Habitat and Crew Worksite Enhancement

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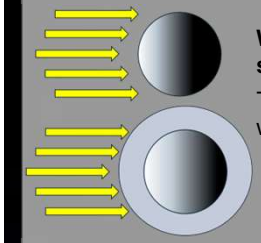
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University of Houston Clear Lake

OVERVIEW

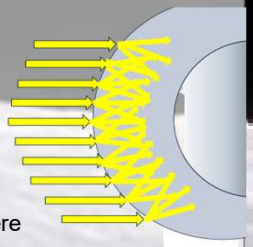
- Long shadows and glare from harsh sunlight make the lunar south pole a challenging visual environment
- LumaShield is a portable barrier designed to diffuse sunlight and protect from secondary debris
- The design uses a stanchion housing to deploy a retractable expanded polytetrafluoroethylene (ePTFE) textile barrier

BACKGROUND & OBJECTIVE



What is collimated sunlight?

This is sunlight whose rays are parallel, with minimal spread over distance



Why does sunlight not behave this way on Earth?

Before striking the planet's surface, sunlight is scattered by Earth's atmosphere

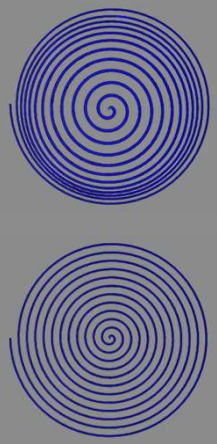
Why is collimated sunlight a problem for lunar operations?

Because the moon lacks an atmosphere, sunlight is not scattered. Collimated light strikes the lunar south pole at low angles and creates high-contrast shadows, making visual tasks difficult [1]. Intense solar radiation can also degrade materials [2].

Main Project Objective: Create a barrier to diffuse sunlight at the lunar south pole

DEPLOYMENT CONCEPT

This prototype utilizes a textile roll that is stored in its base. As the roll is deployed, a force is developed in the spring, pulling the textile barrier back into the base.



Force-induced elastic deformation in a spiral torsion spring



MATERIAL INFORMATION

Properties of Expanded PTFE (ePTFE)

Property	Value	Relevance
Operating Temperature Range	-250 to 260°C	Can the material survive extreme temperature ranges?
Void Ratio	0.33 to 32.33	How much empty space is in the material. This affects density, light scattering, flexibility, etc.
Optical Haze	> 98%	How much transmitted light is deflected by more than 2.5°
Bulk Density	0.4 to 0.6 g/cm^3	Lower density reduces launch mass compared to solid polymers

Sources: [3], [4], [5]

FUTURE WORK

- Design will undergo iterative prototyping during second semester
- Several improvements are being considered, including the addition of a backing layer
- Testing will be conducted on material samples and prototypes to determine key performance metrics
  - Optical testing and simulation to verify a high level of diffuse transmission
  - Cryogenic temperature testing to ensure material survival and ductility/toughness
  - Impact testing to simulate the effects of being struck with lander ejecta or other debris

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References

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DESIGN CHALLENGE