NASA Langley Research Center
Humans in Space

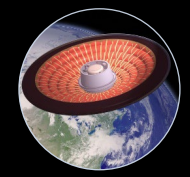
LaRC Humans in Space

As NASA prepares for human exploration of deep space, Langley engineers, researchers, and technicians shape bold ideas that will drive mission success and help make history

Langley is uniquely positioned to offer capabilities of critical importance in the areas of:

- Entry, Descent & Landing Systems
- Autonomous In-Space and On-Surface Assembly & Manufacturing
- Advanced Space Structures, Materials & Mechanisms
- Adaptive & Autonomous Systems
- Enabling Capabilities

ENTRY, DESCENT AND LANDING (EDL) SYSTEMS



Langley is leading the way in Entry, Descent and Landing systems' technologies by addressing the controlled flight of spacecraft through all appreciable atmospheres

Our EDL systems include:

- Entry, descent and safe landing of the spacecraft at its planetary destination
- Return through Earth's atmosphere to safe landing
- Entry to safe orbital insertion
- Descent and landing at bodies without atmospheres
- Autonomous landing system operation using Navigation Doppler Lidar (NDL)

Low- Earth Flight Test of an Inflatable Decelerator (LOFTID)

Mars Entry, Descent and Landing Instrument 2 (MEDLI2)

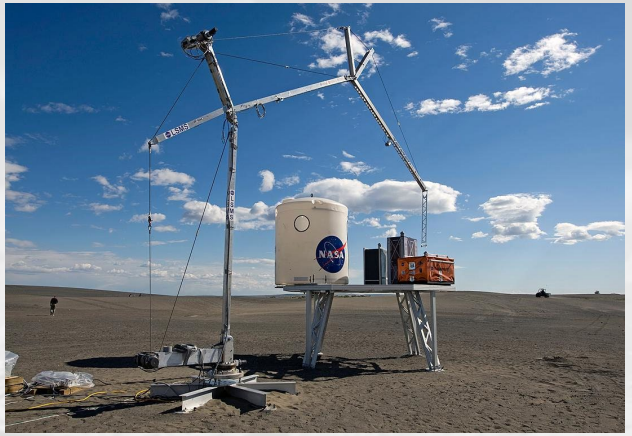
AUTONOMOUS IN-SPACE AND ON-SURFACE ASSEMBLY & MANUFACTURING

Langley develops concepts for safe and reliable autonomous systems to supplement human operations, including mechanisms that can maneuver, assemble and service structures

Our capabilities include:

- Fabrication and testing of deployable composite boom technology
- Autonomous, light weight, and long-reach robotic manipulators
- Methods to ensure trusted autonomy
- Design and testing of large space structures, habitats and modular space systems

Tendon-Actuated Lightweight In-Space MANipulator (TALISMAN)



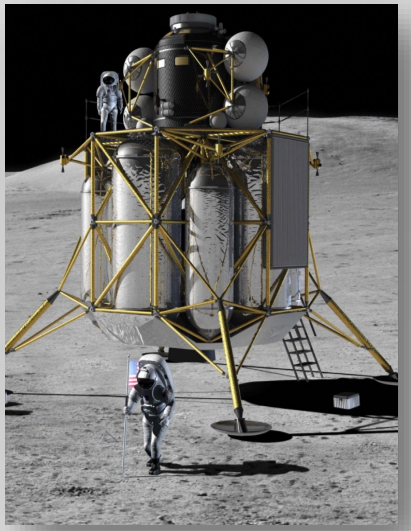
Lunar Surface Manipulation System (LSMS)

ADVANCED SPACE STRUCTURES, MATERIALS & MECHANISMS

Langley develops new materials, foundational technologies, and structural concepts to design, manufacture, validate, and sustain advanced aerospace vehicles and systems

Our areas of expertise include:

- Structural test articles and flight hardware
- Optimized manufacturing solutions for metallic and composite materials
- Durable, reliable, damage tolerant materials and structural systems
- Mitigation solutions for any environmental condition
- Advanced structural health management solutions



Artist Rendition: Lunar Landing Leg Gov't Reference Design

Radiation protection vest prototype

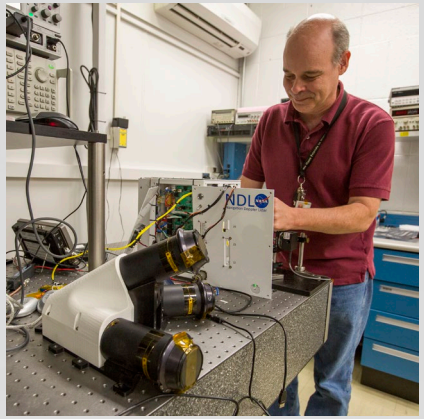
ADAPTIVE & AUTONOMOUS SYSTEMS

Langley develops transformative solutions for Adaptive and Autonomous Systems, Human-machine teaming, intelligent flight systems, and new vehicle and operational concepts

Our areas of expertise include:

- Autonomous Guidance, Navigation and Reconnaissance
  - Physics-based simulation of lunar environment and infrastructure
  - Flight System Expertise: Design validation by integrated simulation
  - Technology demonstration of LIDAR for autonomous landing system operation

- Human Systems Integration (HSI)
  - World-class design, development of operator/vehicle interface
  - HSI Flight Systems Expertise

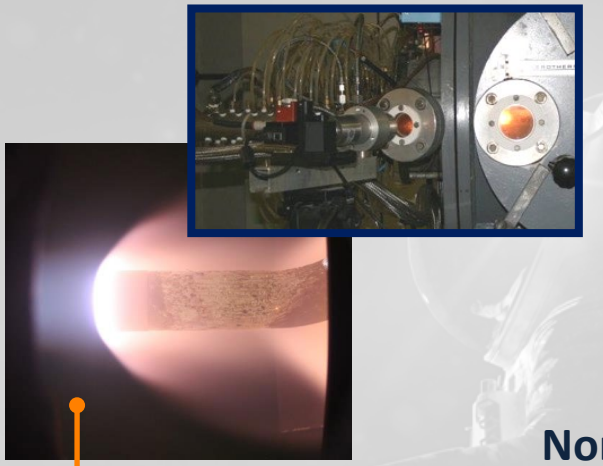


Navigation Doppler Lidar (NDL)

Development, Application, and Evaluation of Lunar Flight Deck Technologies and Surface Operations

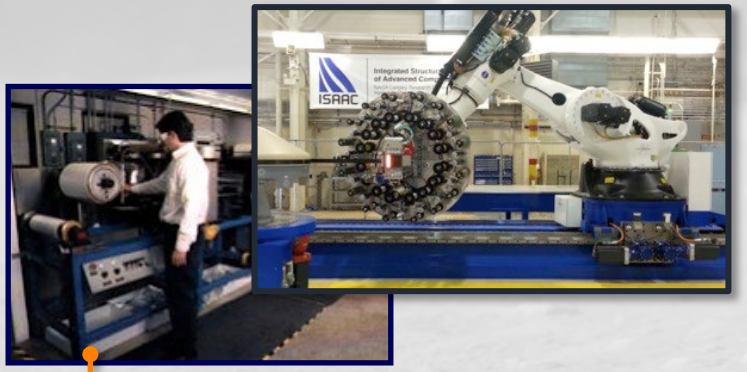
ENABLING CAPABILITIES – TEST FACILITIES

Large-Scale Impact Dynamics Testing (LandIR Facility)



Thermal Testing

Nondestructive Evaluation



Material Processing and Synthesis

Material Characterization

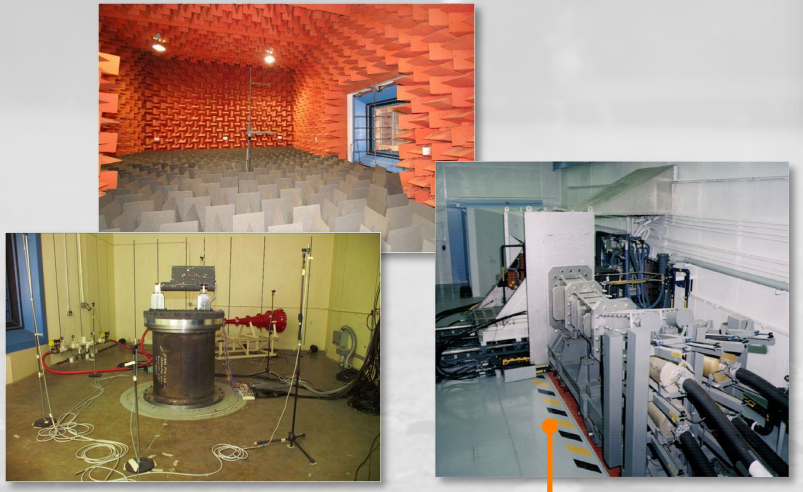
Mechanical & Environmental Testing

ENABLING CAPABILITIES – TEST FACILITIES

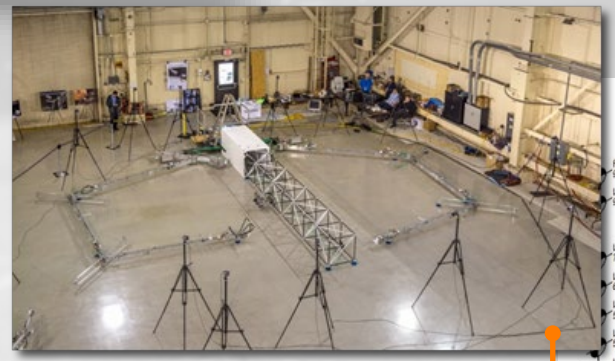
Lunar Landing and LTV Full Scale Testing

Wireless & Electromagnetic Test Facilities

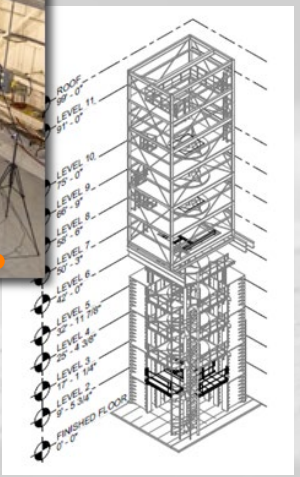
Thermal Vacuum Testing



Acoustic Test Facilities



Space Structures & Deployables Test Facilities

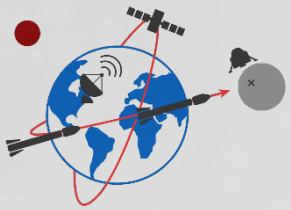


ENABLING CAPABILITIES – SYSTEMS ANALYSIS & CONCEPTS

Our Mission: We enable NASA leadership to effect meaningful change through well-informed decision making by performing concept development, assessment, and integrated analysis of complex aerospace systems.

Strategic Analysis

Framework structures, strategy development, market analysis, **portfolio formulation** & evaluation decision support



Conception, Analysis, and Assessment of

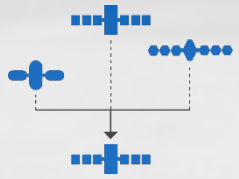
- **Campaigns**
- **Integrated Architectures**
- **Missions/Flights**
- **Vehicles**

Multi-mission/flight planning over extended periods of time to accomplish missions

Highly-integrated architectures developed to support a campaign or multiple missions/flights

End-to-end missions/flights for atmospheric and space missions; strong air and space trajectory analysis capability

Air and space **vehicle design**, sizing, and configuration



Decision Analysis

Portfolio characterization and **prioritization facilitation**, process development, data visualization

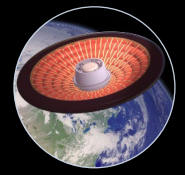
Technology Assessment and Gap Analysis

Characterization of **technology and capability needs** vs. state-of-the-art

SACD frames analysis in terms of performance, risk, and cost to deliver highly-integrated support to decision makers.

Backup

ENTRY, DESCENT AND LANDING (EDL)



Flight Environments
- Atmospheric Characterization
- Wind Tunnel Testing
- CFD
- Flight Testing
- Database Assembly
- Decelerators

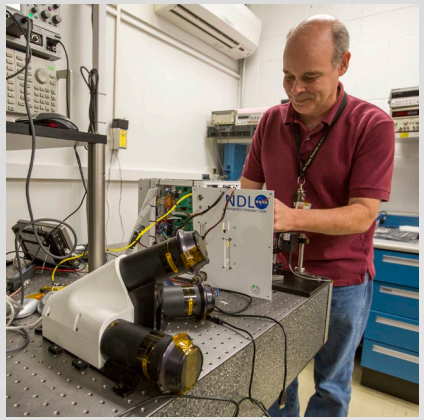
Mission Design and OPS
- Systems Studies
- Mission Architecture
- Hardware concepts
- Aerobraking
- Entry Trajectory Analysis
- Troubleshooting
- Entry Console

Flight Vehicle Tech Development
- Aeroshells & Thermal Protection
- Air Maneuvering, Mission Abort
- Decelerators
- Parachutes, HIADs, SRP
- Landing System (liquid & land)

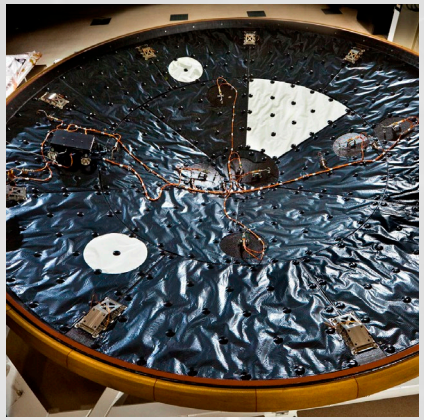
Advanced MODSIM
- Modeling &Analysis Tools
- Development &Testing
- Concept to Flight
- Validation

Integrated systems
- Systems Engineering
- Systems Integration
- Guidance &Control
- Trajectories
- IV & V

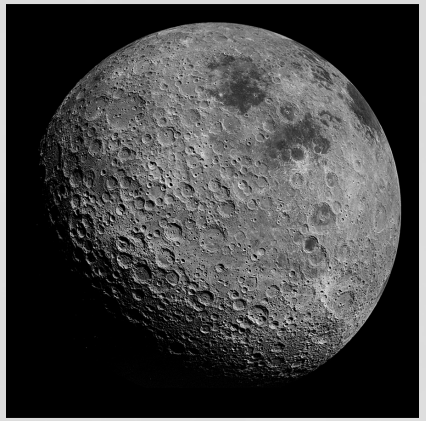
ENTRY, DESCENT AND LANDING (EDL)



Navigation Doppler Radar (NDL)



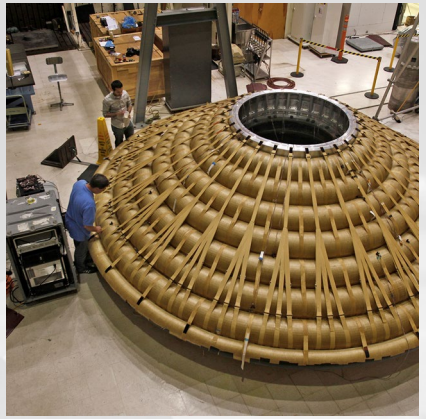
Mars Entry, Descent and Landing Instrument 2 (MEDLI2)



Lunar Descent

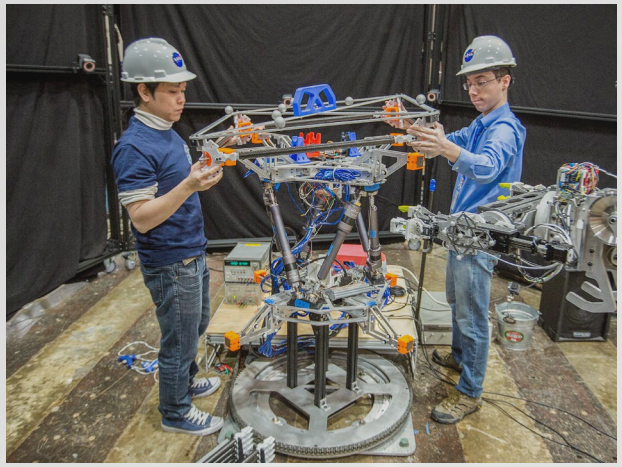
Low- Earth Flight Test of an Inflatable Decelerator (LOFTID)

Stereo Camera for Lunar Plume- Surface Studies (SCALPSS)

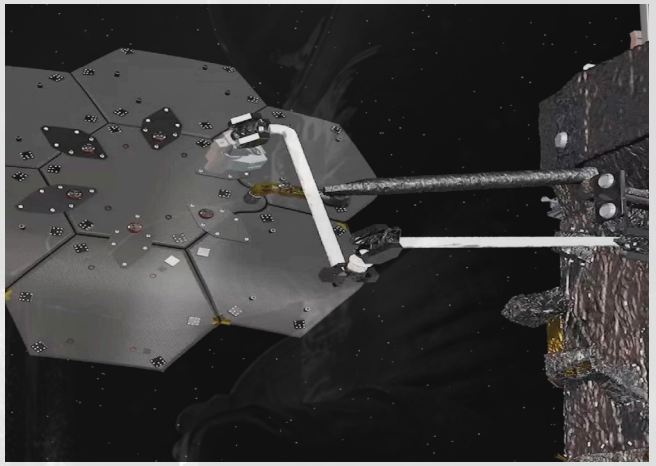


Hypersonic Inflatable Aerodynamic Decelerator (HIAD)

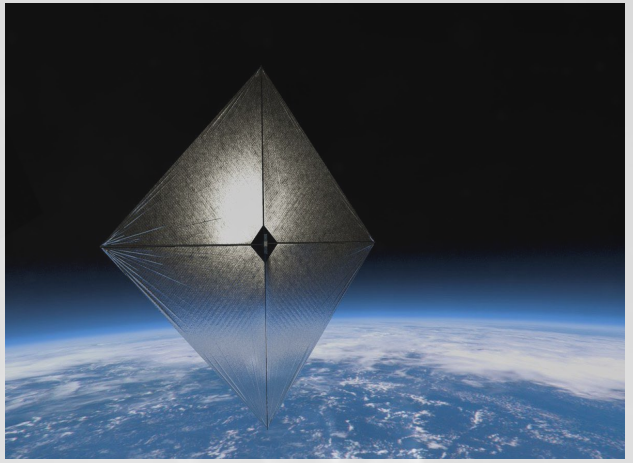
AUTONOMOUS IN-SPACE ASSEMBLY & MANUFACTURING



NINJAN
NASA Intelligent Jigging Assembly Robot precisely positions truss members for welding after hand-off from manipulator (TALISMAN)

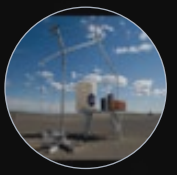


SPIDER
Enables satellites to self-Assembly in orbit. Langley is developing the robotic assembly interfaces



Deployable Composite Boom and Solar Sail Technology
Will demonstrate the successful deployment of the composite boom solar sail in Low Earth Orbit (LEO)

IN-SPACE ASSEMBLY TIMELINE



LEVERAGING OUR HERITAGE TO ENABLE THE FUTURE

A decades long history of leadership in large structural system concepts

1985

First Extravehicular Activity (EVA) Assembly STS-61B

1992

EVA Assembly Methods & Repair Intelsat VI STS-49

1994

Automated Structural Assembly Lab

2018

Supervised Assembly

2030

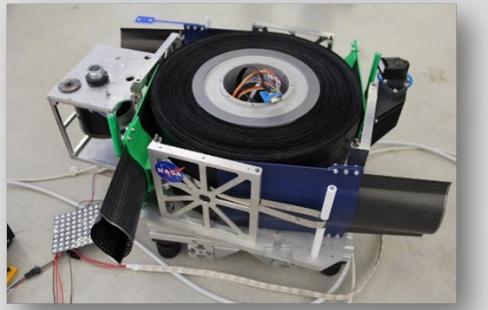
On-Orbit Autonomous Assembly

ADVANCED SPACE STRUCTURES, MATERIALS & MECHANISMS

Deployable Composite Booms

Technology development, fabrication and demonstration of structures and mechanisms for compact, lightweight extendable / retractable multi-purpose masts:

- Imaging / observational platform
- Solar array / solar sail boom
- Communication masts
- Power beaming
- Science



Deployment mechanism

CTM composite boom

Fabrication of up to 16.5 m long composite booms