

Reliable Mechanical Systems, Materials and Communications for Surface Exploration

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Key Challenges for Reliable Surface Exploration



LUNAR DUST: can infiltrate/damage materials and mechanical systems and impair optical, communication, and thermal radiator system performance

EXTREME TERRAIN: Obstacles, craters, slopes, regolith conditions, etc. pose challenges for roving vehicles, excavation and signal scatter for communications systems

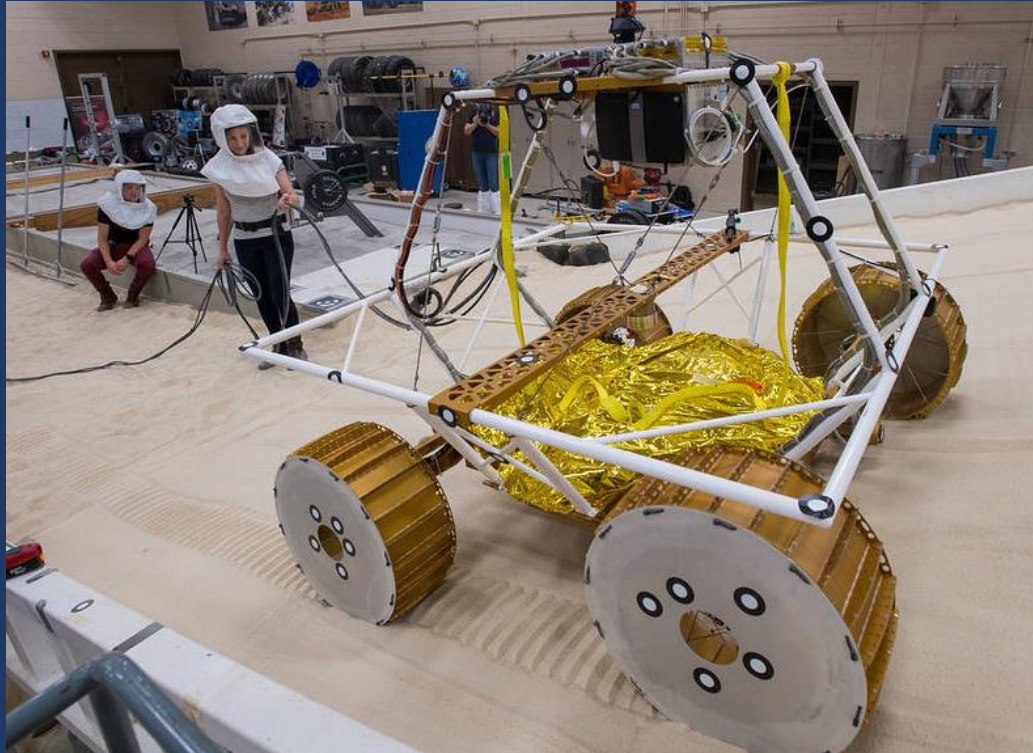
HARSH ENVIRONMENT: Temperature extremes, vacuum, radiation, etc. can limit selection and degrade performance of materials and mechanical systems

LIMITED VISIBILITY TO EARTH: Challenges for communication from desired surface locations

NASA Glenn Research Center (GRC) is developing technologies for mechanical systems, materials, and communications addressing these reliability challenges

Mechanical Systems for Harsh Terrain

Rover Wheels and Tires



Traction/mobility measurements conducted in GRC's Simulated Lunar Operations Laboratory (SLOPE) for Volatiles Investigating Polar Exploration Rover (VIPER) engineering model

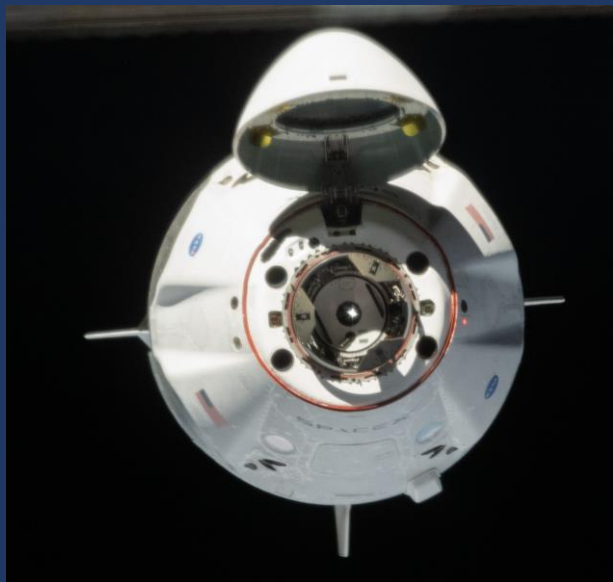
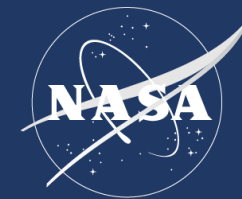


Wheel/tire assemblies are under development and testing at GRC for Mars Sample Return mission's Sample Fetch Rover

New GRC Shape Memory Alloy tires can envelop obstacles without permanent deformation. They can enable faster travel, steeper climbing, and performance over a wide temperature range for surface operations.

Reliable Mechanical Systems for Harsh Environments

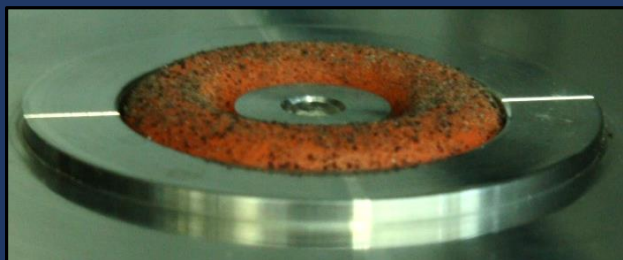
Seals, Bearings, Drive Systems



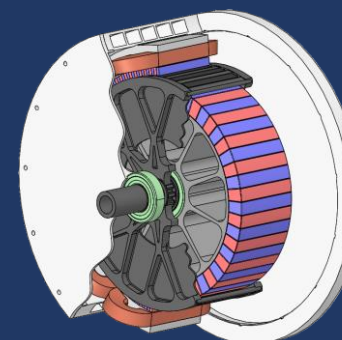
Docking seal technology developed at GRC used for spacecraft docking to International Space Station



Rotating machinery is vulnerable to damage from lunar dust, such as bearing denting; GRC is assessing surface wear from dust abrasion and new concepts for dust mitigation for numerous mechanisms and materials



For lunar surface missions, GRC assessing seals for performance in dusty environments



GRC concept for cryogenic magnetically-gear actuator could mitigate problems for dusty and extremely cold lunar surface operations

Excavation To Enable Use of Lunar Resources

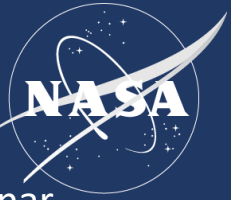


GRC's Advanced Planetary Excavator (APEX) and simulant bins used to measure fundamental forces in excavating granular soils to minimize reaction force needed

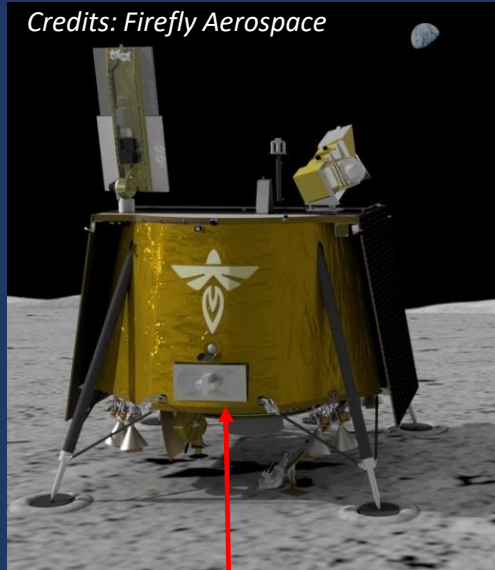


GRC's Shape Memory Alloy (SMA) Rock Splitter enables controlled rock breaking for excavation and sampling using forces generated when SMA material undergoes shape change upon heating

Dust Mitigation for Materials and Surfaces

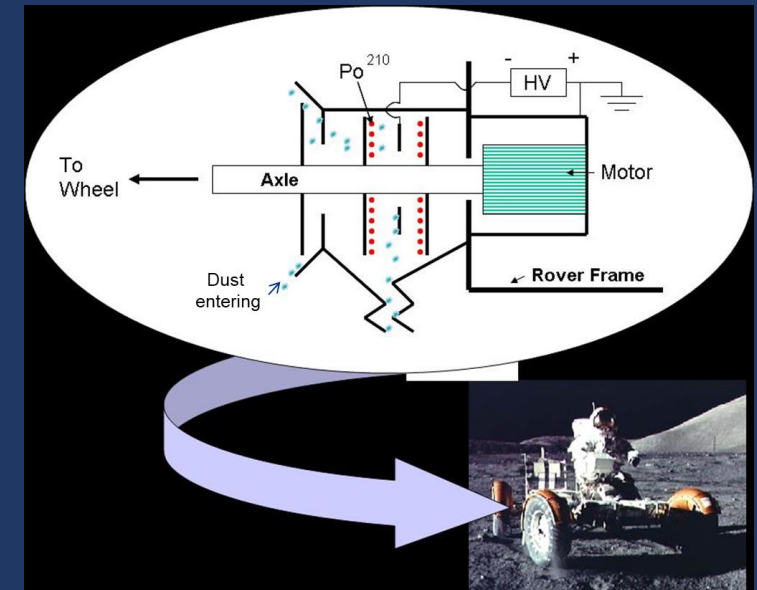


GRC's lunar dust adhesion laboratory is testing dust mitigation technologies for materials and surfaces



NASA passive dust mitigation coatings and surfaces will be flown on the Regolith Adherence Characterization experiment on Firefly Aerospace's Blue Ghost lander, under NASA's Commercial Lunar Payload Services (CLPS) initiative.

For NASA Langley-led LO-DuSST (Lunar Occupancy Dust Surface Separation Technologies) Project: GRC is developing an Electrostatic Repulsion Attraction system using alpha particles to keep dust from entering confined spaces.



Lunar Surface Communications

GRC is developing communication technologies to support lunar surface operations: orbital relays, delay tolerant networking, cognitive communications, link modeling and emulation, and store & forward

Ka-Band
X Band
S Band
UHF
Wireless
Wired Connection

