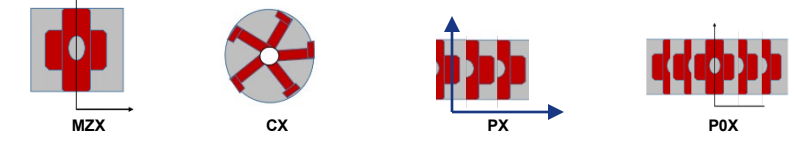
Radial Filling



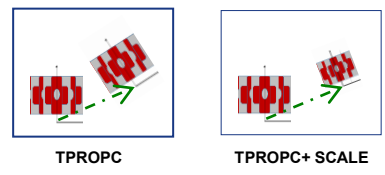
Radial Spokes



Mirror, Cyclic and Periodic Symmetry



Cloning and Cloning Scaling





ANSYS[®] Mechanical GENESIS[®] Enhancements



Outline:

- Remote Force
- Remote Displacement
- Remote Displacement 2
- Solution (A6)
 - Solution Information
 - Total Deformation
- Static Structural 2 (B5)
 - Analysis Settings
 - Remote Force
 - Remote Displacement
 - Remote Displacement 2
 - Solution (B6)
 - Solution Information
 - Total Deformation
- GENESIS (C5)
 - Analysis Settings
 - Topology Regions
 - Topology Objectives
 - Topology Constraints
 - Topology Constraints 2
 - Solution (C6)
 - Solution Information
 - Topology Density Isosurface

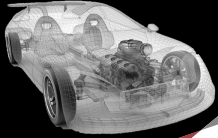
Details of "Topology Density Isosurface"

Geometry	
Scoping Method	All Bodies
Options	
Export Polarized Low Density Element Ids	No
Definition	
By	Time
<input type="checkbox"/> Display Time	Last
Results	
<input type="checkbox"/> Minimum	0.
<input type="checkbox"/> Maximum	1.
Minimum Occurs On	1
Maximum Occurs On	2

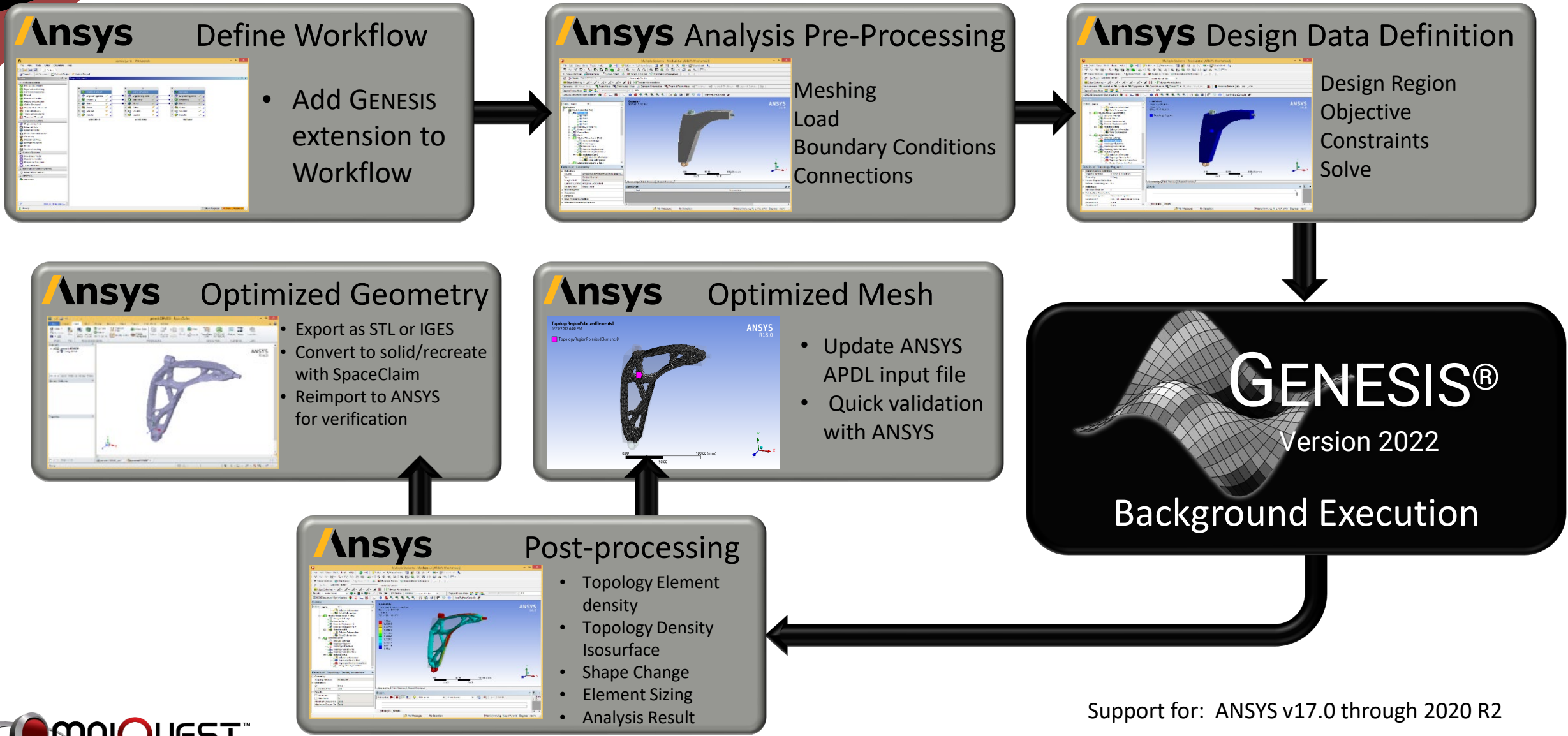
Graph: Animation | 20 Frames | 2 Sec (Autc) | 3 Cycles

Time (s)	Value
0	1.0
5	0.0
10	0.0
15	0.0
20	0.0
25	0.0
30	0.0
35	0.0
38	0.0





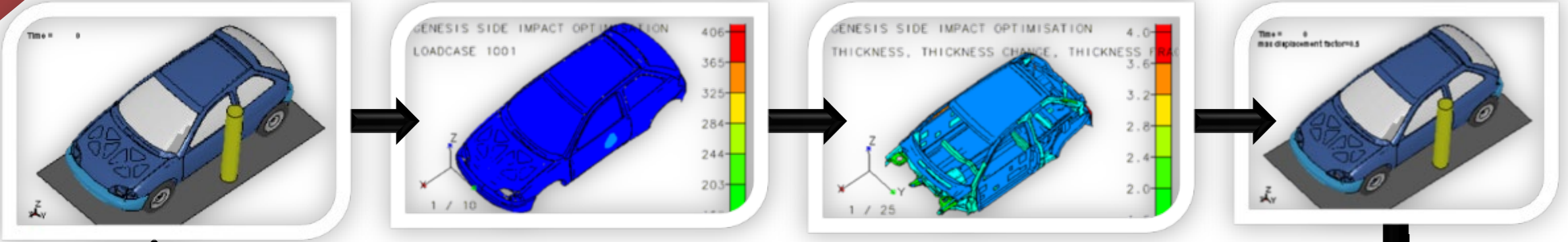
Partner Example: GENESIS Design Synthesis for Ansys



Support for: ANSYS v17.0 through 2020 R2



ANSYS LS-Dyna GENESIS® Enhancements



Baseline
Non-Linear
Model

GENESIS®
Version 2022
Model Interpretation

GENESIS®
Version 2022
Optimization

Updated
Non-Linear
Solution

Rapid optimization convergence showcases LS-Dyna power

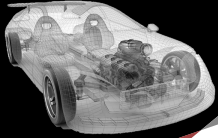
OmniQuest offerings

AUTOMATION

Process

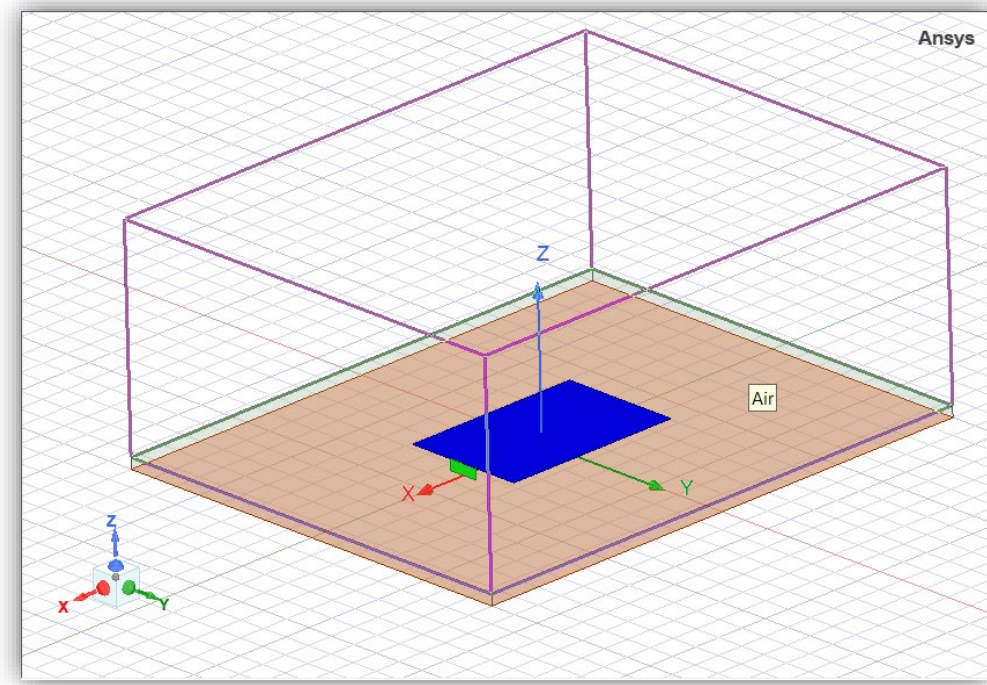
ILIAD™
Version 2021

GENESIS®
Version 2022



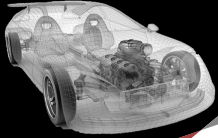
ILIAD™ Antenna Design Improvement

- **Case Study 1:**
Maximize Total Gain
 - 100x improvement
- **Case Study 2:**
Maximize Uniformity
 - 6.5x improvement in weak direction



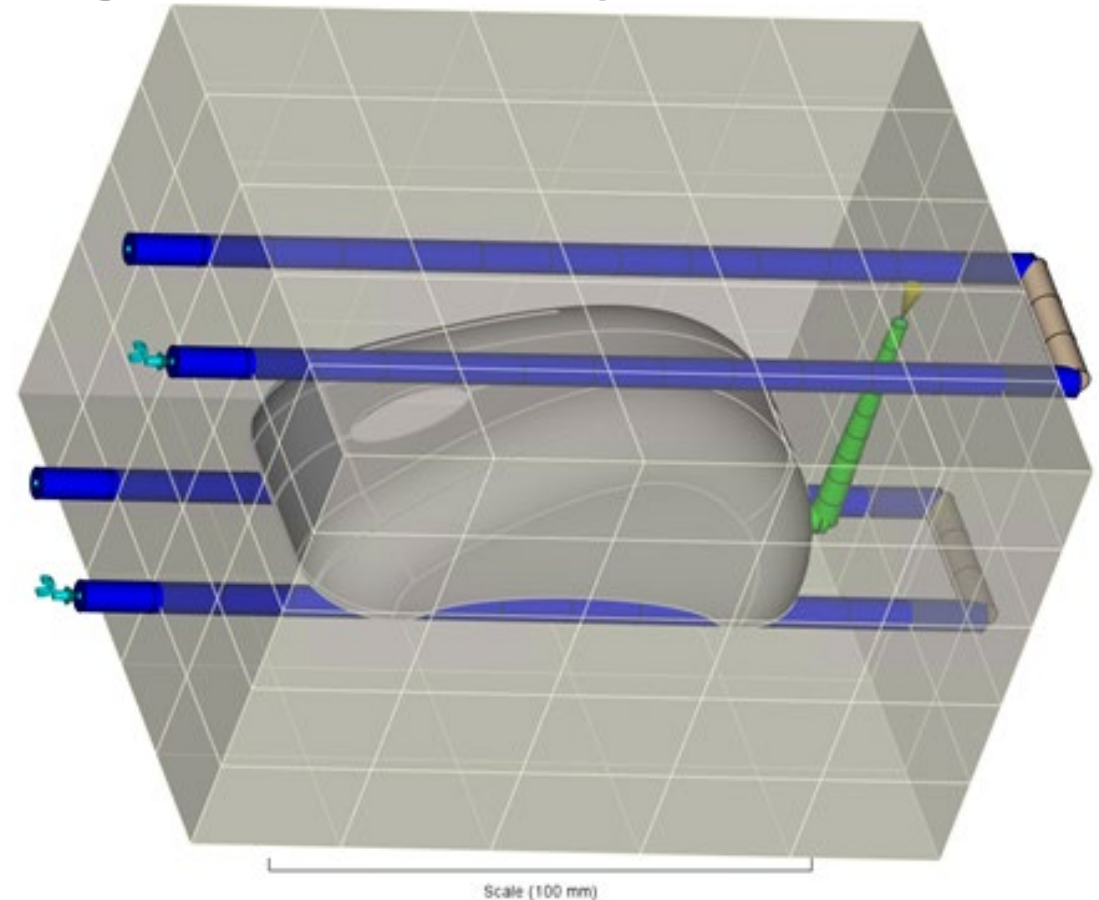
Ansys HFSS

Higher Efficiency and Versatility

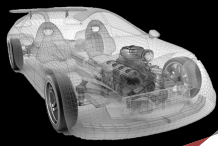


Meta Modeling Driven Optimization

- **Faster optimization by simplifying the problem**
 - Analysis time reduced by 60% using meta-modelling
 - Simpler mathematical relations deduced
 - Shrinkage reduced by 50%



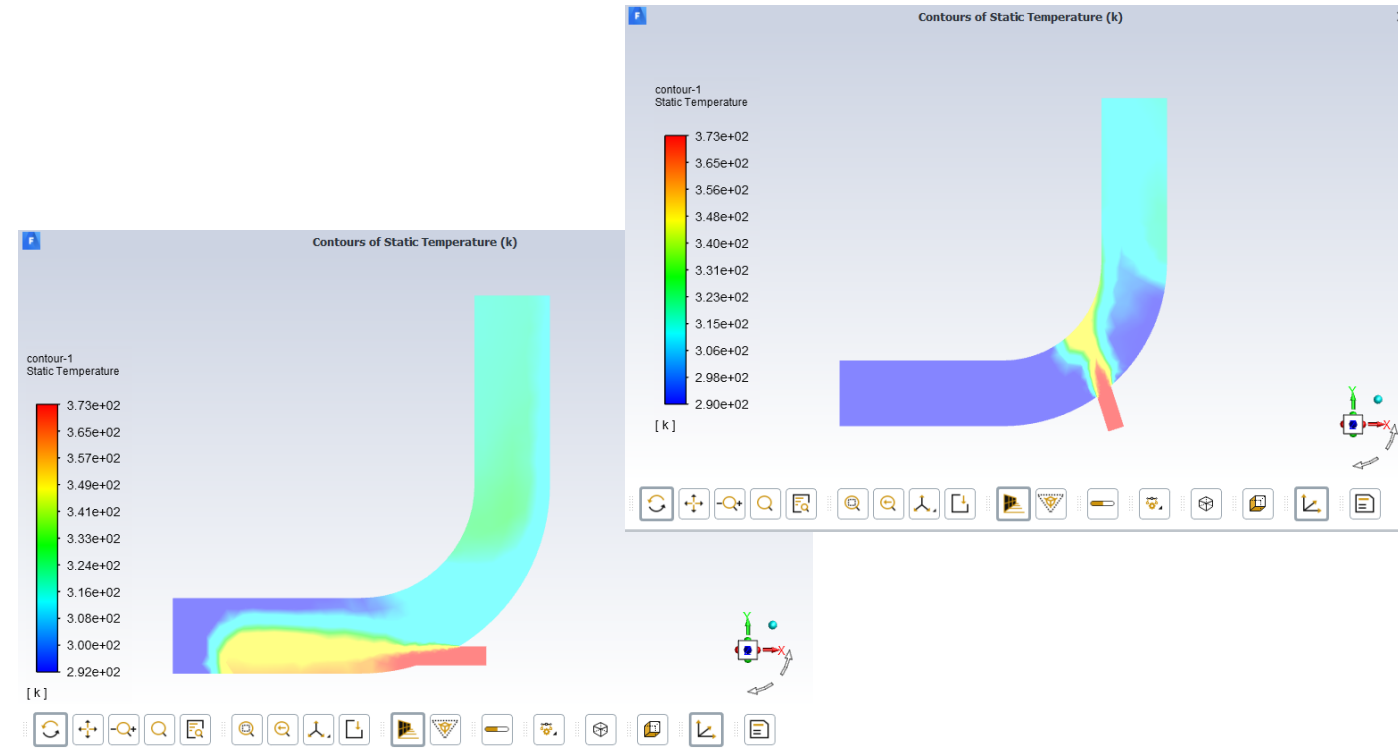
50% Reduced Shrinkage and 60% Reduction in Time



Proprietary Response Surface Optimization

■ Minimal Analysis runs

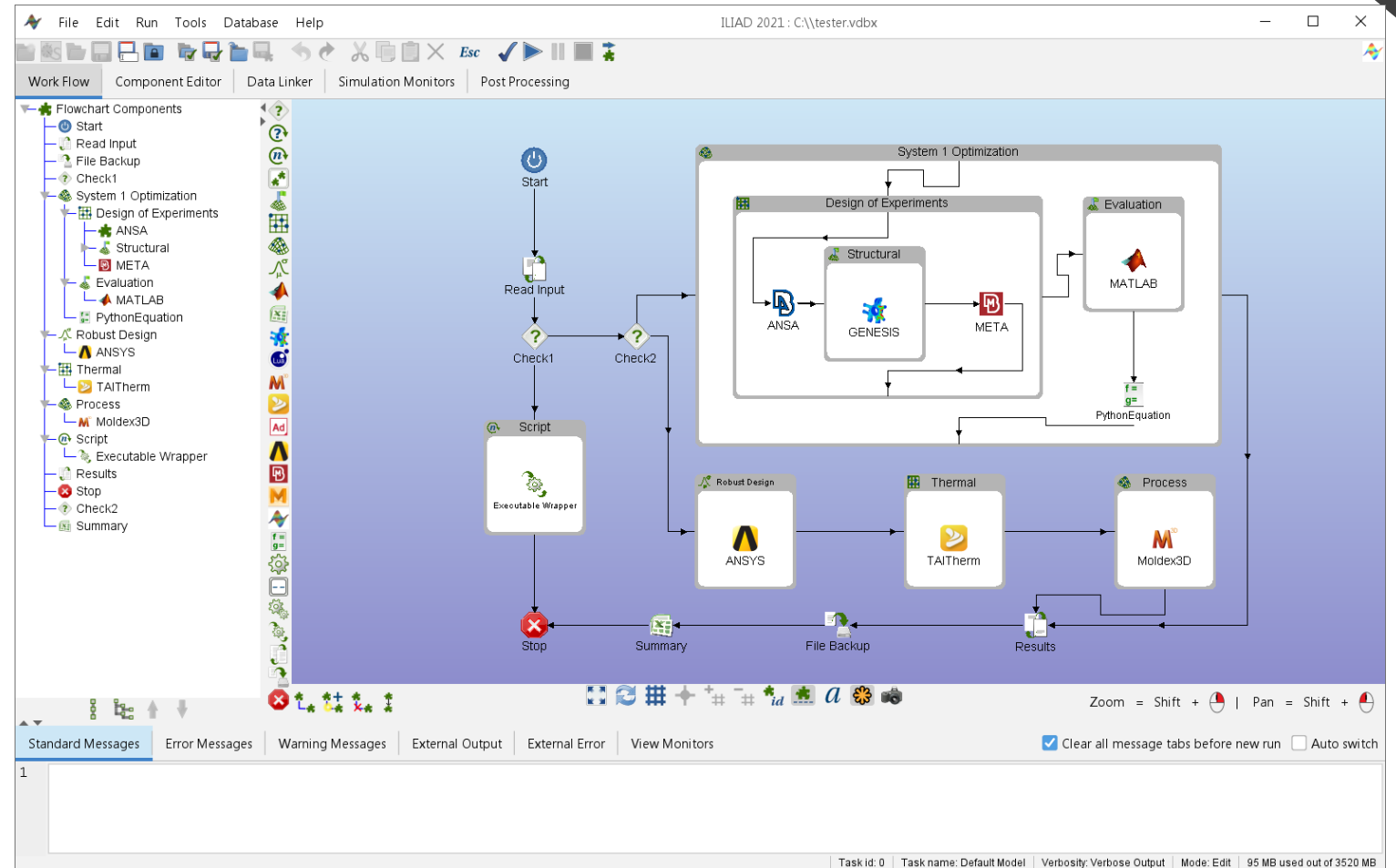
- 70% reduction in Analysis time
- Best solution guaranteed
- Uncompromised accuracy



7x Improvement in Uniform Mixing in Significant Less Time

Design Exploration Automation Studio

- Visual programming
- Drag & Drop
- Process Routing



ILIAD™ Highlights



Dedicated Interfaces

Ansys

MS Excel

Python

LUA

TAITherm

Moldex3D

MATLAB

GENESIS®

ANSA

META

Adams Car

Moldflow

Study Types

Optimization

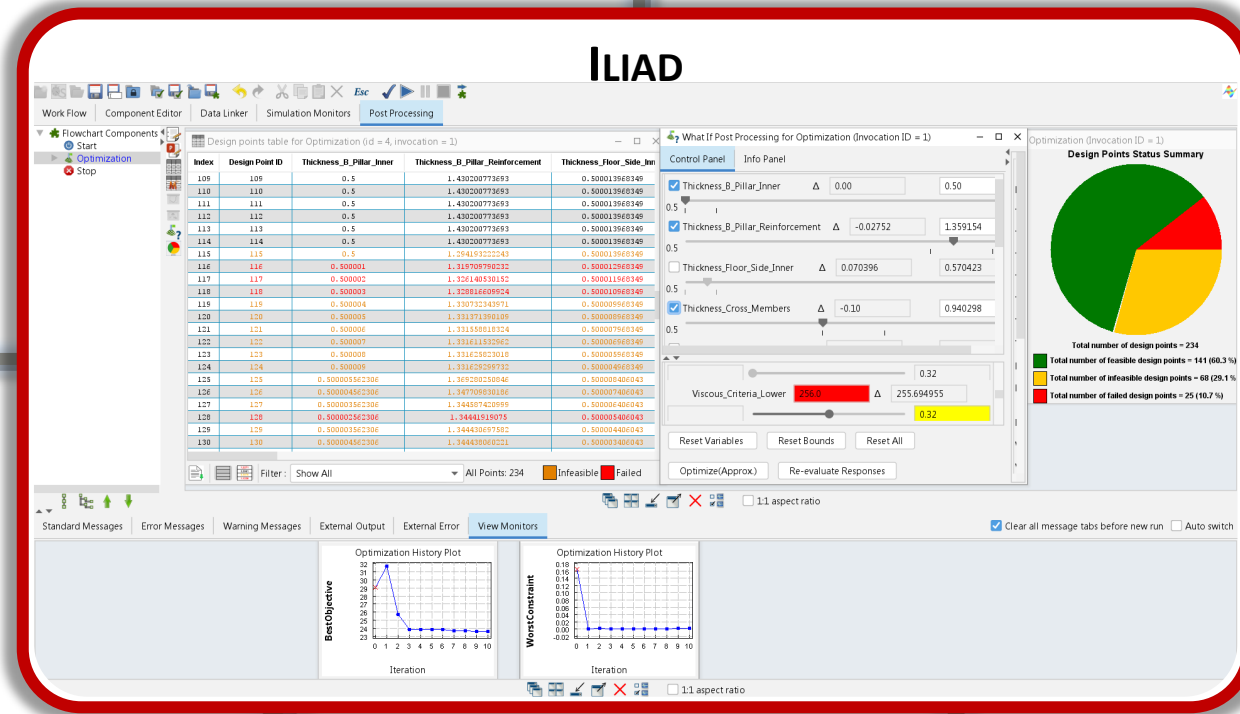
Sensitivity Analysis

Design of Experiments

Meta Modeling

Response Surface Approximation

Probabilistic Analysis



Post-Processing

Comprehensive Report

What-if? Study

Parallel Chart

Pie Chart

Powerpoint Report

Design Point Table

Response Surface

Pareto Chart

Computation Types

Parallel Run

Remote Run

Real-time Control

Loops (If/while/for)

Handling Failure

Simulation Monitors



Strengths of OmniQuest™ ILIAD™

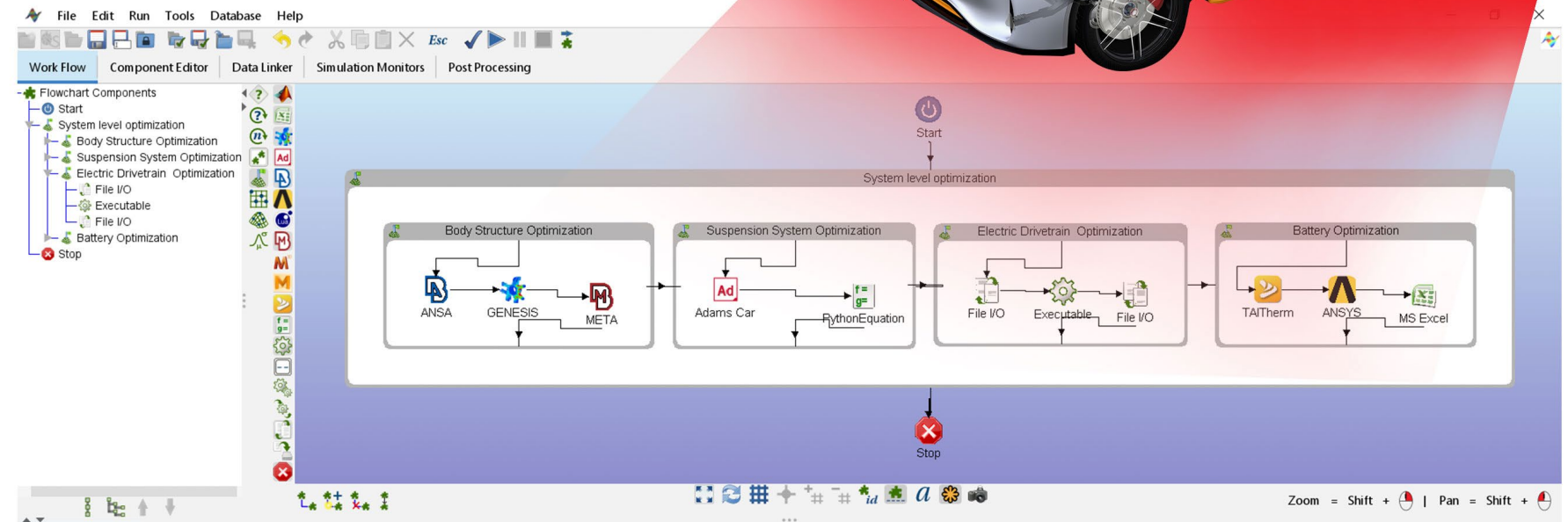
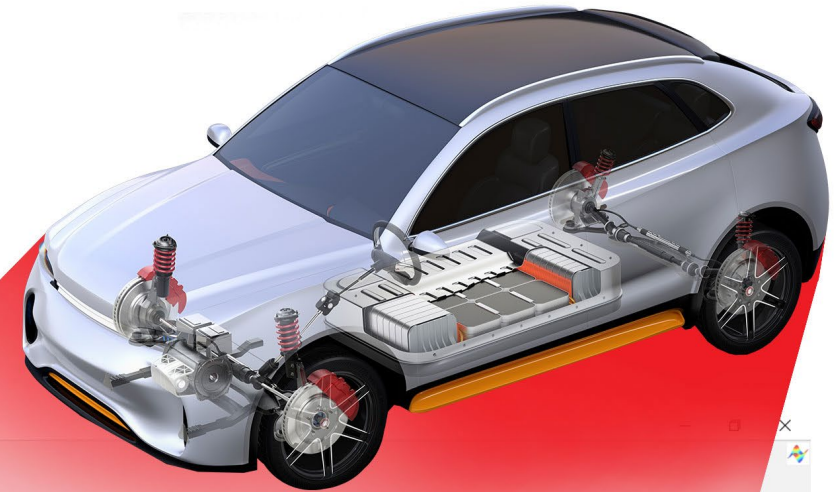
- **Applies 1,000X power technology to all fields**
 - Enables improvement through a diverse fleet of robust optimization engines
 - Delivers faster solve through proprietary meta modeling / response surface capability
 - Delivers augmented heuristics through machine learning for non-simulation data
- **Myriad constituent analyses may be integrated through a single platform**
 - Integrates anything that has an API
 - Couples with custom scripts and executables that accept text input/output
 - Automates solution improvement and design execution
- **Preserves in-house knowledge for long term success**
 - Captures the in-house procedure/protocol and heuristics in a systematic form
 - Enables easy information sharing
 - Enables quick on-boarding through wizards, tutorials and manuals





OmniQuest Immediate Future:

- Transition Engineering Product Design Synthesis Excellence to Process Design Synthesis
- Apply Product and Process Optimization to entire Electric Vehicle (EV) ecosystem
- Become Global Tool for the Supply Chain Digital Twin Baseline



Summary

- OmniQuest® GENESIS® and ILIAD™ deliver the highest-performance, most-extensible Design Synthesis capabilities in the world
- OmniQuest® Extensions to Ansys industry-leading CAE offerings deliver unparalleled performance leadership

Achieve product performance and profitability leadership
empowering your development teams with OmniQuest™





Beyond Human Intuition™

Thank You!

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Website: www.OmniQuest.world

