# UAF Robotics: Overview & Summary

NASA lunar robotics projects

| Name | Goal & Timeline | Lunar Material Specifications | Robot Specs |
| --- | --- | --- | --- |
| NASA [Robotic Mining Competition (**RMC**)](https://drive.google.com/drive/folders/1fy1O4TLxJZBWkZlOSFBaV3gFGflq-MPE?usp=sharing)  [NASA page](https://www.nasa.gov/offices/education/centers/kennedy/technology/nasarmc.html) | 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)](https://drive.google.com/drive/u/0/folders/1pPTIuLwi3I1EOAKfGlkQW4MlG9mOOpWt) | 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](https://drive.google.com/drive/u/0/folders/1GDxad9lXEJlglC0DSUMSVsPDvdHIhXtl)  [NASA page](https://www.nasa.gov/directorates/spacetech/centennial_challenges/break-the-ice/index.html)  [YouTube playlist](https://www.youtube.com/playlist?list=PLzUqxgdd_VrwGryyA1dNWFwa8USb56-2h) | 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](https://drive.google.com/drive/u/0/folders/1aMoQrOoAZjV_H8HfQLa27jnb4D2BWEnJ) | 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](https://bigidea.nianet.org/competition-basics/): alternate locomotion (non-wheel) in extreme lunar terrain. Proposal due in January.

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](https://www.youtube.com/watch?v=9XL0IMKWf_8) | 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. |