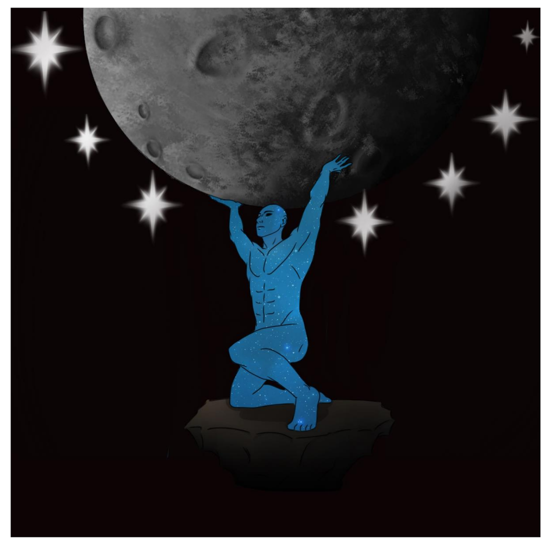

McLennan Community College Presents: The Pleiades Project
NASA MINDS - Artemis Project: Team Atlas

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Problem Statement

Astronauts need a light, simple, and strong anchoring device for quick attachment and release action on a multitude of surfaces or structures.

Objectives

Our main objective was to create an anchoring device for the astronauts to be able to rappel into craters and hold or lower equipment. The following is required:

- Reliable and resistant wear
- Easily serviced on the lunar surface
- Quickly and readily reproducible parts
- Ability to withstand the unforgivable conditions of the moon
- Stay in locked position for an extended period without service

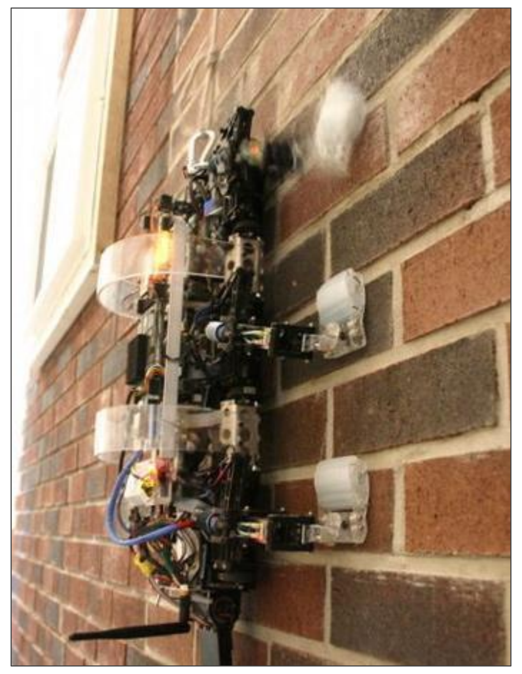
Research

Atlas investigated if there were any existing solutions as well as addressing environmental and terrain factors. Everything mentioned would have to be taken in mind for the prototype design. Moon dust would likely be our objective's biggest enemy. The problem of anchoring to celestial bodies is one that has been researched extensively by NASA, ESA, and other space agencies, but is not dissimilar to terrestrial anchoring problems, which have also seen attention.

Illustration of Philae. By ESA/ATG medialab - https://www.flickr.com/photos/europeanspaceagency/11206758513/, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=36825335

ESA's Rosetta Philae Lander
- Corkscrew anchors
- Angled harpoons
- Could not fasten to comet
- Failed mission

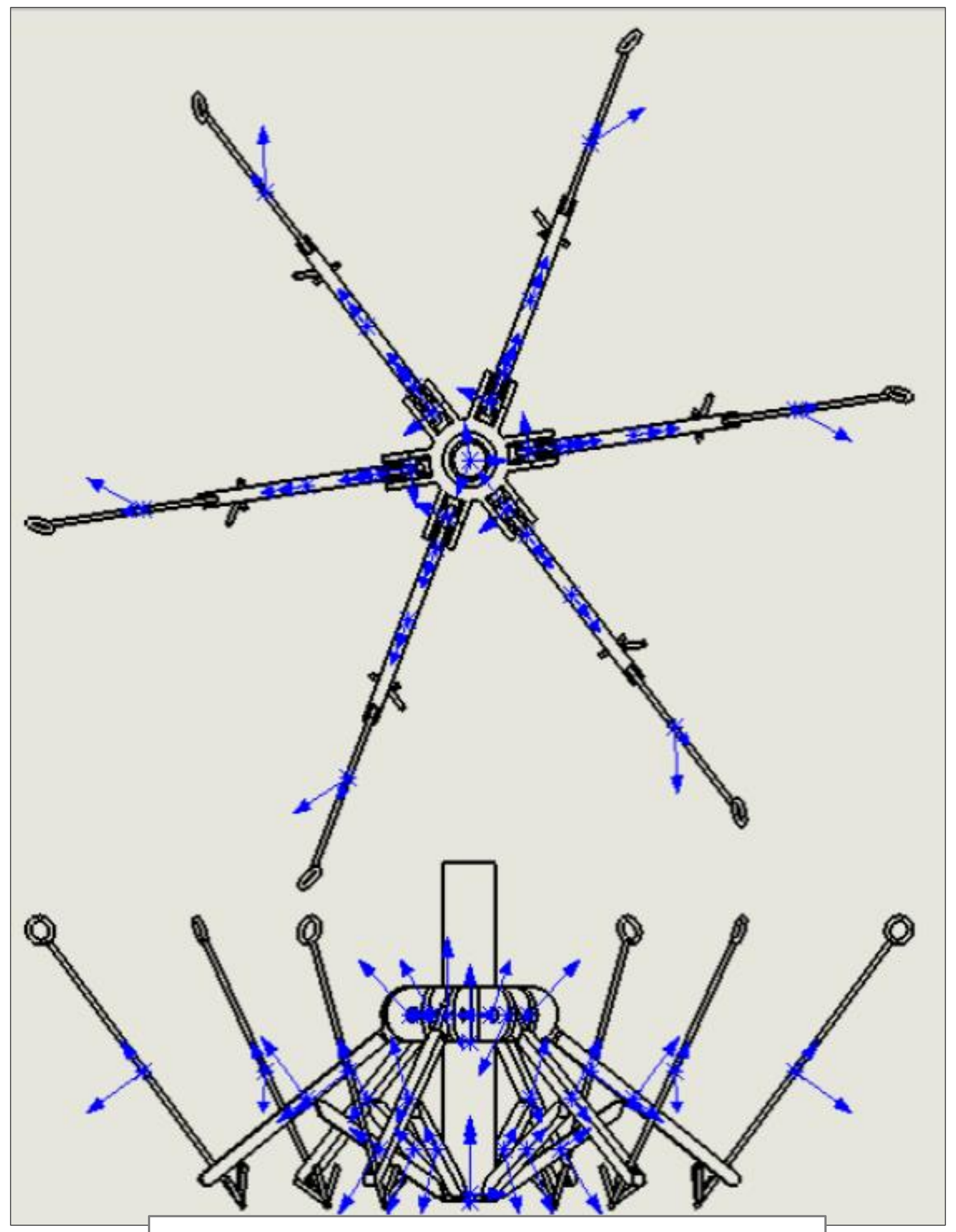
Stanford's Spiny-Bot, Sticky-Bot, and RiSE
- Uses micro-spines for textured surfaces
- Uses directional adhesives for smooth surfaces



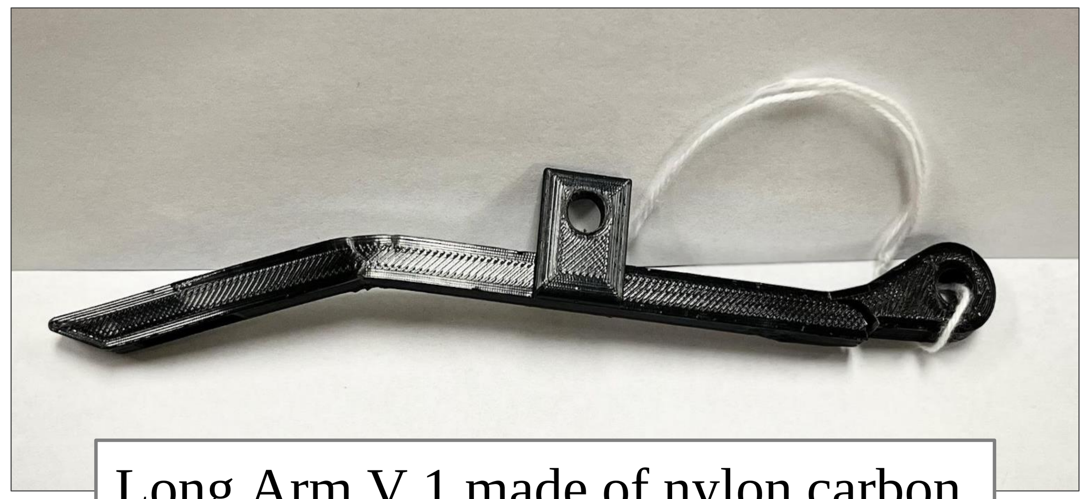
RiSE on Brick. By Mark Cutkosky – 28 Apr 2006

Design & Test

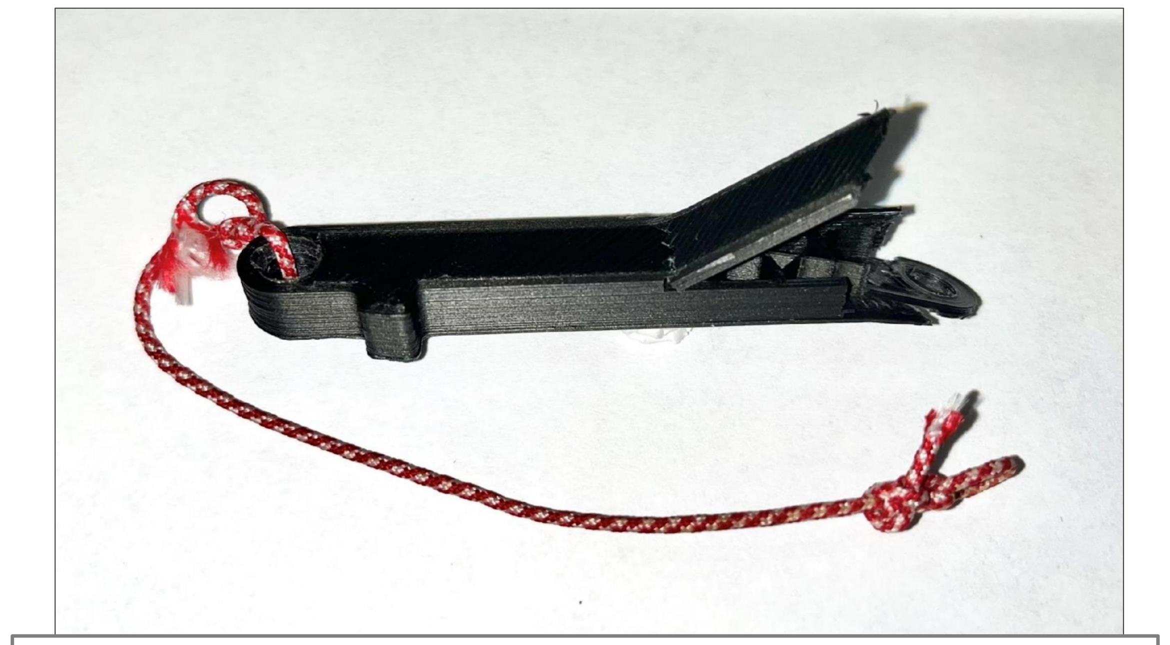
Early on we were able to settle on a base design for the anchor but after our first day of testing our design, we ran into our first issue. The arms of the anchor had difficulty performing to our expectations but after countless amount of redesigning the arms reached success. Following are first failed long arm and short arm:



An early conceptual design of Pleiades Anchor



Long Arm V.1 made of nylon carbon. This arm snapped after 8 kg.

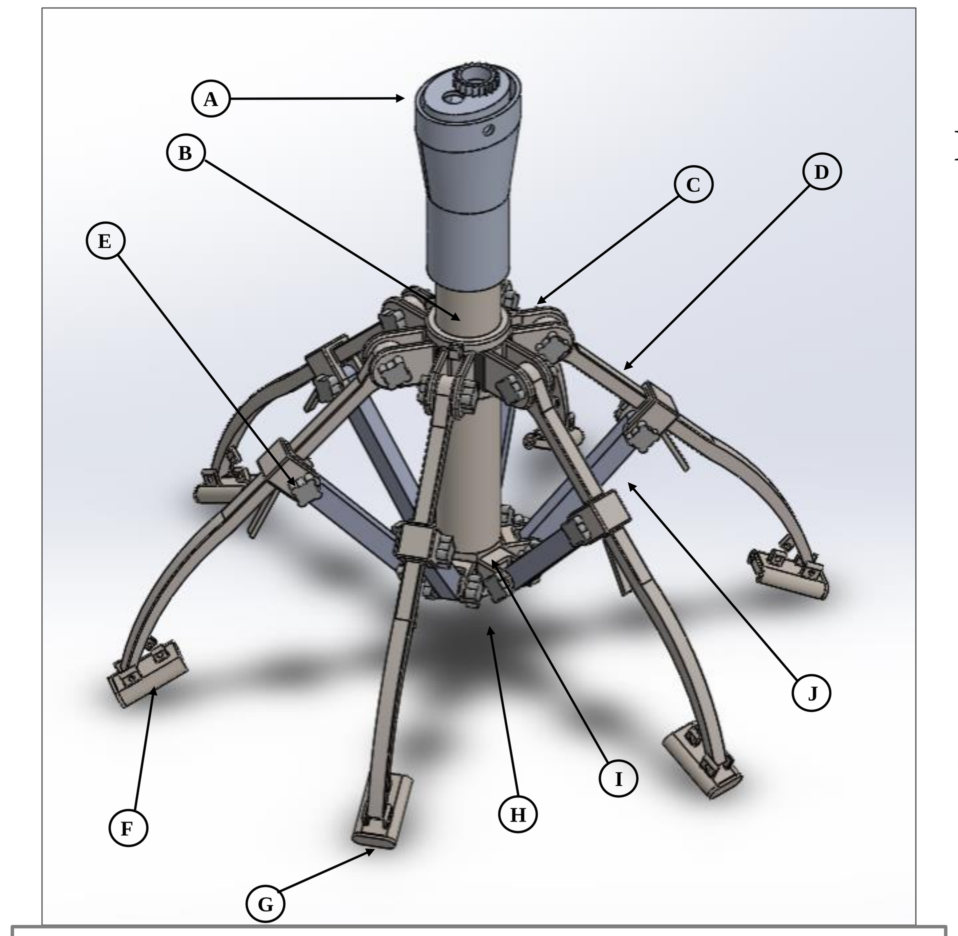


Short Arms V.1 made of PLA. Strapped vertically, this was able to hold at least 11 kg.

Following are two Trade Tables that contain our trade study data. The first compares three different 3D printing materials. The second compares multiple long and short arm designs that were tested in order to determine the best version according to our objectives.

ID	Material	Shear	Tensile Strength	Susceptibility to Breaking in Natural Position	Shear against pins	Over-all Performance	Final Score:
1	PLA (Polylactic Acid)	6	5	6	5	6	5.6
2	NCF (Nylon Carbon Fiber)	2	8	7	2	5	4.8
3	PLA-CF (Polylactic Acid- Carbon Fiber)	8	9	7	7	8	7.8
	Ideal Score: 10						

ID	Part Name	Shear	Tensile Strength	Susceptibility to Breaking in Natural	Shear against Pins	Points of Failure	Final Score:
1	Long-Arm 0.1	6	5	6	4	5	5.2
2	Long-Arm 0.2	4	5	6	6	7	5.6
3	Long-Arm 0.3	8	7	7	6	9	7.4
4	Short-Arm 0.1	6	5	5	7	5	5.6
5	Short-Arm 0.2	9	7	7	8	6	7.4



Final Design Image of Pleiades Anchor

Key:
A. Tensioner
B. Center Tube
C. Top Slide
D. Long Arm
E. Pin & Pin-Lock
F. Micro-spine Housing
G. Micro-spine Pad
H. Bottom Cap
I. Bottom Slide
J. Short Arm

Pleiades attached to a vertical surface

Pleiades Anchor collects a rock

Looking Forward

The Pleiades anchor is a sturdy, reliable device that allows users to quickly grab objects and is easy to learn to operate. Future iterations and improvements upon this design might include:

- Improved modularity
- Usable with one hand
- Spring-loaded needles
- Variants for micro spines
- Authentic materials vs prototyping
- Redesigned tension mechanism to improve stability

Acknowledgments

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