SHELL

Self-Deploying Human Extravehicular Logistics Linkage

DEPARTMENT OF AEROSPACE ENGINEERING

A. JAMES CLARK SCHOOL OF ENGINEERING

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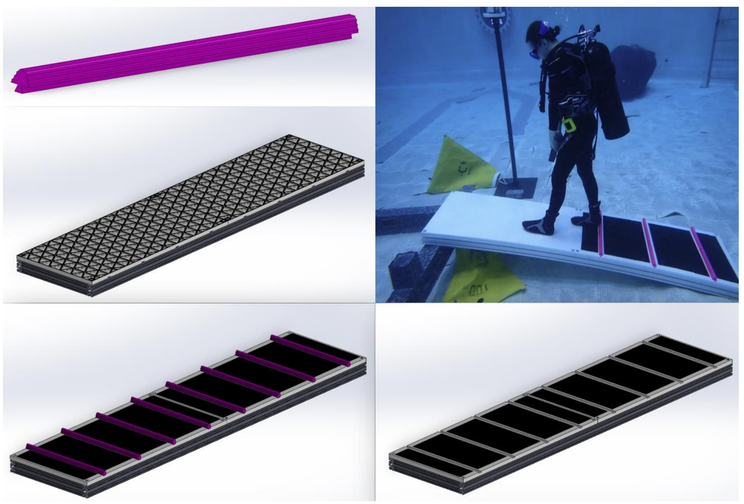
Mission Statement

Design and prototype a robotic pressurized tunnel to operate in the lunar environment, capable of maneuvering to connect lunar modules for logistics transfer.

Selected Mission Requirements

1. The tunnel shall be 3.05m in length while fully extended with ± 0.3m of additional extensibility.
2. The tunnel shall stow to a length of no more than 1m.
3. The tunnel shall be safe for human use without the need of a separate life support system.

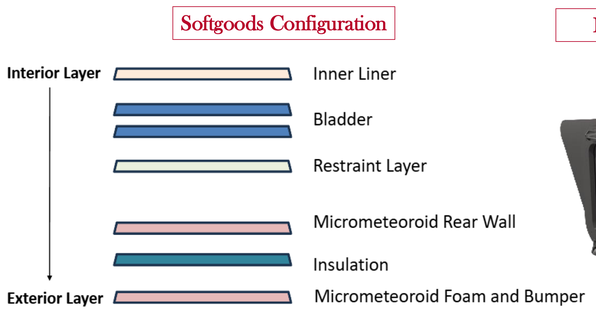
Human Factors Testing



Testing was conducted at the Neutral Buoyancy Research Facility to demonstrate astronaut traversal at inclinations up to the tunnels operating limit of ±30 degrees and to identify the optimal surface texture for ergonomic use. This testing also validated the tunnel size and overhead clearance required for astronauts operating in a lunar environment.

Full Scale Design

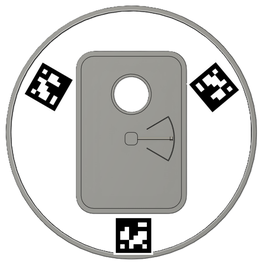
Softgoods Configuration



Full-scale Render

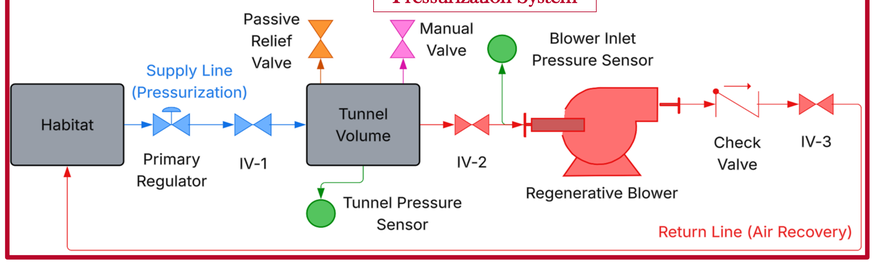
Walkway Design

Hatch Design



Docking System

Pressurization System



Mass Estimates

Full Scale Estimates:

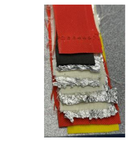
Part Name	Quantity	Part Mass (kg)	Margin	Mass w/ Margin
Inner Rings	5	22	30%	*28.6*
Floor Plates	4	22	30%	*28.6*
Soft goods	1	261	30%	*339*
active endplate	1	700	30%	*910*
passive endplate	1	700	30%	*910*
docking system	2	455	30%	*591.5*
Total				2807.7

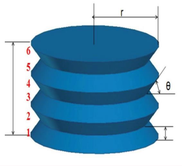
1/8th Scale Estimates:

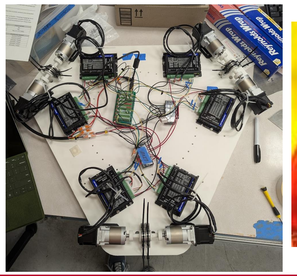
Part Name	Quantity	Part Mass (kg)	Margin	Mass w/ Margin
Corset Boning	1	0.26	30%	*0.338*
Cable	6	0.012	30%	*0.016*
Soft goods		3	10%	*3.3*
active endplate	1	1.5	10%	*1.65*
passive endplate	1	5.48	10%	*6.03*
docking system	1	0.18	10%	*0.198*
Camera Assembly	1	0.575	10%	*0.633*
Motor	6	0.3	10%	*0.33*
Gearbox	6	0.43	10%	*0.473*
Total				17.1

1/8th Scale Model

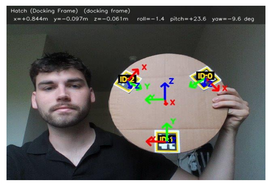
The tunnel has a diameter of 0.3 m, length of 0.38 m, and thickness of 3.24 mm. It contains a softgoods lineup consisting of a pressure bladder, restraint layer, insulation, and MMOD protection. It will be used to test pressurization, articulation, and stowage configuration.







Avionics Testing



Testing was conducted to display functionality of vision system code which estimates position and orientation of a mock hatch with AprilTags.

Gravity testing was conducted to validate tunnel articulation using gravity in place of pressurization. We successfully demonstrated extension, retraction, and 6-DOF mobility, confirming motor performance and system functionality.

Acknowledgements: Dr. Akin, Dr. Mary Bowden, Daniil Gribok, Nicolas Bolatto, Romeo Perlstein, Meredith Embrey, Kurt and Christina Stoskopf, Metal Supermarkets, Julian Cooper, Jeff Vedrin, Howard Grossenbacher, Joseph Hussey. Our ENAE 100 Team!