EXTRATERRESTRIAL ENGINEERING AND CONSTRUCTION (EXTEC) RESEARCH

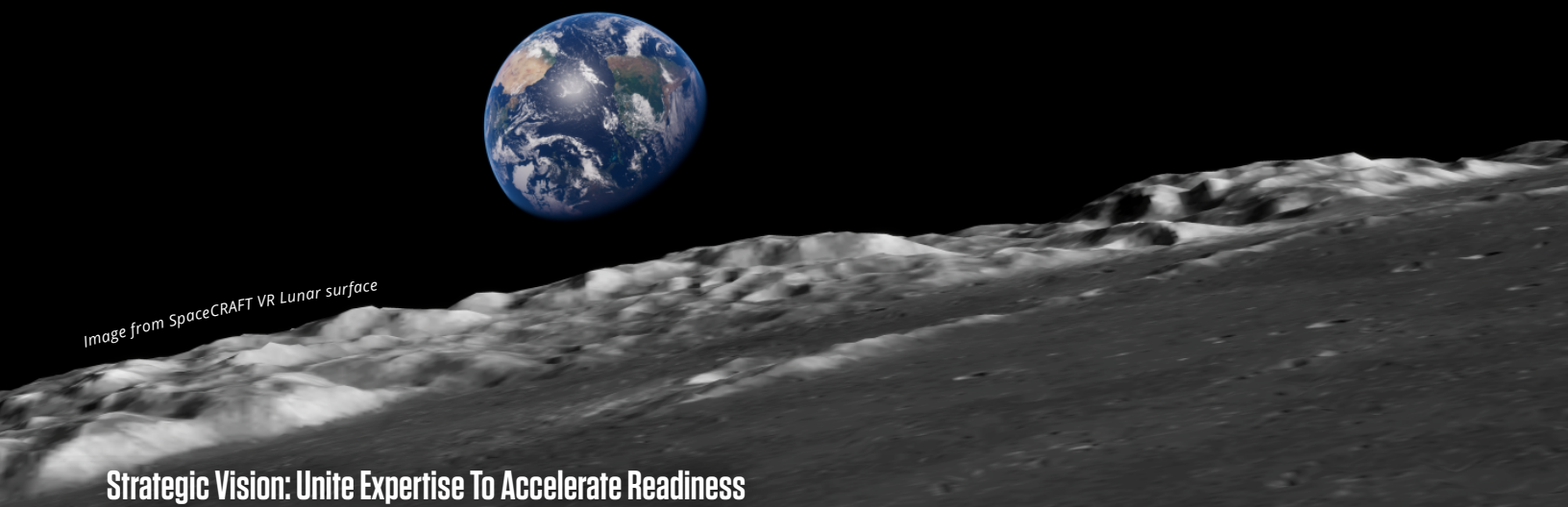


Image from SpaceCRAFT VR Lunar surface

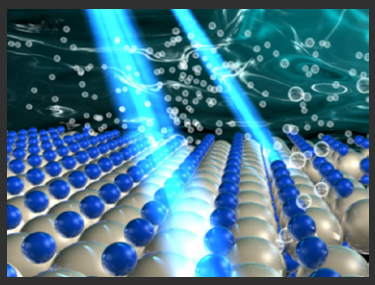
Strategic Vision: Unite Expertise To Accelerate Readiness

Texas A&M University's Extraterrestrial Engineering and Construction — EXTEC— research initiative activates the interdisciplinary internal and external collaborations required to accelerate the development and testing of materials and methods for on- and off-Earth civil engineering and construction solutions. Our ethos is pragmatic, methodic and synergistic. Our function is to discover, develop and validate applied infrastructure solutions through robust modeling, simulation, and rigorous experimentation. Closing the knowledge gaps will mitigate risk and maximize mission success in Lunar and Martian surface operations.

CREDIT: NASA

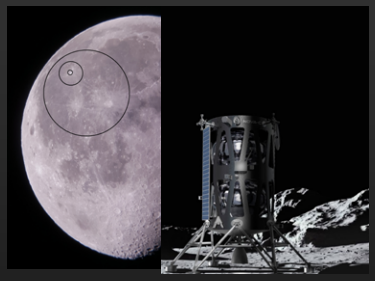
Radical Collaboration – We're here to help.

A comprehensive multidisciplinary approach is required to meet the challenge of rapid and responsive technology development for the Artemis missions. No single discipline or organization is equipped with all the required insights, so the best available minds and resources must act together. EXTEC will facilitate interdisciplinary research teams across the Texas A&M Space Alliance (TAMSA), within NASA, and across industry and academia. This approach will also uncover synergies between STMD, HEOMD and SMD areas of interest.



Dust to Structures

D2S is an integrated program for ISRU-based materials characterization and development. Through experimental testing and multi-scale modeling, it will ensure the performance of infrastructure elements for dust control and repeated access to off-planet surfaces. Landing pads, berms, blast and radiation shields, roads, and path pavers are all targeted products of ISRU. This work will draw upon best practices emerging from other expeditionary-type missions in remote and extreme environments, such as in-theater military operations and global deep oceanic research (IODP). Materials and methods for constructing in the lunar environment will be a primary product of D2S.



Lunar Surface Experiments Program

LSEP is a step-wise initiative to establish the science, engineering, and materials knowledge base required to inform models and methods for lunar surface operations. Initial experiments, to be flown on early CLPS missions, will test 3-phase (solid/liquid/gas) fluid dynamics in 1/6 g, novel solar cell generation and radiative coating performance in the dusty lunar environment while ground laboratory experiments will develop methods for lunar soil consolidation. Increasingly complex and integrated deployments would ride on CLPS and NASA science and cargo missions in tandem with NASA's path to Lunar Sustainability, targeted for 2030.

Prospective landing site in the vicinity of Herodotus crater (left). NOVA-C lander, credit Intuitive Machines (right).

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Enabling Research Areas

- ISRU Materials Development for Structures and Machinery
  - *High-fidelity Simulant Characterization and Testing*
  - *Multi-scale Modeling for Materials Formation, Radiation Degradation*
  - *Planning and Requirements Building for Infrastructure*
- Additive, Subtractive and Automated Construction
- Robotics and System Integration
  - *Materials, Power, CNC for fully autonomous*
  - *Testing of Human/Robotic-Assisted Operations*
- Artificial Intelligence & Data Science
- Sensors and Embedded Systems (for Precision Navigation and Timing)
- Synthetic Environments
- Planetary Analog Studies

Laboratories and Testing Facilities

- Advanced Multi-scale Infrastructure Materials Characterization
- Small-to-Large Scale Seismic/Vibrational Testing
- Mission Control Room for Teleoperations Testing
- Hypervelocity Chamber for Meteoritic Impact Testing
- Center for Radiation Engineering and Science for Space Exploration
- Aerospace Human Systems Laboratory (AHSL) (PoC bjdunbar@tamu.edu)
- Human-Rated Short-Radius Centrifuge (Acquired from JSC) PoC bjdunbar@tamu.edu
- AeroSpace Technology Research and Operations (ASTRO) Lab
- Land, Air and Space Research Lab (LASR)
- Aggie Satellite Lab (to build space-ready instruments)
- Innovation Proving Ground Complex *(coming in 2021 for Army Future's Command)*
  - *Autonomous Operations in Challenging Environments*
  - *1km-long, 2m-diameter Hypersonic Impact Tube*
- Lunar Yard for Excavation, Construction and Mining *(coming in 2021)*
- Regolith Test Beds: High-Fidelity Simulants, Large-Scale Testing (proposed)
  - *Regolith Dust Chambers for suited astronaut and rover testing (proposed)*
  - *X-Large "dirty" TVAC (notional)*

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