Tensegrity Building Blocks for Space Habitats

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Introduction

The design of a 3D printed, pre-strained, Tensegrity Prism is to be used as a lightweight, fundamental building block for structures in space. The Tensegrity Prism consists of three bars in compression and nine strings in tension, combined together to form a strong base that reduces the load bearing mass by about 90%. In addition, the design allows for individual pieces to be compressed and transported within a limited volume. Tensegrity Prisms are already used to build terrestrial structures and the technology is available to expand its use from near-earth orbit, Mars, and beyond.

Background

The concept of Tensegrity structures is derived from its name: tension and integrity. In its most basic form, a Tensegrity structure consists of compressive parts--rigid bodies--and tensile members--the strings. A Tensegrity configuration is achieved only when the tensile members, connected between the rigid bodies, are used to stabilize the structure. Moreover, the most ideal Tensegrity design involves a combination of three compressive members and nine tensile members, which ultimately minimizes mass and maximizes load-bearing.

Solution

The design that our team chose uses Shape Memory Polymer for the three vertical strings, stretchable polymer for the other six strings, and stiff polymer for the three bars. The three bars and strings would be printed flat. Next, the stretchable polymer strings would be tied to the ends of each bar to form two triangular faces. The SMP strings would then be heated using the

thermal energy of the sun. This process causes these strings to expand and become malleable, allowing them to be attached in the desired configuration. Finally, the SMP strings are cooled to revert back to their original shape. This final step creates the tension required for the Tensegrity Prism to be structurally sound.

Conclusion

The Tensegrity Prism can be a useful building tool in space. The convenience of 3D printing coupled with available resources makes the Tensegrity Prism an ideal building block for structures in space. The ability to recycle and reuse the material opens up possibilities which were previously unattainable without 3D printing. Given all the benefits of Tensegrity Prisms, we hope that they become a vital building block for structures in the future.