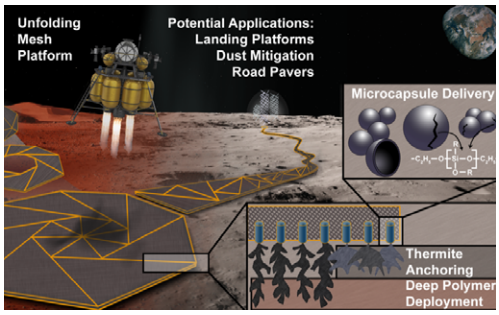
EXTRATERRESTRIAL ENGINEERING AND CONSTRUCTION (EXTEC) RESEARCH

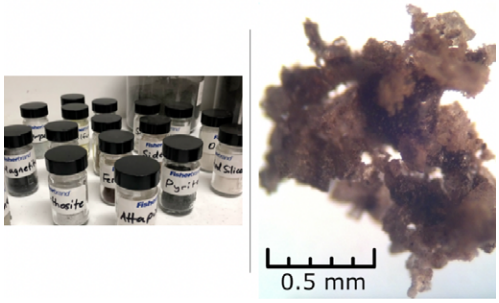
TEXAS A&M UNIVERSITY

Featured Projects



Flexible Lightweight Infrastructure Platform (FLIP) for Planetary Surfaces

A proposed breakthrough approach for preparing the early landing sites using flexible, lightweight heat-resistant mesh that auto-deploys to form a stable platform. Microcapsule delivery systems on underside and rim deliver precursors to spot-weld anchor points to underlying regolith through in-situ formation of advanced high-strength steel pegs. It also delivers additional subsurface regolith stabilization precursors deeper within the soil resulting in an underlying bulwark of thermite-fused regolith that provides dust control and load-bearing capacity.



Regolith Characterization: Real Granular Morphology and Mineralogical Composition

Research is underway on regolith simulants and Apollo samples to characterize chemical and physical reactivity and traffic-ability. This information will be used to test polymerization/modification of the simulants and to develop materials for applications such as space craft landing pads, roving vehicles, and 3D-printing mixtures.

Credit: Exolith Labs (left) and Outward Technologies (right) for simulant and agglutinated particles respectively.

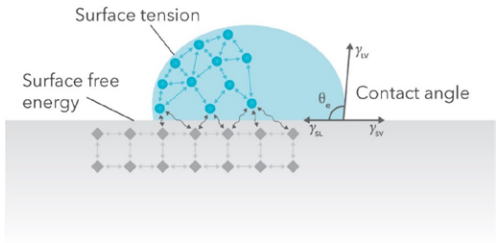
Space CRAFT Virtual Reality "Sandbox"

SpaceCRAFT VR is a high-fidelity, physics-based solar system simulator made for large scale engineering system design, integration and collaboration. Its architecture allows for quick, modular integration of physical and analytical models of the simulated environment, engineering systems, and human-computer interfaces so that actual operational scenarios can be tested in a richly detailed VR space. Complete Lunar data comes from LRO LOLA (Lunar Orbiter Laser Altimetry) data at 170-meter resolution.

Pictured: Realistic terrain and lighting at the south pole

Semi-Autonomous Navigation of Detrital Environments (SAND-E)

Martian science and operations analog studies using rover path-planning through AI-enabled terrain interpretation and unmanned aerial systems. Scientifically, the task is to study the Mars-like terrains of Iceland in order to learn more about how the sediments change physically and chemically. Operationally, the task is to test the capability of artificial intelligence and drones for rover science operations and navigation for NASA ahead of its Mars 2020 mission.



Partial-Gravity Fluid Dynamics Research

Proposed is a small experimental payload on a Lunar lander which will collect data on gas/liquid phase change on the Moon to quantify buoyancy, convection, reaction rates of fluids and gases which are integral to processing and utilizing the Lunar resources as well as managing cryogenic fuels. TAMU Aerospace Human Systems lab (AHSL) is currently developing CFD models which extrapolate the behavior of gas/liquid/solid systems between 1 g and zero g. This data will serve to validate such models and also contribute to future parametric modeling of fluid systems for the surface of Mars, with 3/8g. PoC: bjdunbar@tamu.edu

EXTEC TEAM MEMBERS

(NOT EXHAUSTIVE AND STILL GROWING)

Sarbajit Banerjee

Professor, Chemistry and Materials Science Engineering

Nanoscale design of novel materials for 3D printing, catalysts for water splitting for H2, trigger activated thermal insulation, corrosion inhibition

Bjorn Birgisson

Professor, Civil-Geotechnical and Materials

Multi-scale (nano—macro) modeling, characterization, development of materials for construction

Jeffrey Bullard

Professor, Civil and Materials Science Engineering

Thermodynamics, chemical kinetics, digital image modeling to understand and control microstructure development for construction materials

Greg Chamitoff

Professor, Aerospace Engineering

Director of Aerospace Technology Research and Operations (ASTRO) Lab, Creator of SpaceCRAFT VR

Bonnie Dunbar

Professor, Aerospace Engineering
Former NASA Astronaut

Partial gravity fluid dynamics experimentation and modeling, Spacesuit design, HEOMD liaison

Alaa Elwany

Industrial and Systems Engineering; Materials Science and Engineering

Modeling, analysis, control, materials development for advanced metal additive manufacturing; Co-Investigator in NASA HOME

Ryan Ewing

Professor, Geology/Geophysics

Atmospheric particle transport, planetary analog mission planning, terramechanics, AI-enabled terrain navigation and autonomous operations

Zachary Grasley

Director of Center for Infrastructure Renewal
Professor, Civil Engineering

Analytical, computational, experimental techniques for advanced infrastructure materials

Yong-Rak Kim

Professor, Civil Engineering and Materials

Multi-scale modeling and testing for regolith simulant sinter-ability

Manoranjan Majji

Assoc. Professor, Aerospace Engineering; Director of Land, Air, Space Robotics Laboratory

Tensegrity structural systems, computational vision, autonomous robotics, terra-mechanics

Marion Nachon

PostDoctoral Researcher, Geology/ Geophysics

Mars Science Laboratory experience, Curiosity Rover Chemcam data acquisition/analysis, science operations, basaltic dust characterization and transport

Z.J. Pei

Mechanic and Systems Engineering

Cyber-manufacturing systems, additive and subtractive manufacturing processes

Julia Reece

Assistant Professor, Geology & Geophysics

Sedimentology, Sediment Mechanics, leading agglutinated simulant particle characterization

Helen Reed

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Director of the Aggie Satellite Laboratory

Designs, builds, tests space-flight ready instrumentation, payload integration, hypersonics

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Research Synergist, Construction Science (Architecture) and Center for Infrastructure Renewal:

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Professor, Aerospace Engineering

Tensegrity structural systems for Moon and Mars Applications

Patrick Suermann

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Military expeditionary construction and operations, ASCE and ASTM protocols development

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