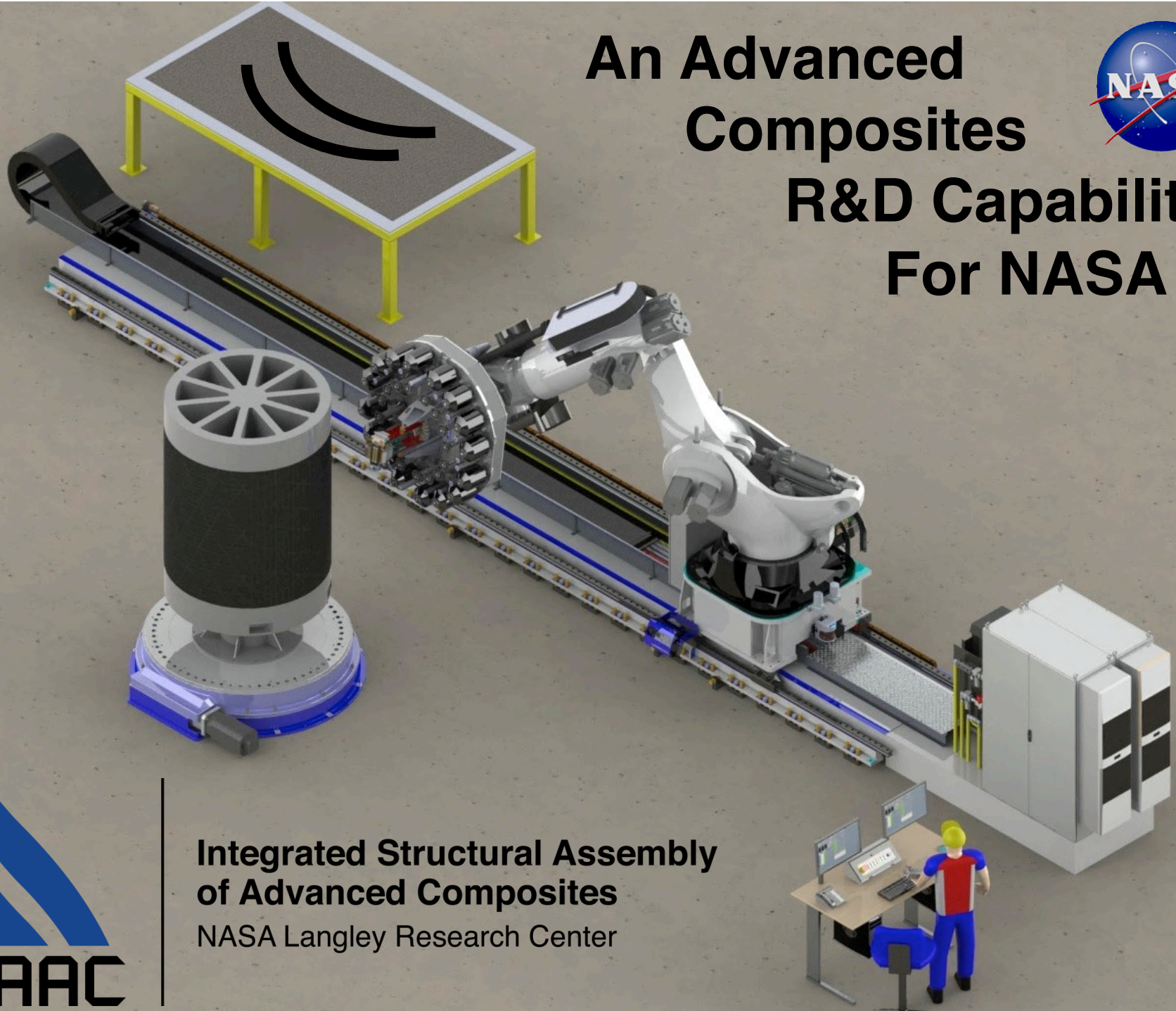
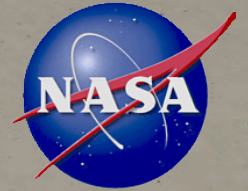


An Advanced Composites R&D Capability For NASA



**Integrated Structural Assembly
of Advanced Composites**
NASA Langley Research Center

Presentation Outline

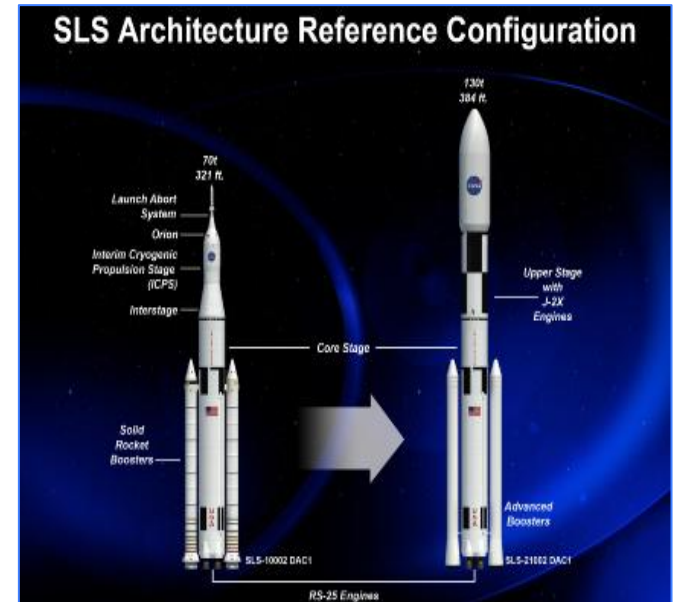
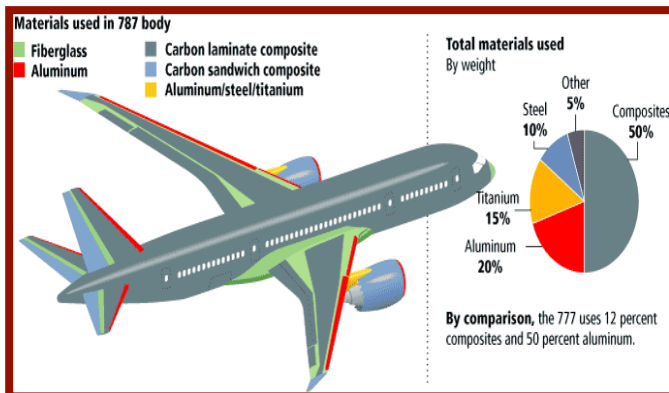


- **Motivating factors**
 - National
 - Agency
 - Langley
- **Composite Cryotank**
- **ISAAC description and capabilities**
- **Future opportunities**
- **Summary**



Composites Manufacturing Supports Agency and National Needs

- Supports all Mission Directorates: Aeronautics Research, Science, Human Exploration and Operations, Space Technology
- Supports Advanced Manufacturing National Initiative, and National Network for Manufacturing Innovation
- Supports other Government Agencies: DOD, DARPA, DOE
- Identified in NASA's Space Technology roadmap TA12 (lightweight materials and structures among the highest priorities identified by NRC)
- Spans multiple Centers and disciplines
- Industry and Research community



Composite Cryotank

- **Point design built by Boeing for NASA**
- **Large, mostly unexplored, trade space of design and process variables**
 - Laminate optimization
 - Mechanical joints
 - Material out-life studies
 - Material development, selection & evaluation
 - Out-of-autoclave materials
 - Thin-ply materials
 - Access points
 - Tank penetrations
 - Bonding
 - Softening strip development
- **Need better understanding of entire trade space**
- **Be a *smarter buyer* and a more effective, more relevant partner to the entire Aerospace Industry**
- **Make smarter investments in advanced composite systems – leverage knowledge for future projects**



Scope: Material Process Development, Coupon & Joint Testing

- ARES I: > \$5M
- CCTD Phase I: > \$3 M
- CCTD Phase II:
 - Boeing: > \$2.4M
 - CS FTE: 3
 - NASA WYE: 1



Integrated Structural Assembly Of Advanced Composites

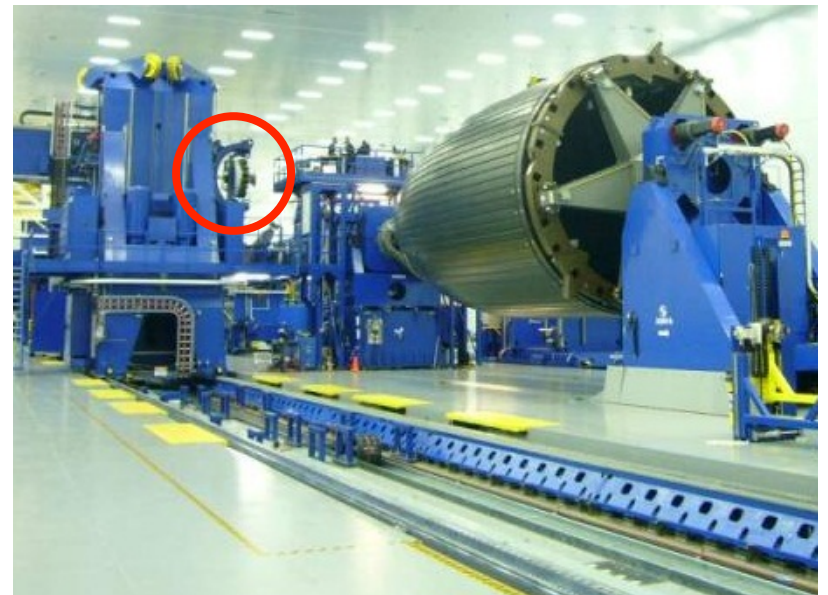
A NASA Capability

“Extraordinary Platform for Composites Manufacturing”



- Mature, highly flexible, automated composites manufacturing capability
- Appropriate scale for research activities and support of NASA missions
- Will provide opportunity to establish NASA leadership role in composites
- Will provide opportunity for stronger Government-Industry collaboration
- Will provide training ground for young talent, offering hands-on experience
- Will foster innovation, leadership, collaboration, competitiveness

Will greatly increase our understanding of composites



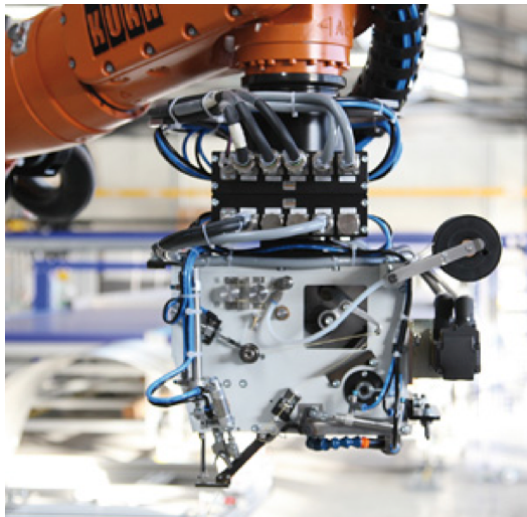
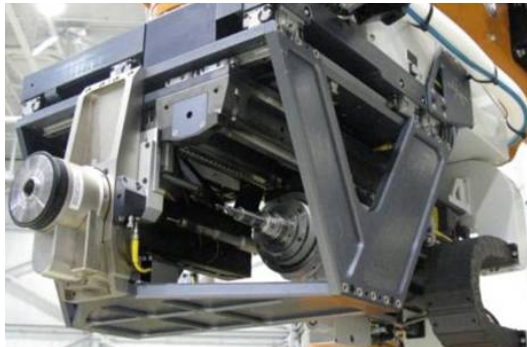


LaRC Vision for Advanced Manufacturing

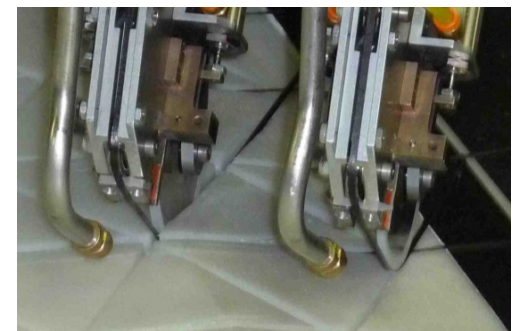
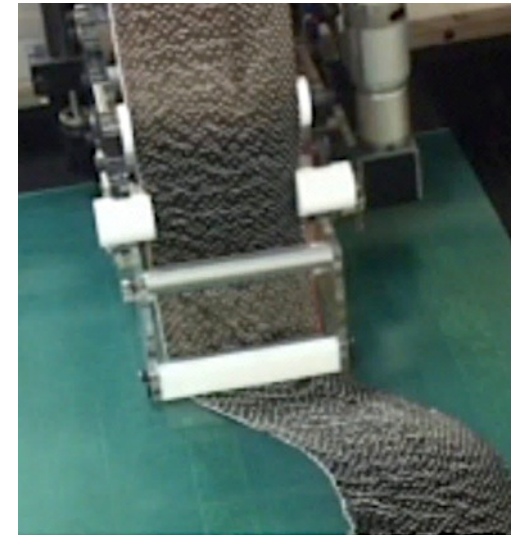
Integrated Structural Assembly of Advanced Composites (ISAAC)



Integrated Structural Assembly Of Advanced Composites



IOC system (AFP)



A robot-based system that utilizes multiple end effectors to develop and evaluate next generation composite materials, processes, structural concepts, manufacturing, and inspection techniques

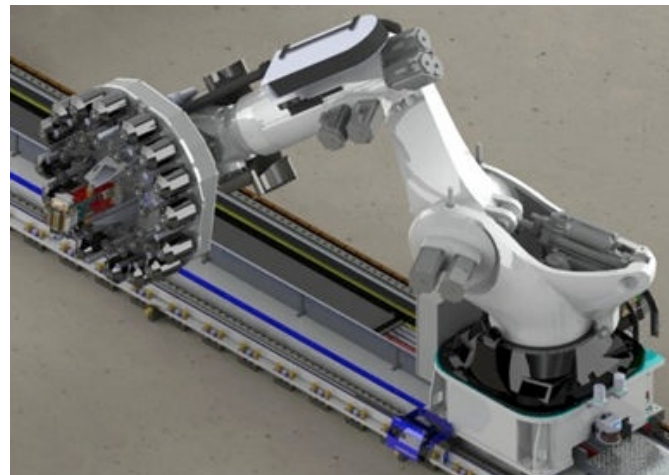
TRL 1-3

Develop
New Resins
and Fibers

Pre-Pregging of
Composite Tows

Develop Advanced
Manufacturing and
In-Line NDE Processes

TRL 4-6



IOC system shown

Fabrication of
Flight Vehicle
Structures

TRL 7+

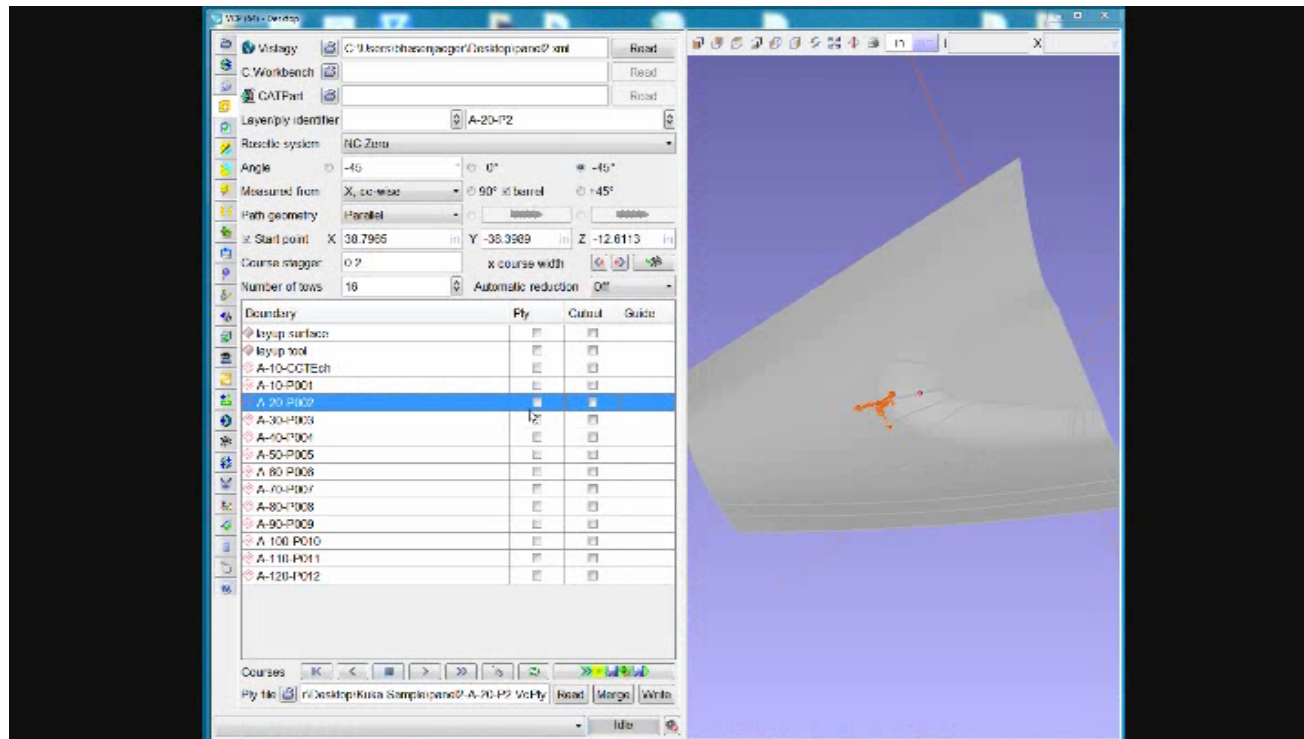
Testing and Analyses of
Composite Structures

Post-Cure Characterization
of Composite Structures

Design and Manufacture of
Composite Structures

Parametric, feature-based modeling with full bidirectional associativity

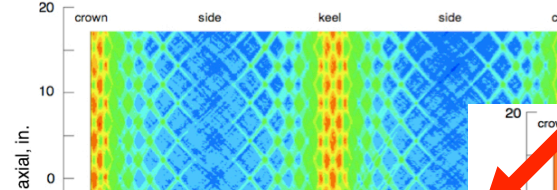
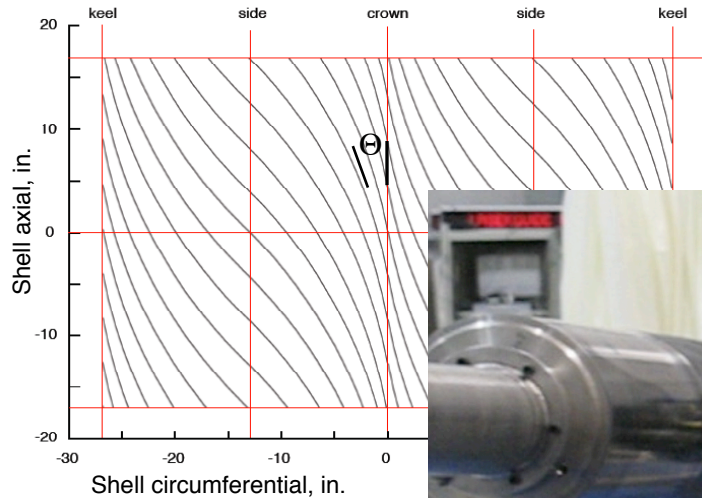
- No commitment until tooling is fabricated
- More relevant trade studies
- Faster design - analysis - design for manufacturing (DFM) cycles



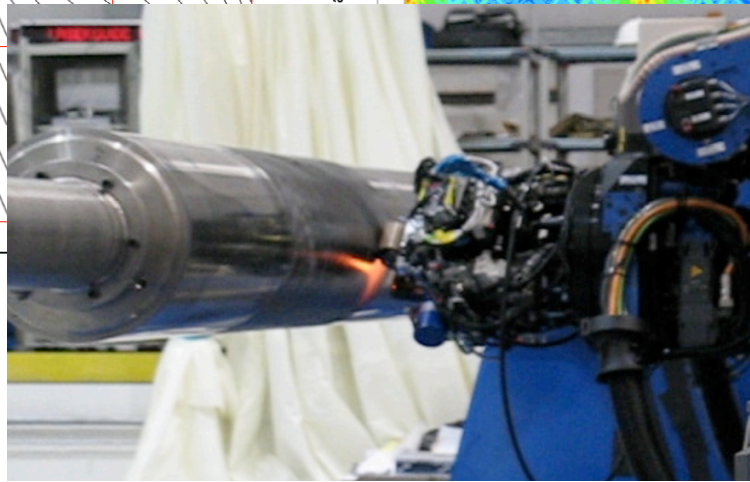
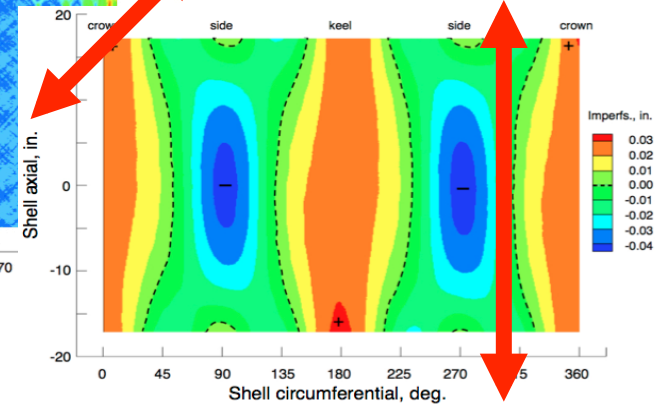
Highly Integrated Digital Manufacturing

Advanced Composite Tow-Steered Structures

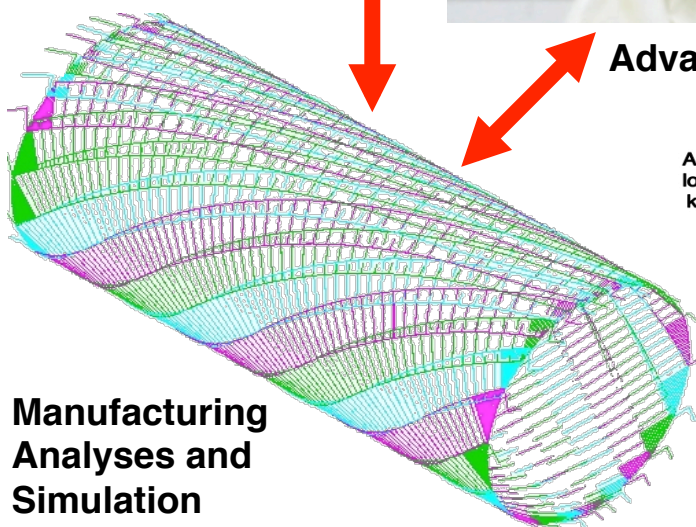
Integrated Structural Assembly Of Advanced Composites



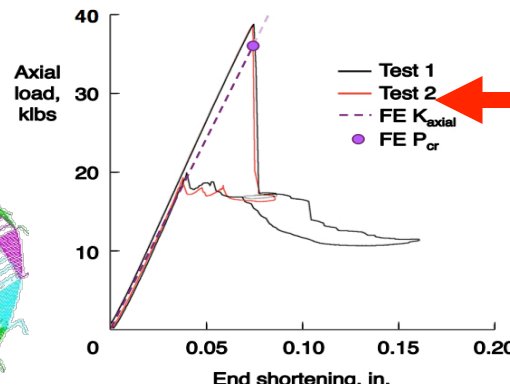
Characterization of As-Built Structures



Structural Concepts, Design and Analyses

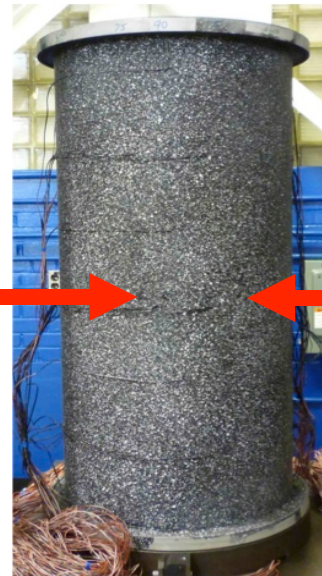


Advanced Manufacturing

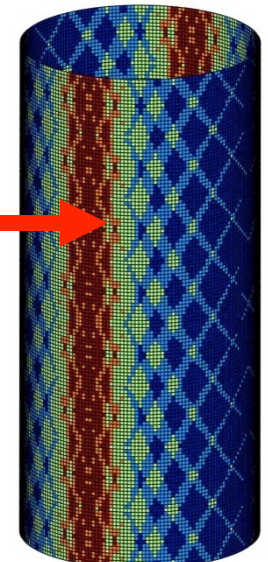


Test-Analysis Correlation

Structural Analyses with Nonlinearities



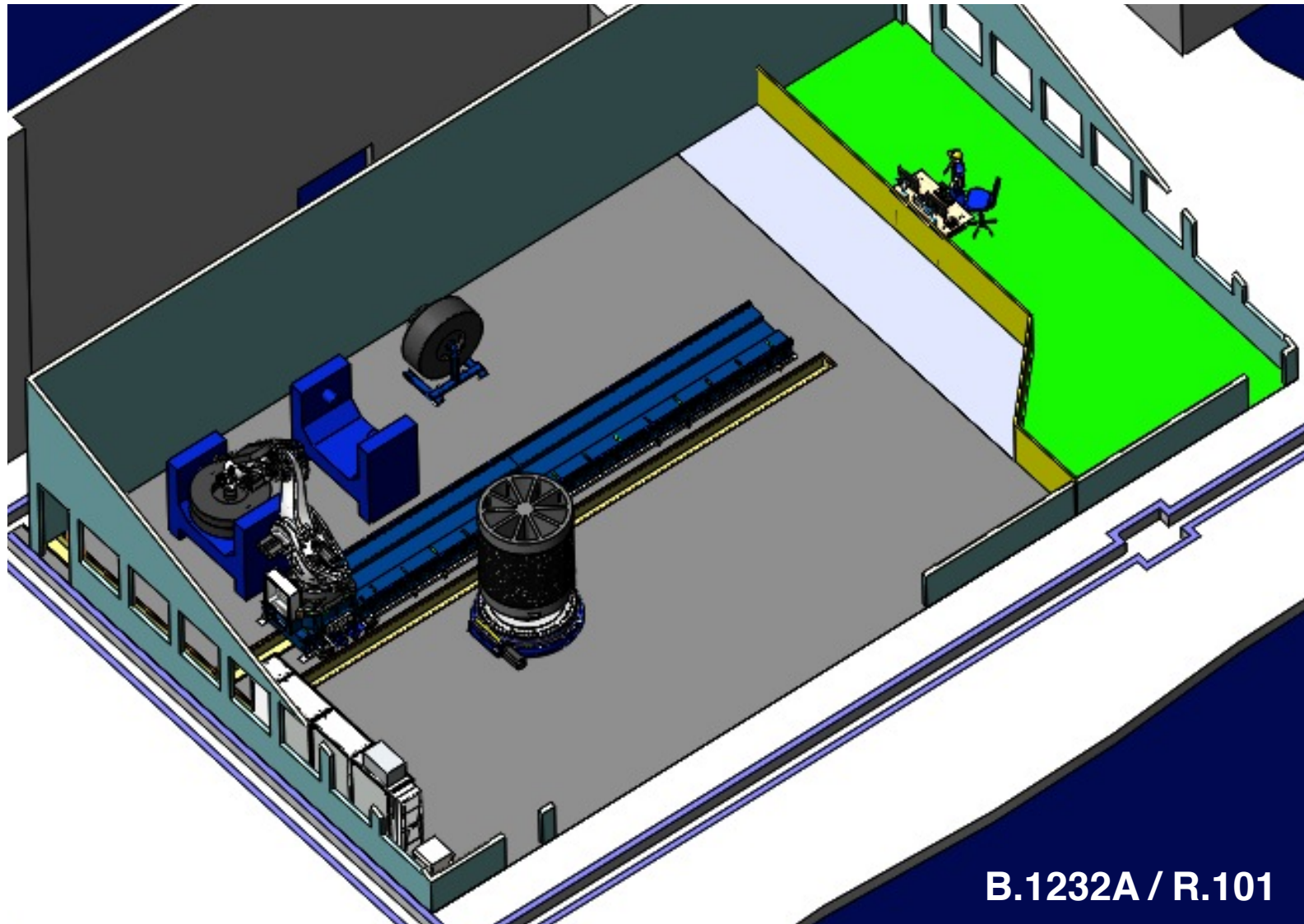
Testing





Integrated Structural Assembly Of Advanced Composites

Planned ISAAC Facility at NASA LaRC



B.1232A / R.101



Integrated Structural Assembly Of Advanced Composites

Summary



- **ISAAC will offer a digital advanced composites R&D environment**
 - Support mission directorates, DARPA, DOD/MANTECH, and DOE
 - Enable NASA to lead and truly collaborate with industry - instead of paying them to get further ahead.
 - Become *smarter buyer* and fosters more competition through NASA-owned processes.
 - Train the next generation of engineers and technicians.
- **The ISAAC system is mature, scalable, flexible, and enabling**
 - IOC AFP head is used from lab scale up to 787 production.
 - Multiple quick-change heads avoids obsolescence. Not just AFP.
 - Simulation software enables truly advanced composite designs (e.g., tow-steered structures).
 - Accuritized robot platform with secondary feedback ensures precise, repeatable hardware builds for analysis and test correlation.
- **The ISAAC system is affordable**
 - Cost is comparable with a CNC milling machine, CNC turning center, or scanning electron microscope.
 - Additional end effectors can be bought or developed as required.
- **ISAAC can be a nexus for composites activities at LaRC and the region**



Integrated Structural Assembly Of Advanced Composites

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