UAF Robotics: Overview & Summary

NASA lunar robotics projects

Name	Goal & Timeline	Lunar Material Specifications	Robot Specs
NASA Robotic Mining Competition (**RMC**) NASA page	University contest to dig up gravel "icy regolith" simulant at Kennedy Space Center. UAF wasn't selected for 2022, but next year's contest will be autonomous construction.	2.5 x 6.8 meter arena (steel box) Dig through 30cm of dust to get to icy regolith (limestone chips). Points for autonomy, but can be teleoperated.	1.1 x 0.6 x 0.6 meter robot Up to 80kg robot 15 minute competition run Beacon 1m x 0.25m (top) or 1m x 0.5m (bottom).
NASA **LuSTR** Grant proposal: Autonomous Robotic Terrain Manipulator (ArtM)	Dr. Lawlor's grant proposal to robotically build landing pads on the moon. Collaboration with Crow Industries. Proposal sent out in September 2021. If funded, we'd start late spring 2022.	Build a 10 meter diameter landing pad by compacting the top 30cm of dust, fill craters, and remove rocks. Must be fully autonomous.	1.5 x 1.5 x 2.5 meter robot Up to 83kg robot Beacon as big as you want.
NASA **Break The Ice** Lunar challenge NASA page YouTube playlist	NASA challenge to extract water from the permafrost at the lunar poles. Phase 1 is complete (we won $25,000!). Phase 2 starts early spring 2022.	Dig through 20cm of dry dust, 80cm of granular icy regolith (cookie hard), and up to meters of hard icy regolith (concrete hard). Deliver water several kilometers uphill to lander.	No hard limits, but it needs to fit on a lander. Our current "excahauler" robot is 1.4 x 1.6 meters, 60 kg, with a powered rockbreaker.
Regolith Milling project	Undergraduate space grant fellowship for Joren Bowling, advised by Dr. Lawlor. Fellowship runs through spring 2022.	Measure how regolith can be milled to a consistent grain size on the moon: vacuum, gravity, etc.	No hard limits. Looking at building up a dusty thermal vacuum chamber, in the 20-100 gallon volume range.

Other possible competitions:

- NASA BIG Idea: alternate locomotion (non-wheel) in extreme lunar terrain. Proposal due in January.
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Non-NASA robotics projects

Name	Goals & Timeline	Hardware Required
Robot snow manipulation	Dr. Lawlor really wants to test autonomous robot excavation by cleaning up the snow in his driveway. (Not bulk plowing, that's solved, but the tricky cleanup for doors and such.)	Same scoops & manipulators as regolith, plus snow density * Earth gravity = regolith density * lunar gravity
Frostcrete: ice-bonded dust Dr. Lawlor talk from 2020	Frozen mud sets about as hard as concrete. Frostcrete is a 3D printable 100% locally made building material for Alaska, lunar shadowed regions, or Mars.	Frostcrete extruder attachment for a robot or 3D printer.
Caregiver Robot	Ping Lan's company wants to develop an in-home care robot. UAF would be building a prototype sometime in the 2021-2022 timeframe. Funding is an NSF SBIR.	Wheeled base, multi-link manipulator arm.