DRD TECHNOLOGY

Metal Additive Manufacturing Webinar #1: Simulating Laser Powder Bed Fusion (LPBF)

Kevin Adams – Senior Applications Engineer

October 23, 2024

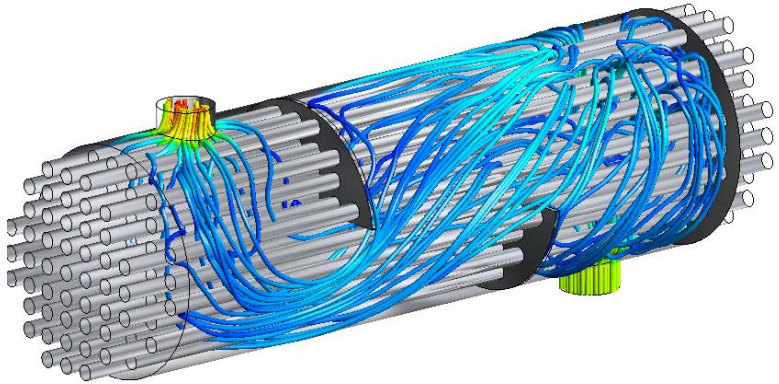
DRD

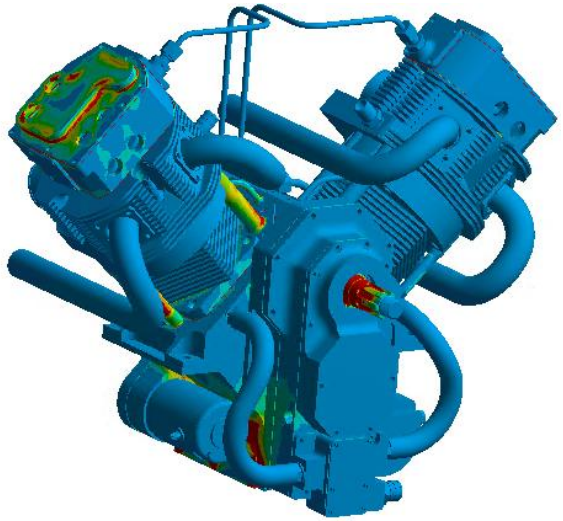
Agenda

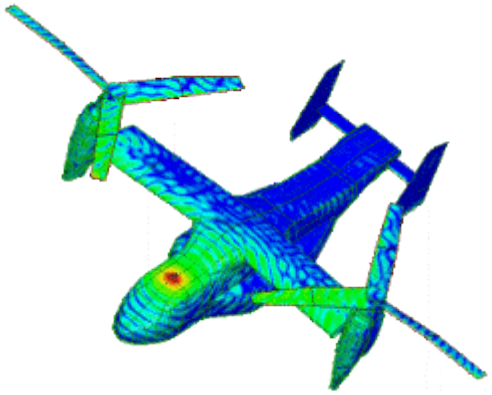
- Introduction to DRD
- Metal Additive Manufacturing Background
- Why Simulate?
- Ansys Additive Suite
- Workbench Additive Features
- Ansys Workbench Additive LPBF Demo
- Questions

Mission Statement

DRD Technology helps engineering teams accelerate product development. With in-house expertise spanning the entire range of physics, we ensure customers succeed when using Ansys simulation tools for virtual prototyping and design verification.







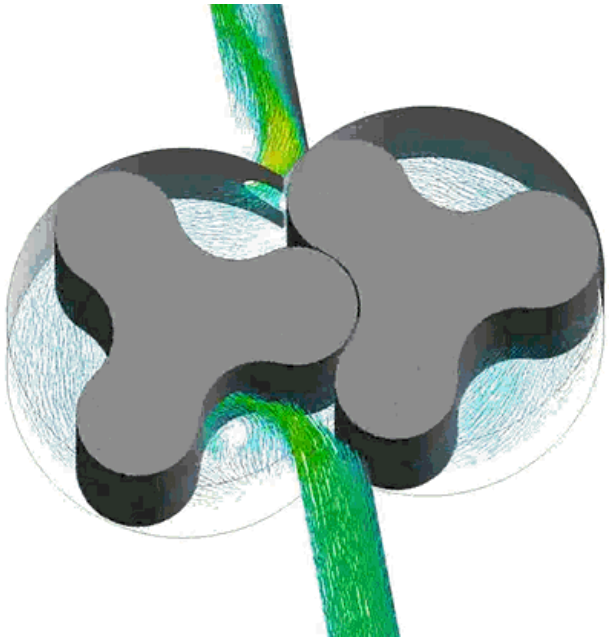
Ansys

CERTIFIED ELITE CHANNEL PARTNER

DRD History

Since 1980, DRD Technology has been focused on engineering simulation.

In 1984, DRD became an Ansys Channel Partner.



Lobe pump

I've been working with DRD for 29 years. Working with your team has been one of the more enjoyable parts of my career. You have always been ready to help in any way.

- Rick Kunc
Sr. Research & Development Engineer
SOLVAY
asking more from chemistry®

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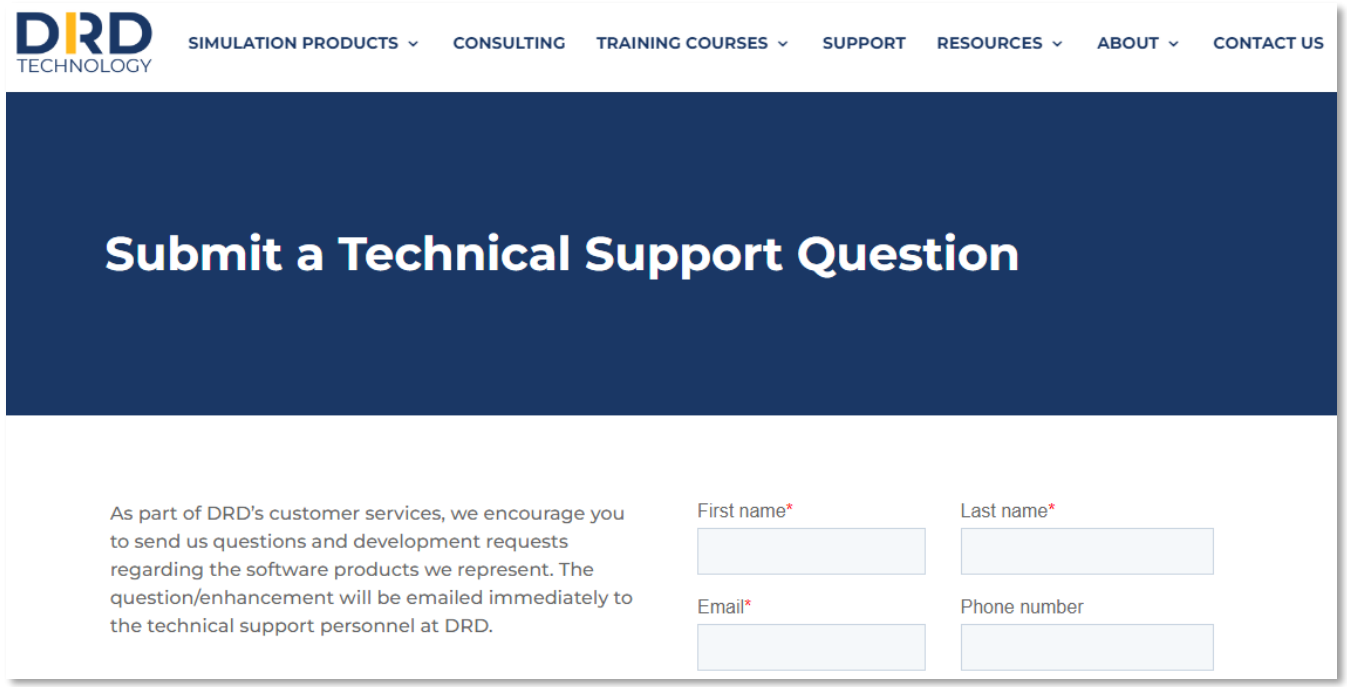
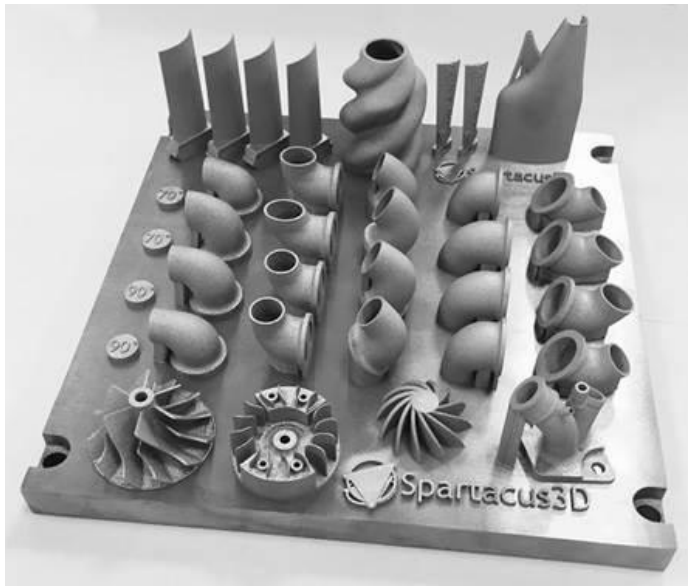


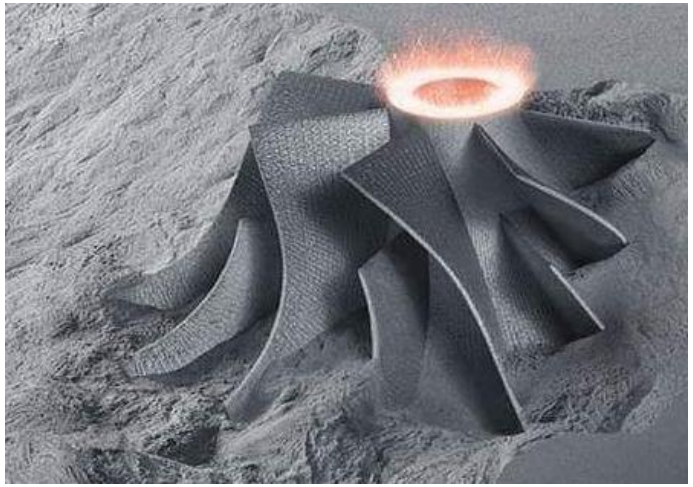
For more than five years, I have worked closely with DRD Technology to execute tactical and strategic initiatives here at EaglePicher due to our unprecedented growth. We've been very happy with DRD and will continue to work with them as our business partner for using Ansys tools effectively and efficiently.

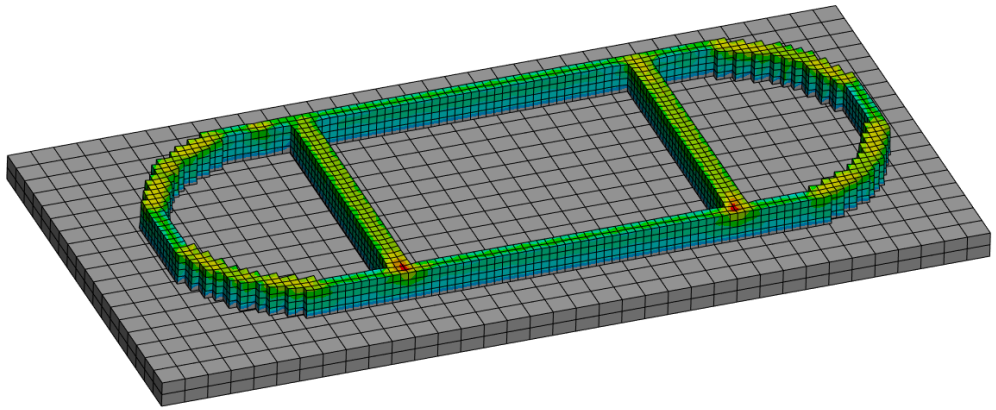
- Doug Austin
Director of Research and Development
EaglePicher™ Technologies, LLC

Metal Additive Manufacturing Background

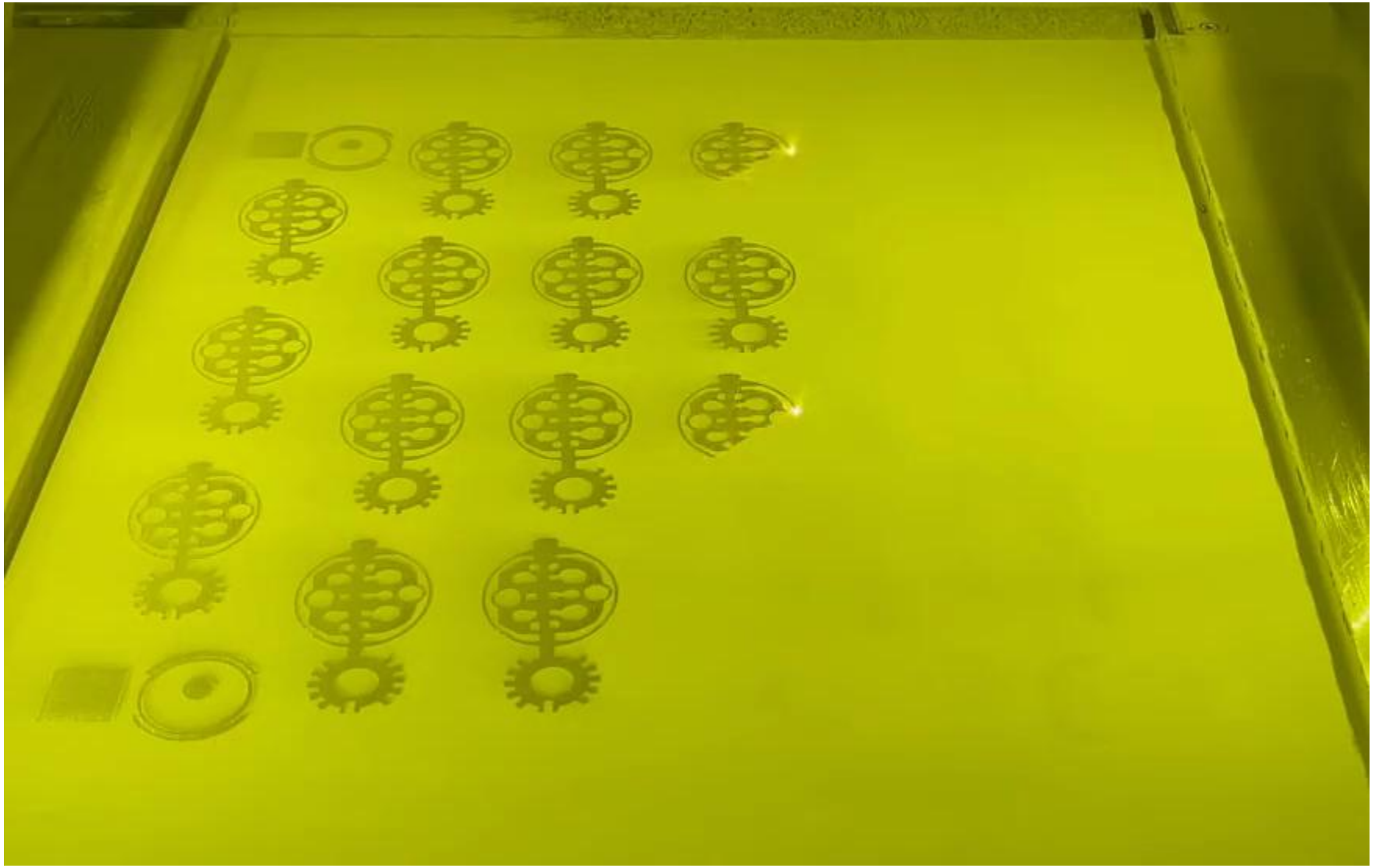
- What is metal additive manufacturing?
- Ansys simulates Laser Powder Bed Fusion (LPBF) and Directed Energy Deposition (DED) to predict:
  - Part Distortion (and compensation)
  - Residual Stresses
  - Plasticity
  - Blade Crash (LPBF)
  - Build Plate Distortion
- The DED workflow is also applicable to Additive Friction Stir Deposition (AFSD)







Laser Powder Bed Fusion

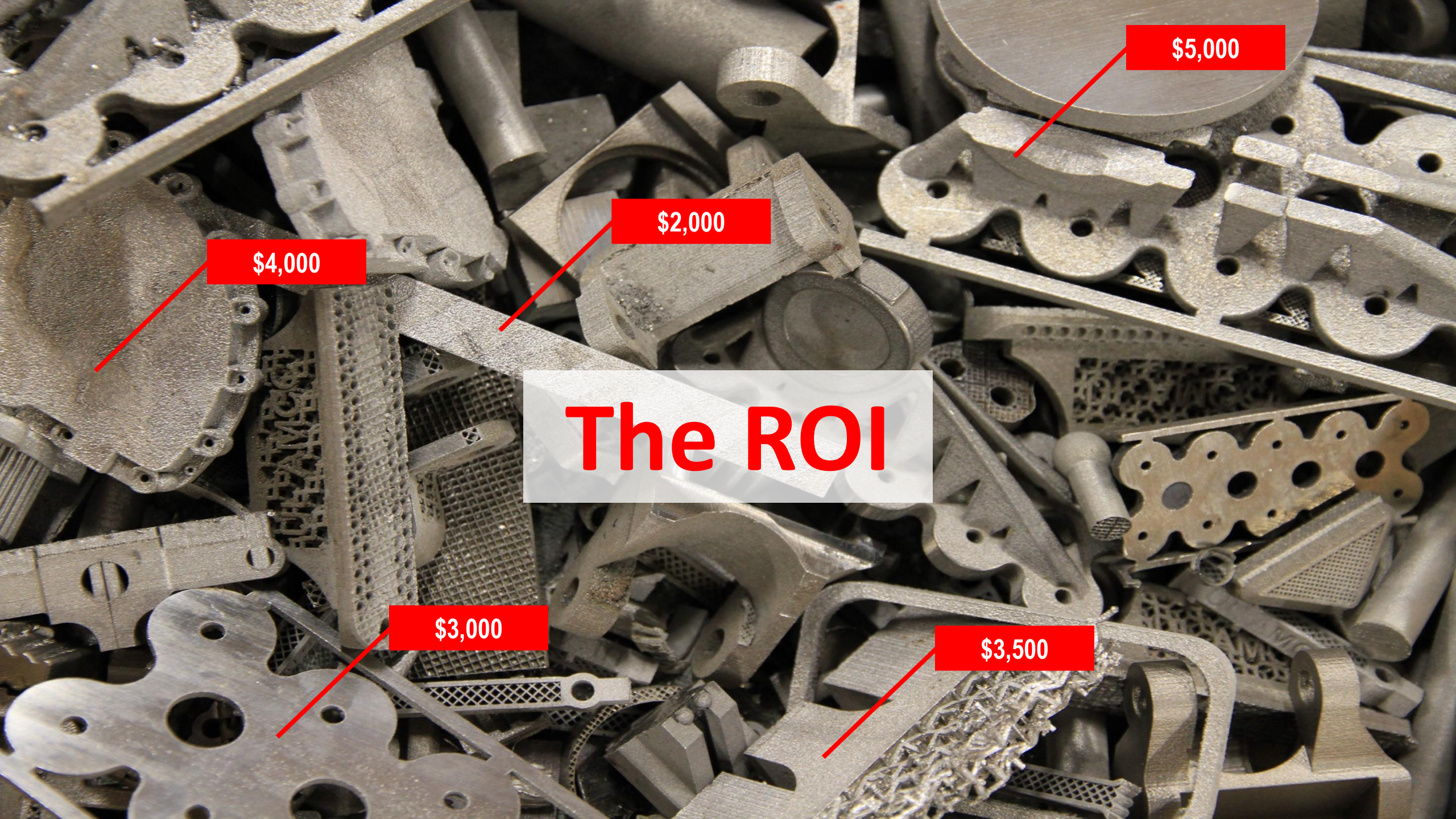


Reference: National Centre for Additive Manufacturing (NCAM)

Why Simulate?

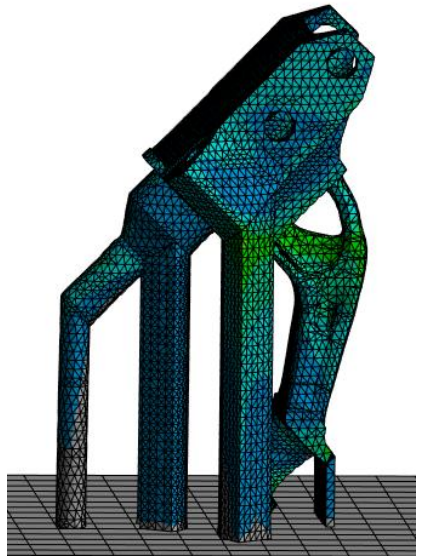
Original Geometry

Compensated Geometry


$5,000
$2,000
$4,000
The ROI
$3,000
$3,500

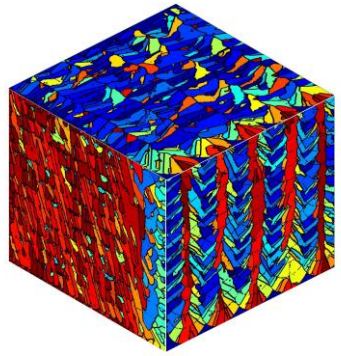
Ansys Additive Suite

- **Additive Print**
  - Standalone user interface originally developed by 3DSIM
  - Designed for machine operators
  - Inherent strain approach only



- **Workbench Additive**
  - Built into the Ansys Workbench Mechanical user interface
  - Developed by Ansys
  - Includes both full-physics and inherent strain approaches

- **Additive Science**
  - Designed for metallurgists and material scientists
  - Used to optimize machine parameters and investigate additive materials
  - Features include: single bead analysis, porosity analysis, and microstructure prediction



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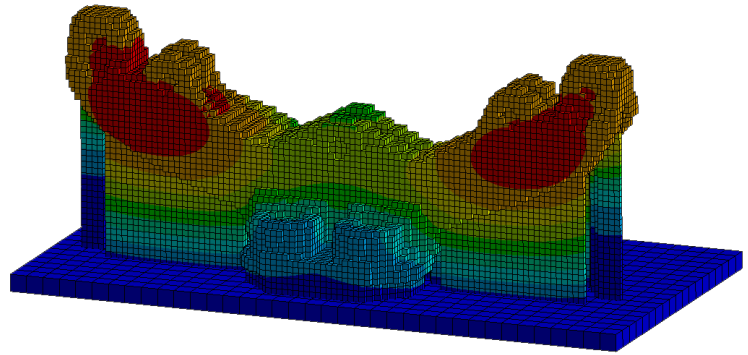
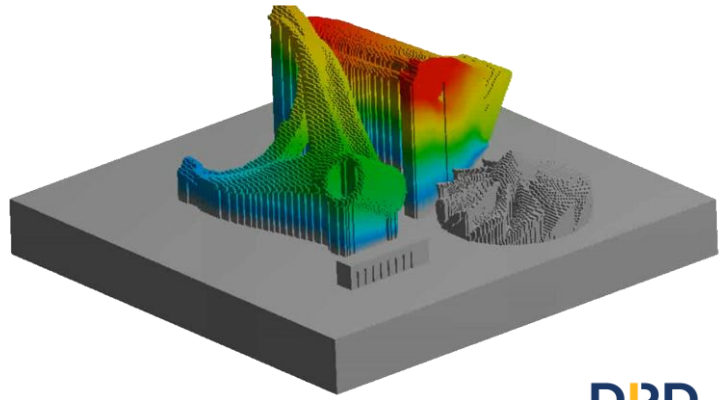
Workbench Additive Features

- **Full-Physics Thermomechanical Simulation**
  - One-way coupled Thermal-Structural using Lumped Layer Approach
  - Uses temperature-dependent material properties
- **Inherent Strain (requires calibration)**
  - Isotropic (single scaling factor)
  - Anisotropic (X, Y, and Z scaling factors)
  - Scan Pattern
    - Starting layer angle
    - Layer rotation angle
    - Deposition Thickness
    - Scaling factors relative to laser direction
  - Thermal Strain
    - All settings for Scan Pattern
    - Full build settings:
      - stripe width, beam diameter, beam power, hatch spacing, and scan speed
    - Uses Machine Learning data for fast and accurate simulations





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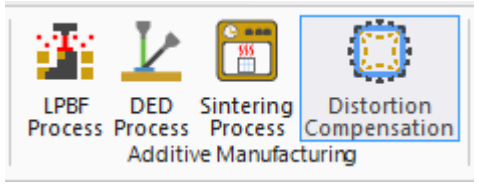
Automatic Distortion Compensation

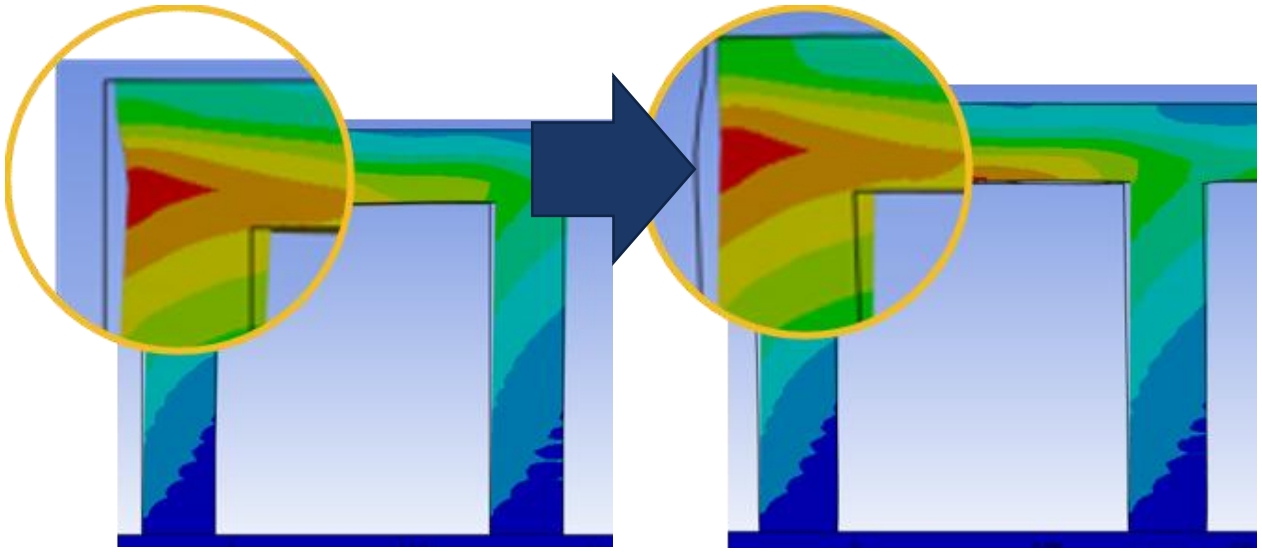
- Distortion Compensation iterates through multiple solves to generate a compensated geometry
  - Compensated geometries deform during processing to be within a specified tolerance of the original geometry
  - Automatically iterates through solutions until the deformed part falls within tolerances



Details of "Distortion Compensation"

Geometry(Body)	
Scoping Method	Geometry Selection
Geometry	1 Body
Convergence Criteria	
Average Deviation	0.1 mm
Maximum Deviation	0.5 mm
Maximum Iterations	5
Advanced	
Scale Factor	0.75
Remesh Geometry	Yes
Triangle Side Length	1 mm
Statistics	
Iterations Completed	0
Average Deviation	0 mm
Maximum Deviation	0 mm

Original geometry **Compensated geometry**



Deforms to the right, out of tolerance

Deforms into originally designed shape

*Outlined geometry in images represents the geometry before deformation

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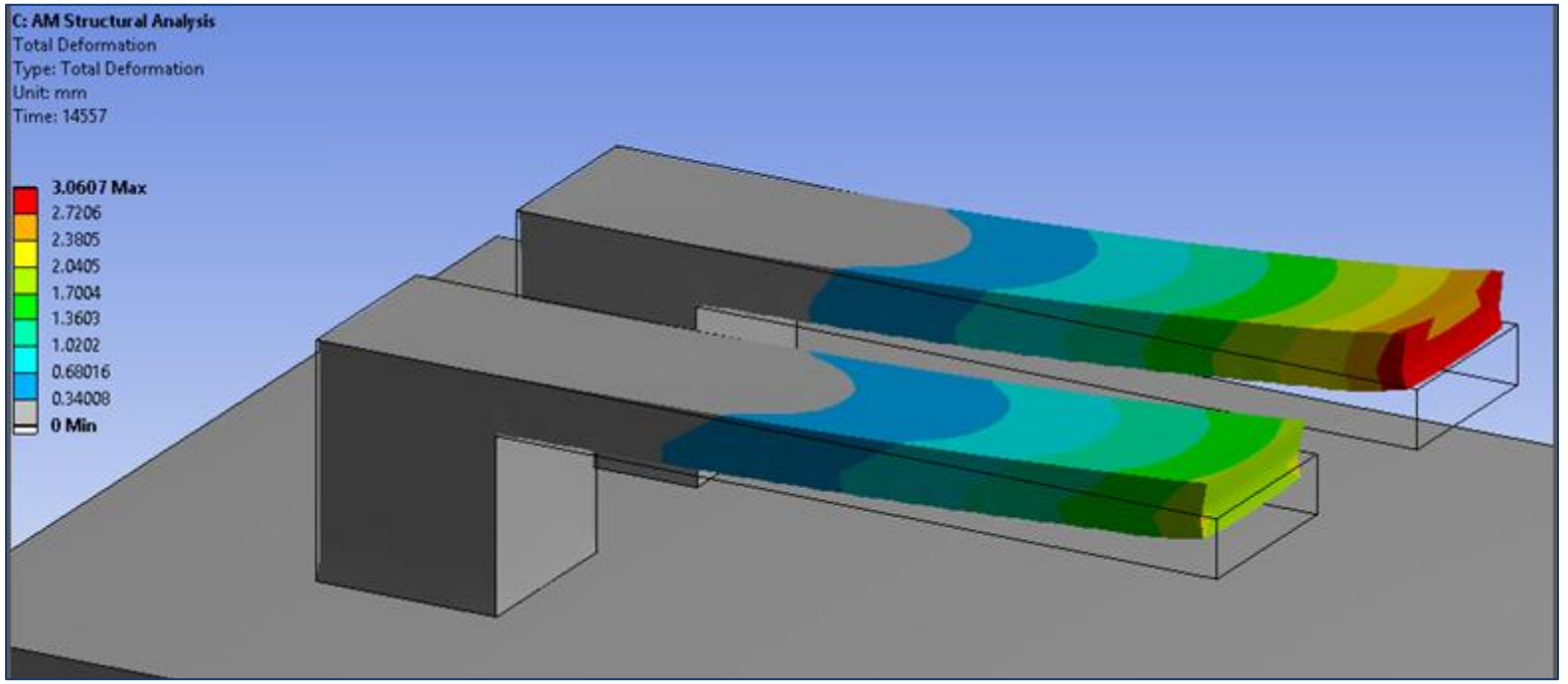
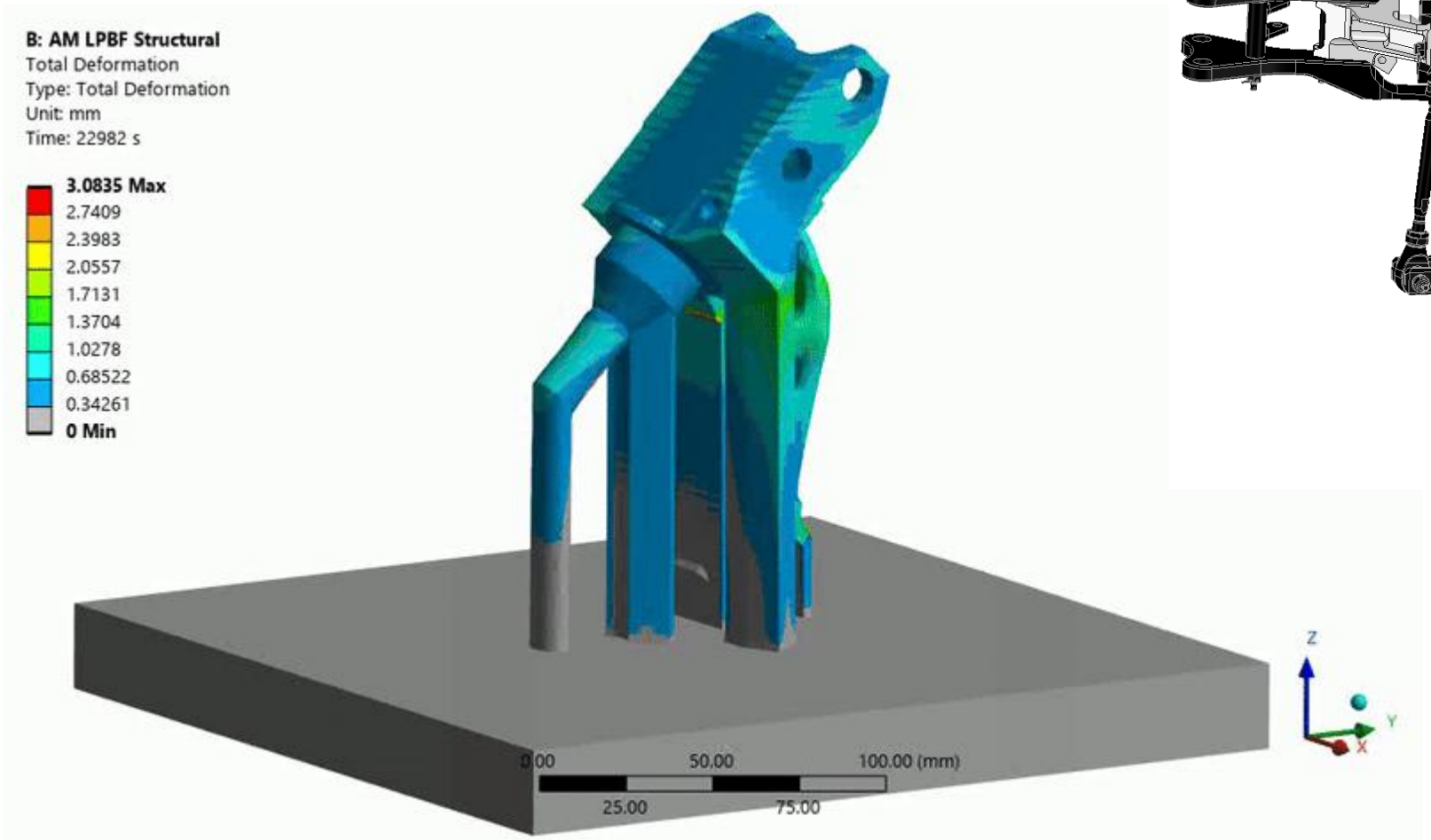
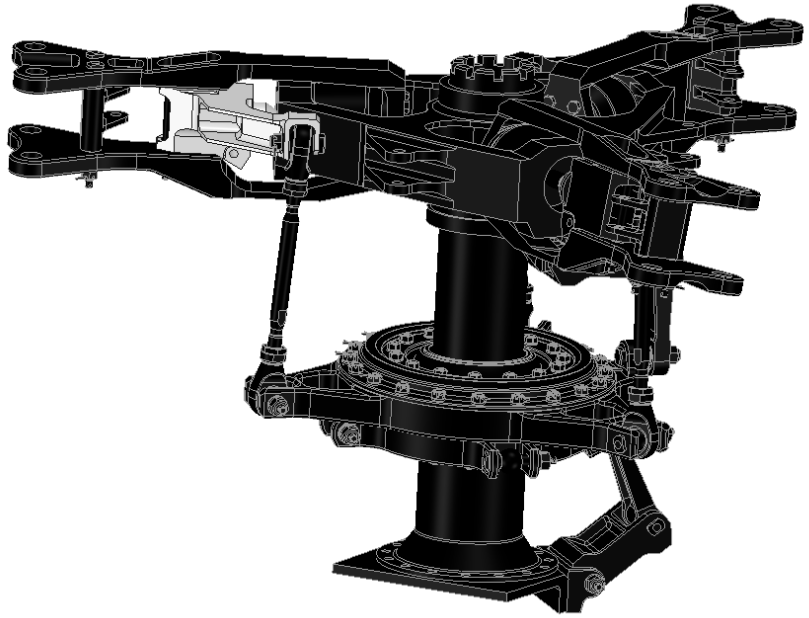
Heat Treatment

- Heat treatment can be included as part of the additive process simulation
  - Can be performed either before or after support and build plate removal
  - Two mechanisms available for stress relaxation:
    - Stress relaxation temperature
    - Custom creep model



Ansys Workbench Additive LBPF Demo





DRD Mail List

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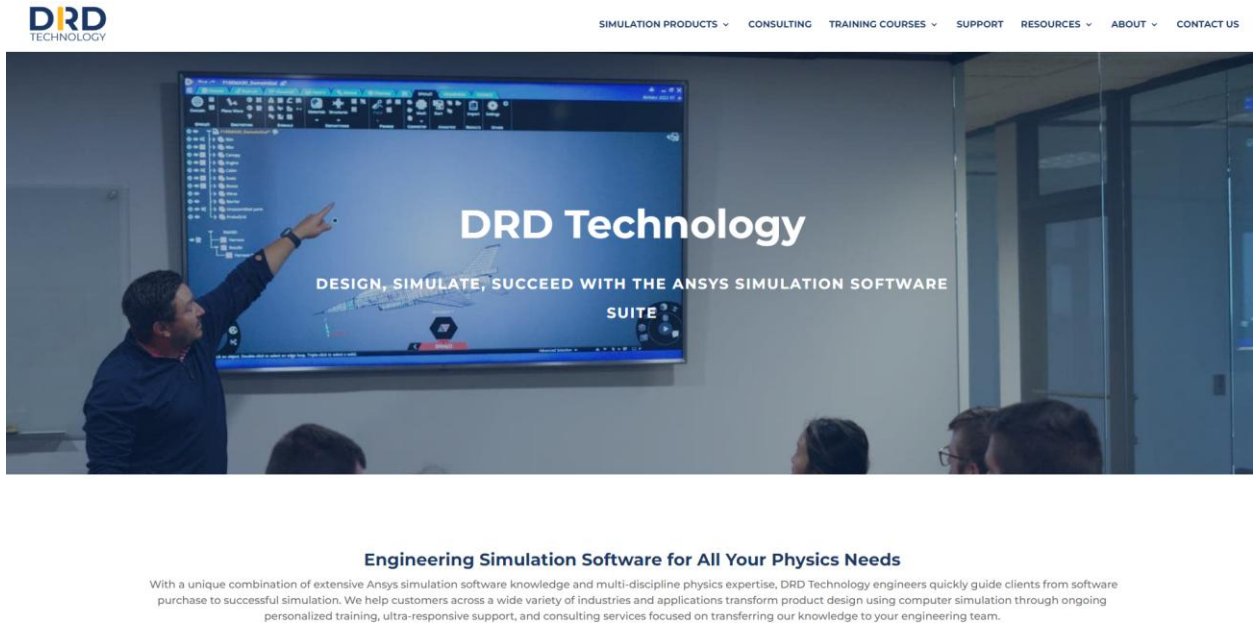
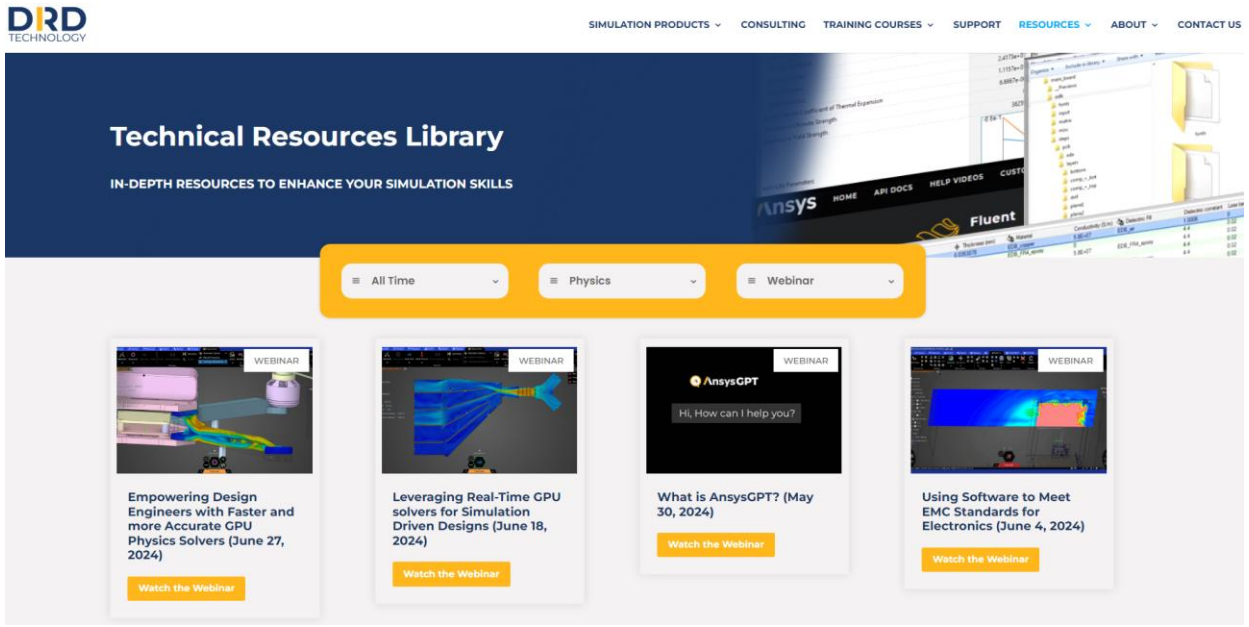
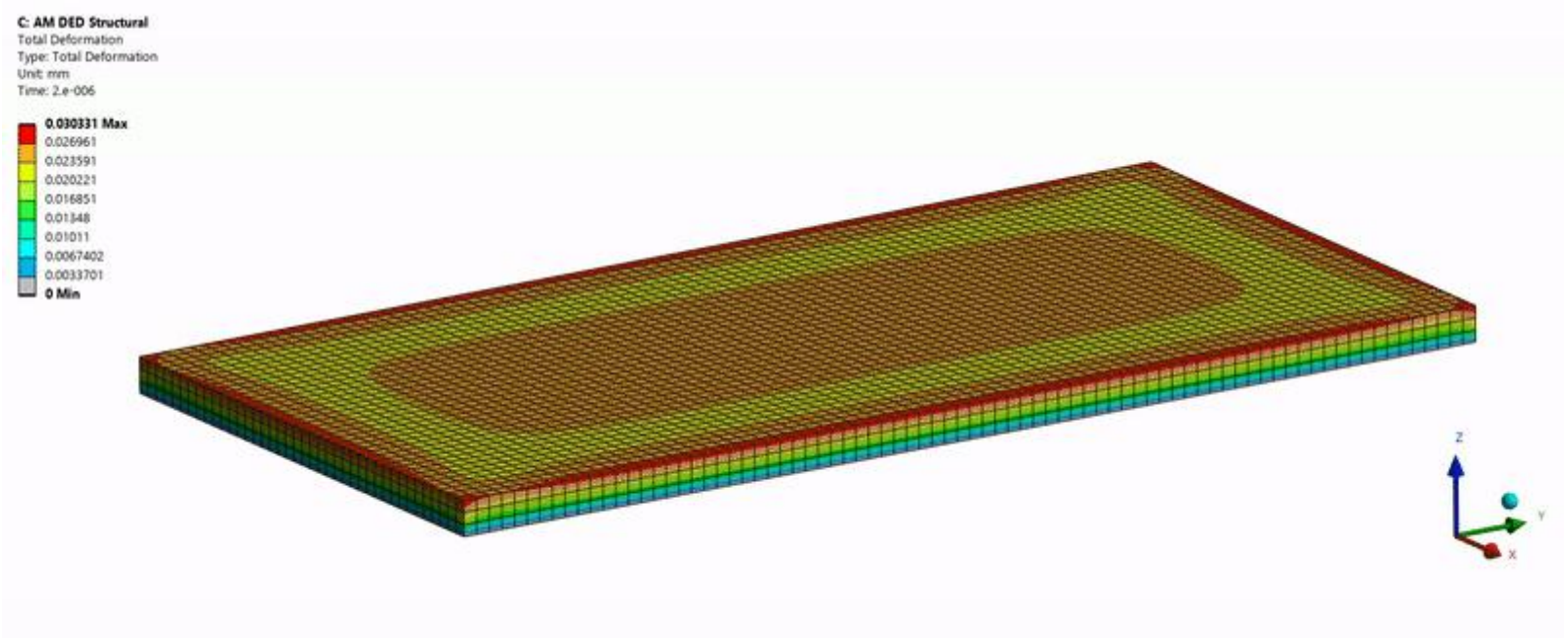
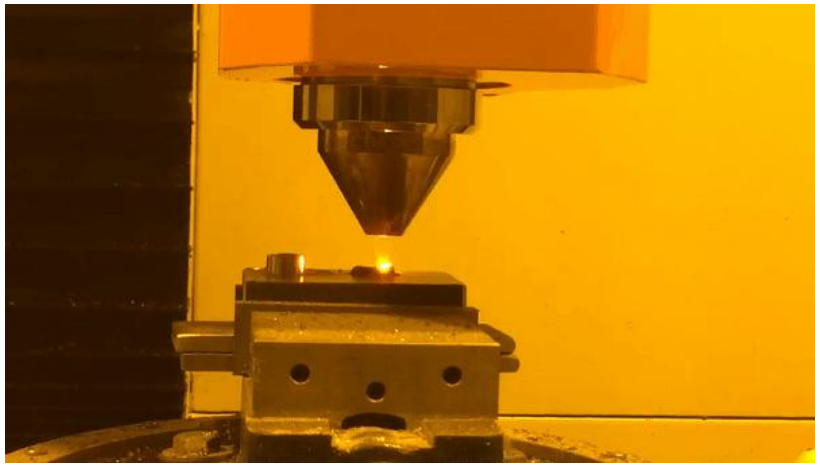




Metal AM Webinar Part 2: DED and AFSD

Join us on November 1st, 2024, at 9 AM for Part 2.





Questions

Thanks for your time