TECHNOLOGY
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Challenge Title:

Packaged Handrail for Inflatable Structures

Organization Name:

NASA Johnson SpaceCenter

Team Assignments Available: 3

Example of metallic handrail currently used

Summary of the Challenge and Team Project

Background:

Inflatable structures are being used as habitats currently on the ISS and for future deep space stations. These structures are made of high strength materials that are flexible and packed during launch, then inflated and rigidized in space – much like packing up an air mattress and inflating it when needed – but these air balloon are bullet proof and very strong.

Problem Statement:

To accommodate crew movement both inside and outside an inflatable habitat, we need handrails for the crew to grab onto and move their bodies. Metallic handrails are located all over the ISS both inside and outside, but are made of metal tubes and attached to the metal structures with bolts. For an inflatable, we need a handrail that can be attached to the fabric (likely stitched) and packed with the material during launch. It could be a totally fabric handrail using strong straps, or an erectable system with metal tubes attached to stitched tabs, or an inflatable tube handrail that is inflated by hand or anything you can come up with!

Important Design Considerations (These can be discussed, and possibly negotiated, in more detail after the Team has been assigned):

Size: All handrails need to meet specific size requirements to ensure a suit glove can fit underneath it and there is enough material to grip. For this design we will use a standard handrail size and shape that will be provided, in general, it's approx.. two feet long with standoffs at each end with a standoff distance of 2.25" from the wall of the inflatable habitat.

Strength: The handrail must be able to take 125 lbf of pulling force without breaking off of the wall. It must also be strong enough that a crew member can grip the handrail with one hand and rotate herself around the rail. To achieve this, the handrail must have a high torsion strength and allow for stiffness in that direction. (This is the difficulty with using a simple strap!)

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Packaging: The handrail must be attached to the fabric walls and able to be packed (very compactly) with the fabric materials. Once in orbit, the inflatable will be pressurized and the handrail should take shape and become rigid. This rigidizing could be done by a secondary hand pump operation if needed (for example if using an inflatable tube as a handrail). It could also be achieved by attaching rigid tubes to some flexible brackets and erecting a handrail (much like the poles of a tent).

Additional details on current handrail requirements and images can be found in the Human Integration Design Handbook:
https://www.nasa.gov/sites/default/files/atoms/files/human_integration_design_handbook_revision_1.pdf

What funding and/or resources can be provided to each Team? (The details of the payment arrangements must be negotiated with the Team.)

I will provide design details and guidance on the team's design. I can also provide structural testing if the team would like their design to be tested. I can provide small material samples if needed, but cannot provide funding or large amounts of materials.

Deliverables (the final product the Team is to provide – such as a report, garment, user evaluation, …):

The final product will be a presentation that outlines the design of the handrail and a demonstration of a handrail prototype that can be packed and shown to rigidize.

How Will the Results Be Used?

The handrail will be used for inflatable habitat designs of the future. We are currently looking for inflatable habitats on the Deep Space Gateway and are in need of a flexible handrail.

What deliverables (if any) are to be transferred to the organization at the end of the project?

I am interested in a working prototype and design details (outlined in presentation) to be transferred to me at the end of the project.