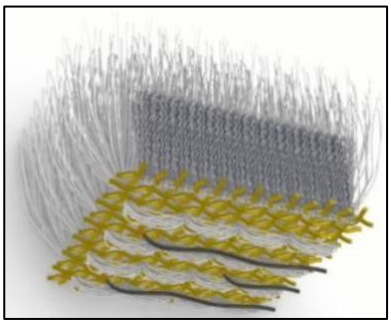
2021 BIG Idea Challenge Finalists



Brown University with Rhode Island School of Design

"TEST-RAD: Tufted Electrostatic Solution To Regolith Adhesion Dilemma"

Faculty Advisors: Dr. Rick Fleeter and Dr. Christopher Bull

Team Video: https://youtu.be/GhYIjW1dW88

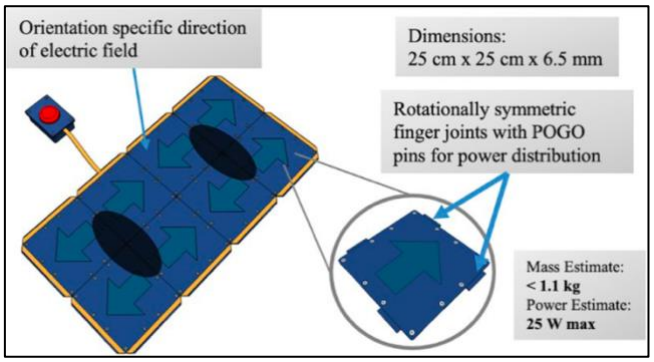
TEST-RAD aims to prevent suit & seal damage from electrostatically charged regolith and create a higher standard of safety for astronauts. TEST-RAD provides systematic layers of protection at the suit's most vulnerable points through implementing tufted electrostatically charged repulsion fibers and regolith catching fibers where abrasion is most likely to occur.

California Institute of Technology

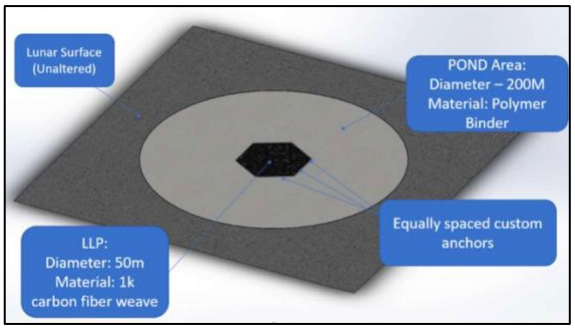
"Habitat Orientable and Modular Electrodynamic Shield"

Faculty Advisor: Dr. Soon-Jo Chung

Team Video: https://youtu.be/d_2UnNPtdXQ



To address the issue of lunar dust intruding in habitable spaces, the Caltech team introduces the Habitat Orientable and Modular Electrodynamic Shield (HOMES). HOMES is a collection of 0.25 m x 0.25 m and 1.1 kg panels requiring 8 W embedded with an Electrodynamic Dust Shielding (EDS) system to mitigate lunar dust in a variety of applications.



Colorado School of Mines with ICON, Masten Space Systems and Adherent Technologies Inc.

"Lunar In-Situ Landing/Launch Environment (LILL-E) Pad"

Faculty Advisors: Dr. George Sowers, Dr. Christopher Dreyer, Dr. Kevin Cannon, Jason Ballard, Matthew Kuhns, and Dr. Ronald Allred

Team Video: https://youtu.be/Tf-_ul1WaY8

The Lunar In-Situ Landing/Launch Environment (LILL-E) Pad, addresses landing dust prevention and mitigation on the Moon. The system consists of two parts:

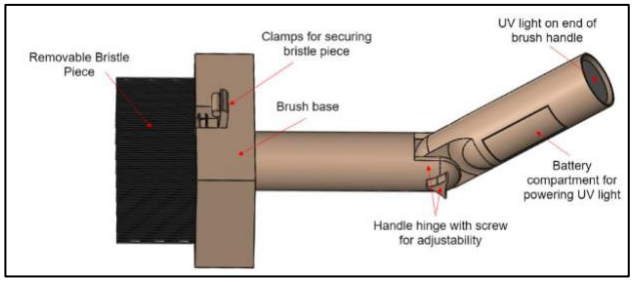
1) the POlymer Nozzle Distribution (POND) area, which consists of a binder-regolith reinforced surface, and
2) the Landing/Launch Pad (LLP), a carbon fiber fabric barrier that is anchored to the surface as the central landing/launch point.

Georgia Institute of Technology

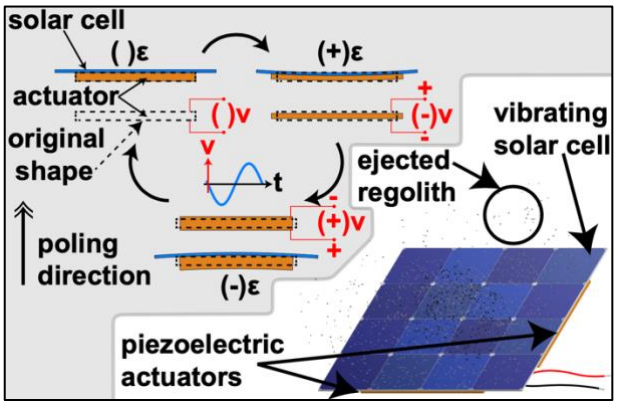
"Hybrid Dust Mitigation Brush Utilizing EDS and UV Technologies"

Faculty Advisors: Dr. Julie Linsey, Dr. Thomas Orlando, Dr. Edgar Glenn Lightsey, and Dr. Zach Seibers

Team Video: https://youtu.be/D8fADKdK7TQ



Shoot for the Moon proposes a hybrid brush which utilizes EDS and UV technologies to remove lunar regolith from space suits and other applicable surfaces. Bristles in the brush contain electrodes in an EDS system that attracts the charged lunar regolith particles and brushes them off the suit. Remaining, uncharged regolith particle are charged by UV emitters to enable removal by the EDS system.



Missouri University of Science & Technology

"Contaminant Ultrasonic Removal via Vibration Ejection from Solar Cells"

Faculty Advisors: Dr. Daniel Stutts, Dr. Fatih Dogan, Dr. Ed Kinzel, and Dr. Leslie Gertsch

Team Video: https://youtu.be/X41g6UfQPGs

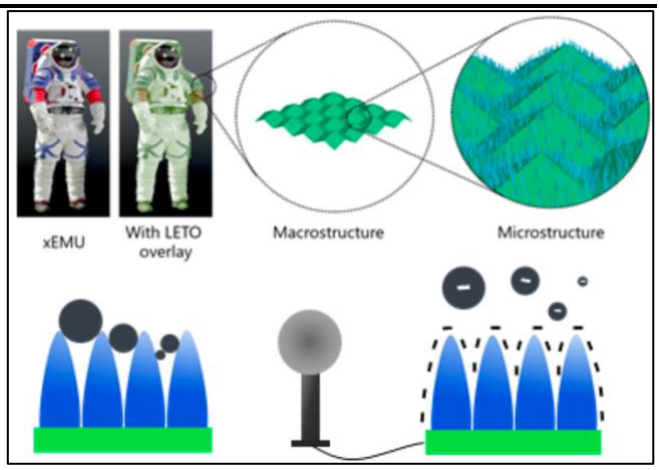
To mitigate dust on the surface of objects on the moon or Mars, we propose to remove particle contaminants on solar cells via ultrasonic vibration through a strategy of maximizing surface acceleration through optimally placing PZT elements on a phosphor bronze substrate supporting the solar cells, and through the use of sol-gel surface treatments to reduce Van der Walls forces.

University of Central Florida with Morphotonics

"LETO - Lunar Dust Mitigating Electrostatic micro-Textured Overlay"

Faculty Advisor: Dr. Lei Zhai

Team Video: https://youtu.be/iF0Idk-vXLg



We propose a bio-inspired materials engineering solution to mitigate lunar dust through three aspects:

1) constructing a hair-like surface microstructure which mimic pollinators, to decrease the strong interaction between the dust and the exterior of the suit
2) fabricating conductive fabrics to dissipate charges on lunar dust, and
3) use of origami-based design to improve material longevity.

Figure 1 Using liquid nitrogen to remove lunar dust simulant with the Leidenfrost effect

Figure 2 CAD rendering of system concept

Washington State University

"Leidenfrost Dusting as a Novel Tool for Lunar Dust Mitigation"

Faculty Advisors: Dr. Jacob Leachman, Dr. John McCloy, and Dr. Konstantin Matveev

Team Video: https://youtu.be/E-92eErZLW4

Liedenfrost dusting uses the novel evaporation of cryogenic liquid droplets to lift and transport lunar dust from spacesuit materials. We have designed a cryogenic spraybar utilizing present fluids and no auxiliary power to remove, collect dust at the lowest point, and pressurize within an airlock. Preliminary tests with liquid nitrogen and volcanic dust indicate 89.5% dust removal.