

The Future of Additive Manufacturing

A VISION FOR NASA'S JET PROPULSION LABORATORY

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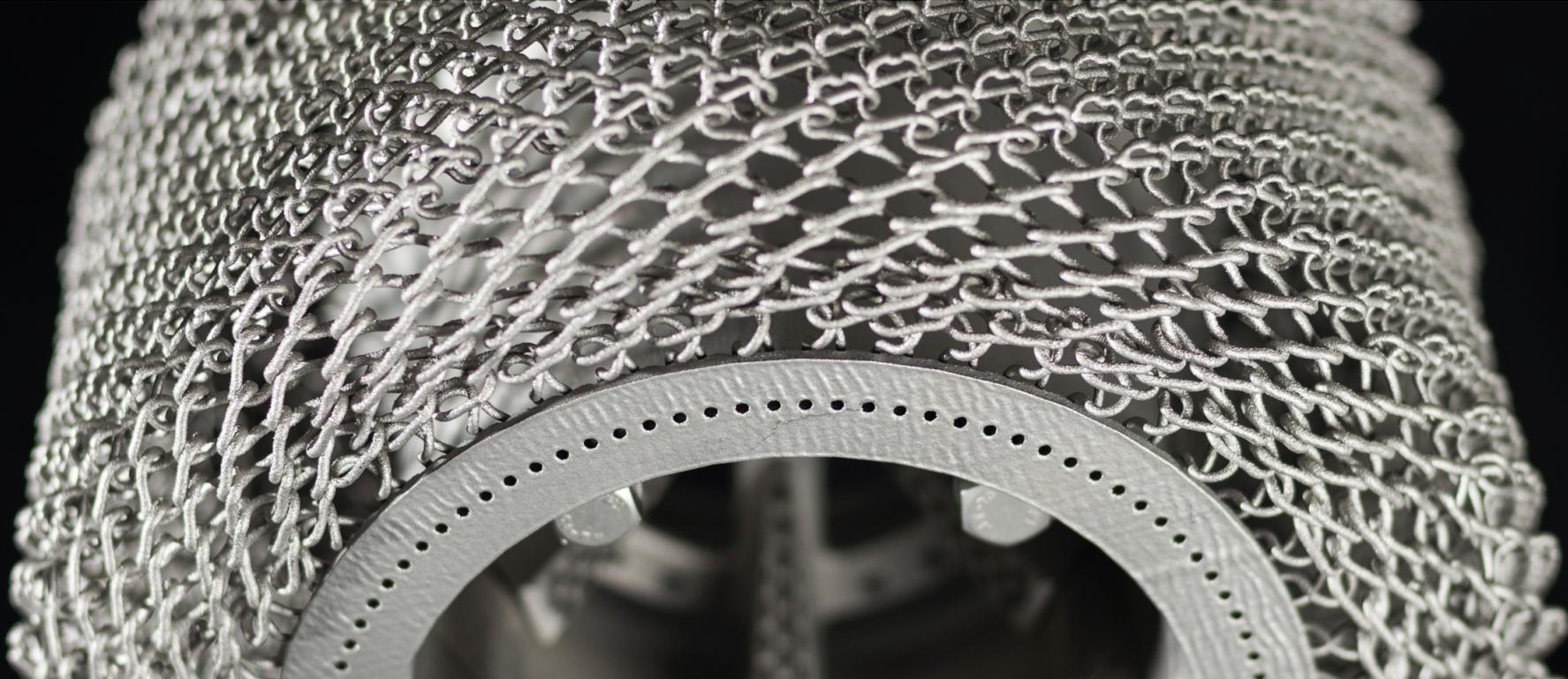


*A Larger Evolution for Advanced Manufacturing,
Modeling, Materials and Design*



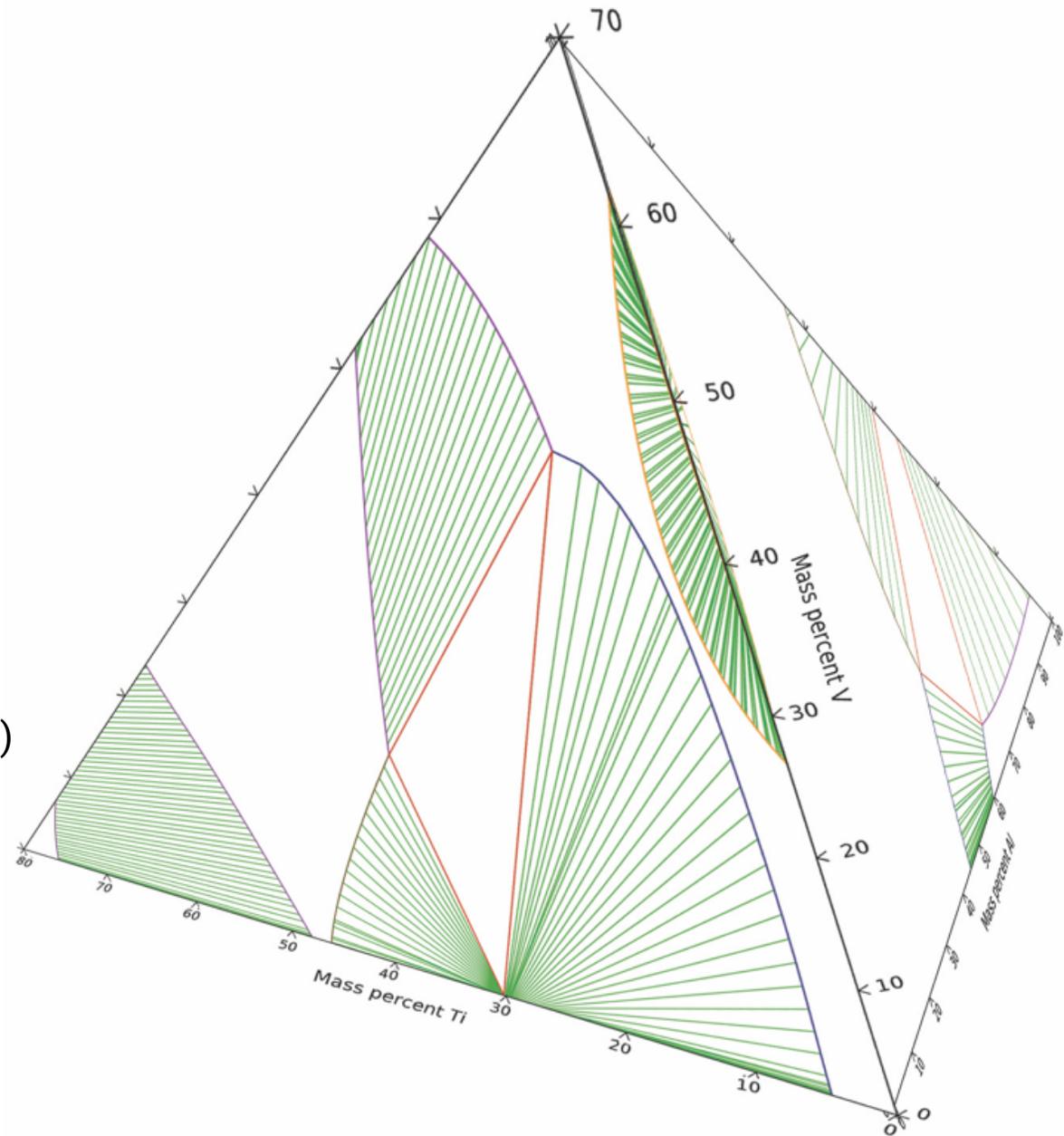
From a NASA Perspective

- A. Integration of multiple spacecraft functions.
- B. Fabrication of complex shapes.
- C. Integration of multiple parts for a single function.



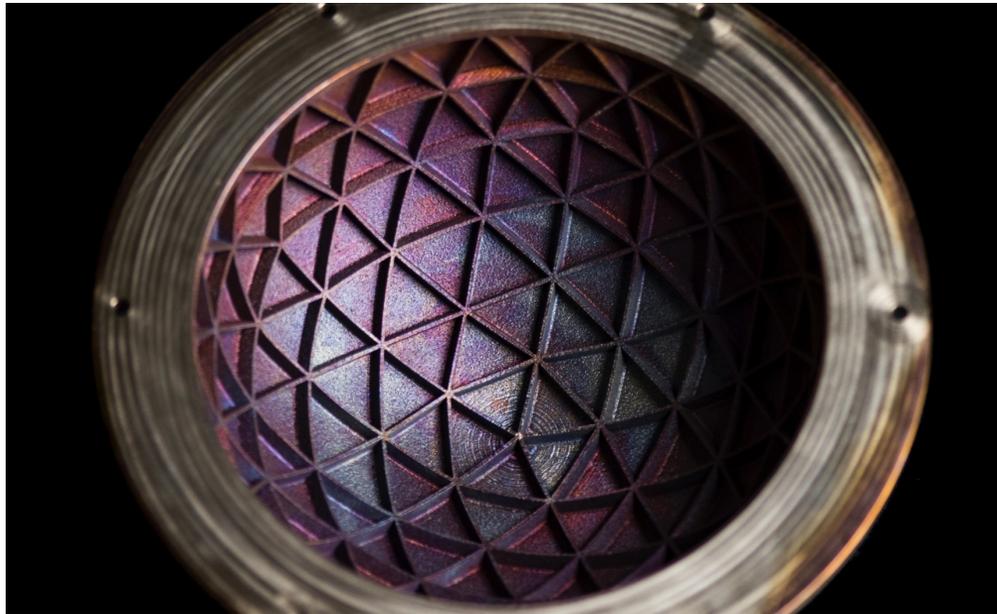
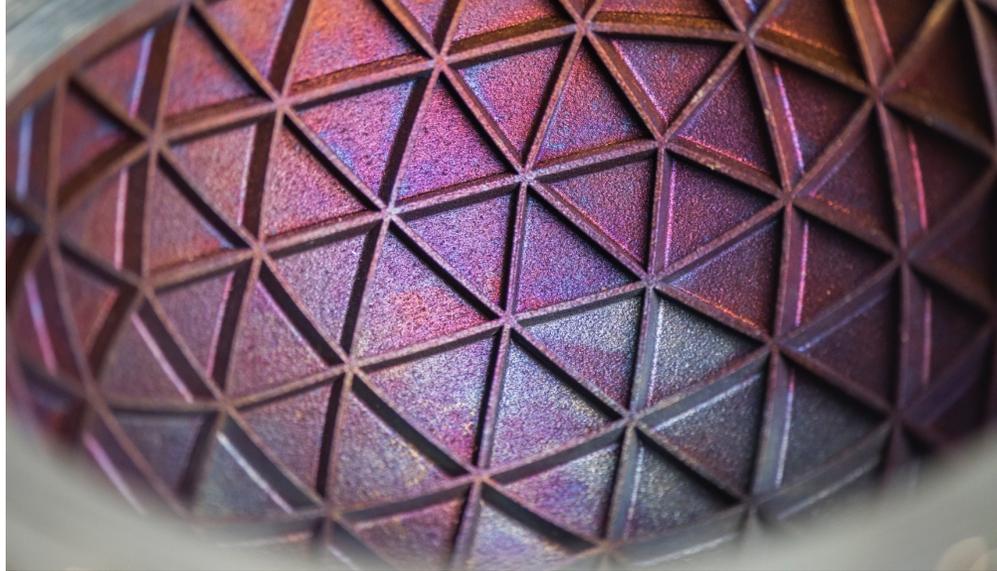
Change the Way JPL Designs Spacecraft

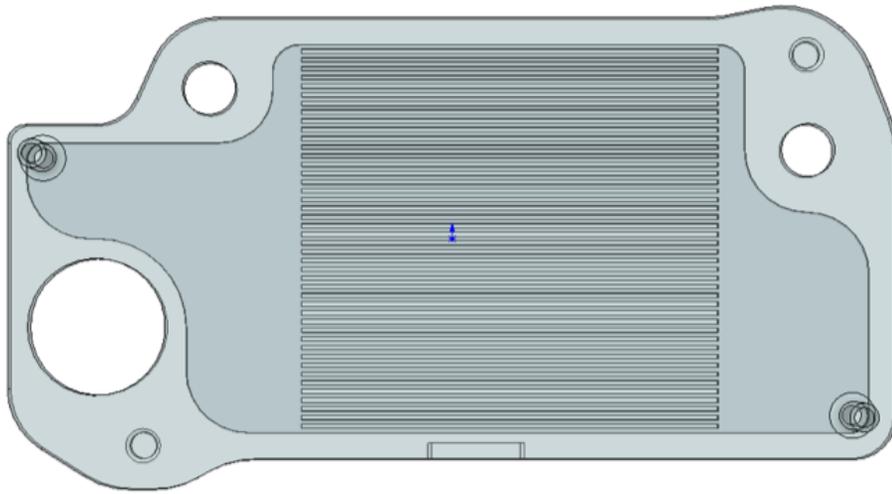
- A. Integrated functions
- B. Design for space-loading (not launch loading)



Design Process must contain essential elements

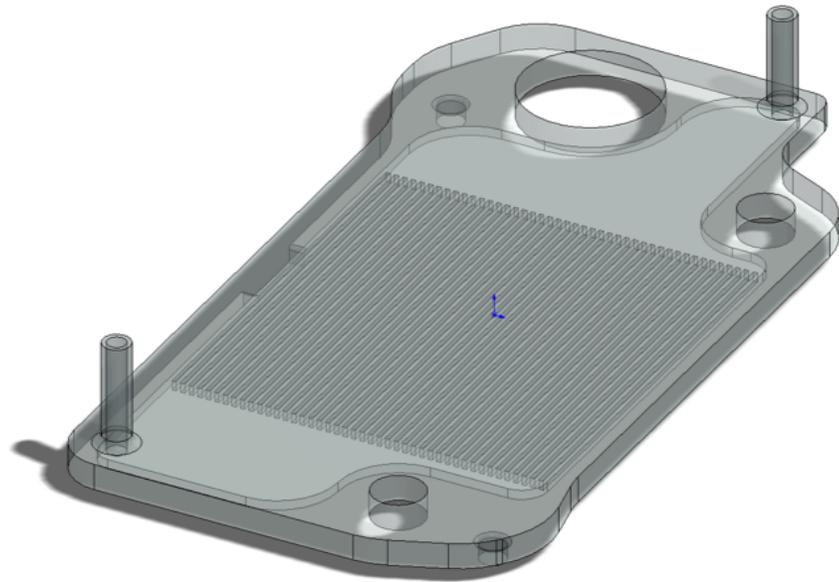
- A. Ability to integrate and evaluate multiple functions.
- B. Real-time multi-physics functional analysis as design trades are made.
- C. Simultaneous:
 1. Static loading
 2. Dynamic loading
 3. Thermal Analysis
 4. Optical Paths
 5. Power Distribution
 6. Mass
 7. Materials





Design Process must contain essential elements

- D. Topology Optimization
- E. Physics properties optimization
- F. Light-weighting – 3D Lattices
- G. Gradient properties
- H. Built-in test points/methodologies
- I. AM decision gating
- J. Other things I haven't thought about yet





PRO — CESS

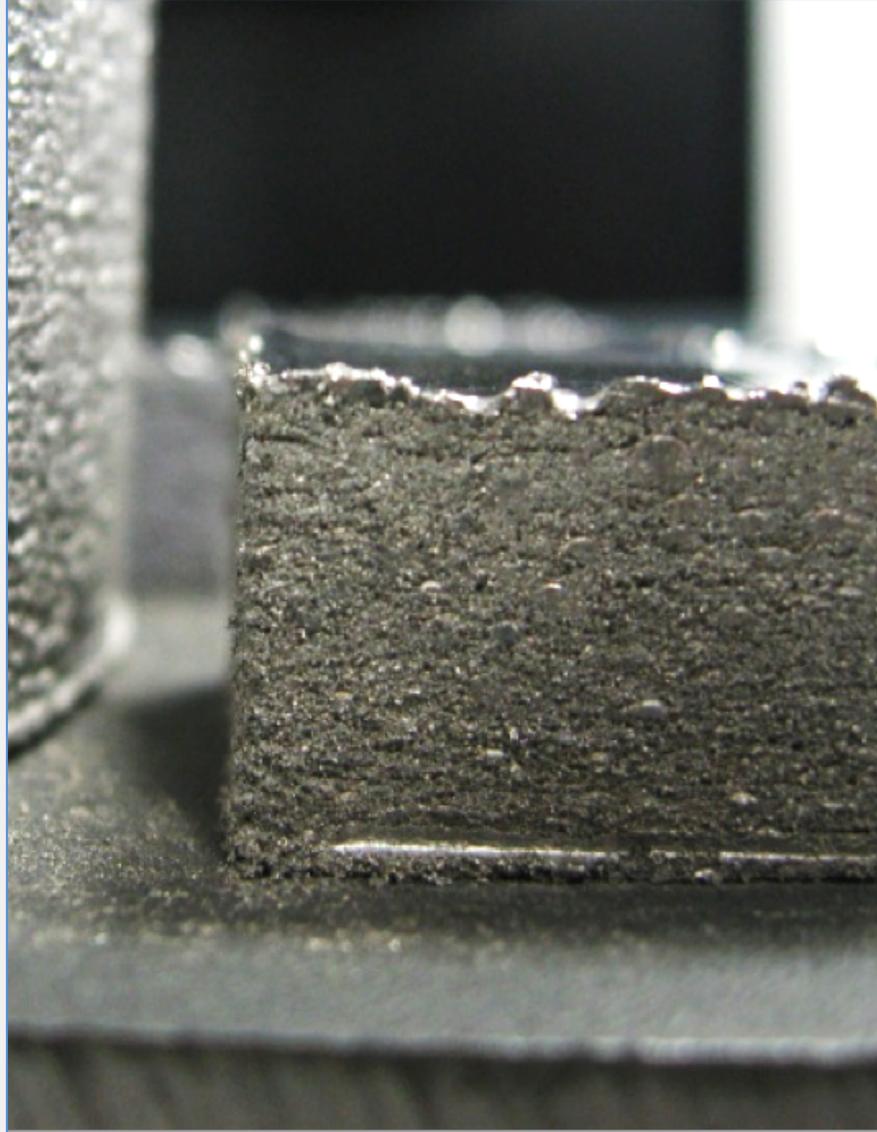
Enabled by Process Modeling

- A. Residual stress
- B. Materials properties
- C. Diffusion models – also used for weld evaluation and allow combinations
- D. Grain size
- E. Uncertainty quantification
- F. Gradient paths
- G. Post-processing
- H. Intelligent screening (feeds into DoE)
- I. Real-time, in-situ data collection and part modeling
- J. Thermodynamic modeling



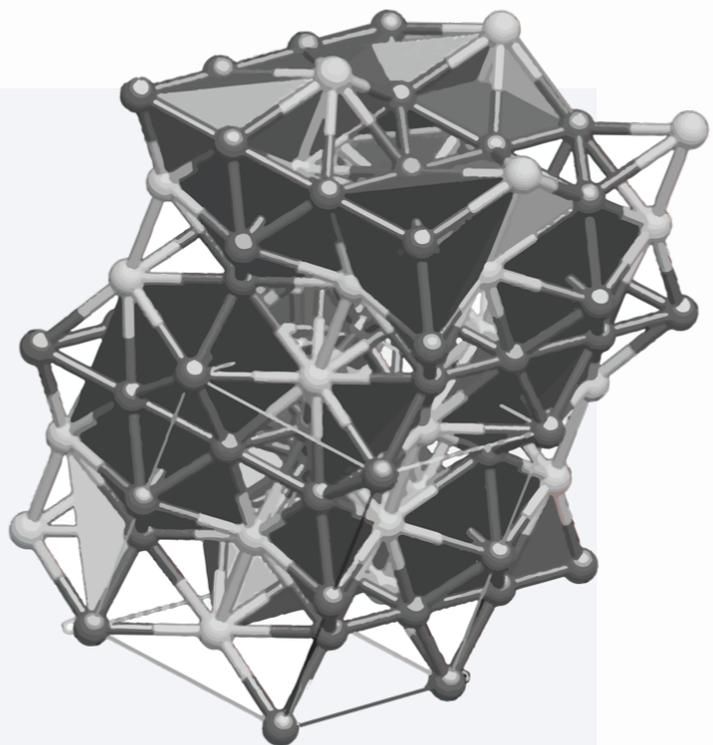
Gaps &

CHALLENGES



- A. Industry process control
- B. Predictability of materials properties
- C. No guidelines / industry standards for design or process
- D. Independent testing of integrated subsystems
- E. Ability to create test points for integrated subsystems
- F. Integration of models from disparate sources
- G. Data management
- H. Lack of government moderated databases
- I. Institutional rethinking
- J. Enabling true concurrent engineering
- K. Removal of traditional stovepipes





Some Potential Solutions

- A. Model Interface specification
- B. Data management specification
- C. Design guidelines
- D. Common reference standard cases for benchmarking
- E. Implementation of concepts within academia / industrial base



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Deck assembly by Faith Oftadeh, STO Communications Lead



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