Antenna Mounting Structure For Lander or Zero Gravity Crewed Environment

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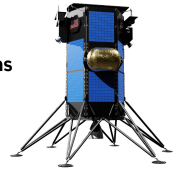
Background

The Intuitive Machines Nova – C lander is set to land on the moon in early 2022 and requires an antenna that can support proximity communications for lunar operations. A compact antenna mounting mechanism that can successfully deploy at a high elevation would solve this issue.



Objective

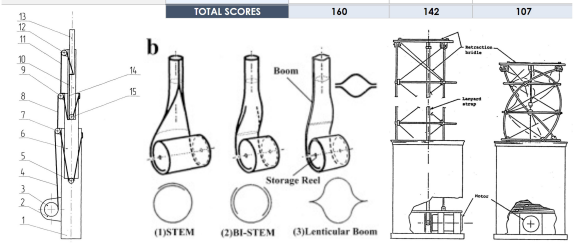
The objective of this project is to propose and explore numerous novel concepts for antenna mounting structures, free of specific mission imperatives, produce several feasible options, then prototype and test the most adequate candidate.

Design Requirements

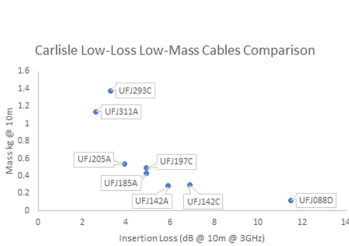
- Dust/Grit Resistant
- Height of 10 ft (w/ lander)
- Lightweight ~ 5 kg
- Deployable (compact)
- Withstand Temperatures from –280˚F to 260˚F
- Vibration Resistant
- Lifecycle ~ 20 yrs
- Attachment must support the design

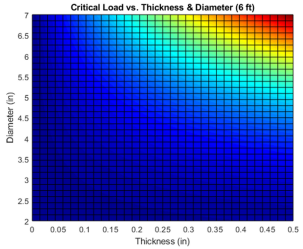
Design Concept

		DESIGN CONCEPTS		
		Concept 1	Concept 2	Concept 3
		Telescoping Mast	Deployable Boom	Triangular Truss Mast
CRITERIA	WEIGHT (1-5)	Concept 1 SCORES	Concept 2 SCORES	Concept 3 SCORES
Reach Deployable Height (10 feet)	5	5	5	5
Low Cost	3	3	4	3
Lightweight	1	3	4	4
Endure Vibrations from Launch/Landing	5	5	4	3
Stowed in Small Volume	2	3	5	4
Deploy in Vacuum Conditions	5	5	4	3
Mounting Ease to the Nova-C Lander Side Panel	5	4	3	2
Ease of Deployment	4	4	4	3
Strength to Hold Antenna Weight without Buckling/Failing	5	5	2	1
Simplicity (Reduction in Assembly)	2	3	5	2
	TOTAL SCORES	160	142	107



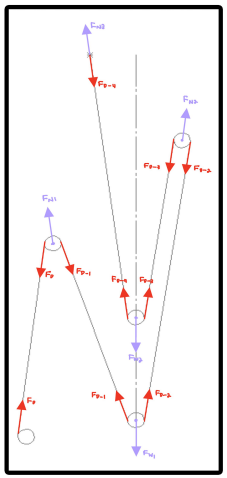
Analysis

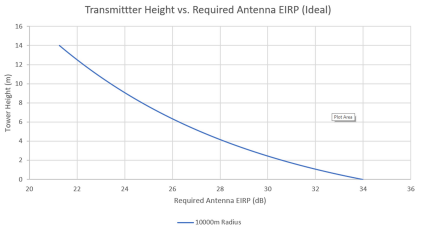




- Cable UFJ205A was chosen to minimize loss and mass

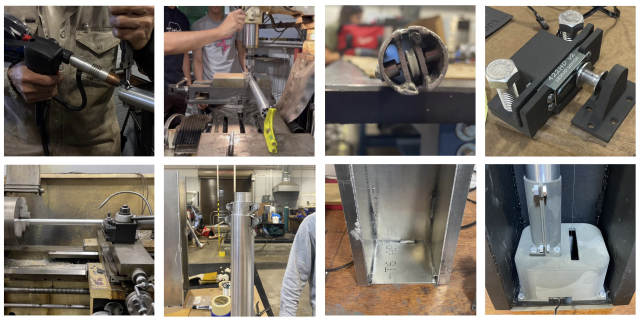
- Determined major O.D. of 1.75 in and minor O.D. diamter of 1 in



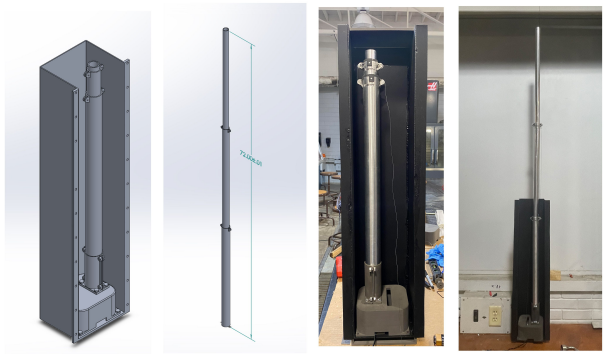


- Height of 6 feet was achieved by a preliminary radio link design model.
- The motor torque was estimated using a force analysis of the pulleys; a necessary torque of 2.8 N*m was calculated.
- Mast only needs to deploy once, so lunar dust is not an issue after deployment.
- Locking pins were added to the middle and top segments to lock the mast

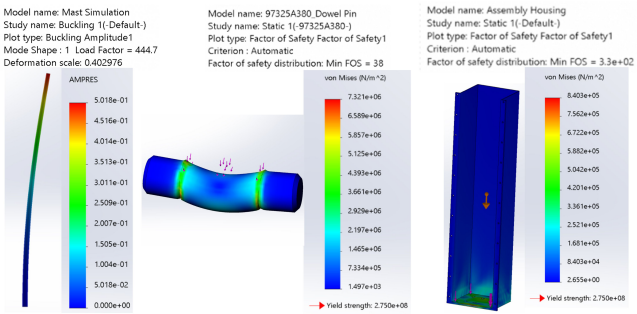
Manufacturing



Final CAD / Prototype



Results



- Load Factor = 444.7 therefore mass will not buckle
- Pin Factor of Saftey = 38 therefore it will not fail
- Housing Facor of Saftey = 330 therefore it will not fail

Conclusion / Future Work

- Need to replace braided fishing line for dyneema cables
- Attatch a lid and vacuum seal to fully seal the housing
- Schedule a vibrations test to test the integrity of the structure
- Find lighter material to make the structure more lightweight
- Ability to reduce material size due to very large saftey factor

Acknowlegements

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