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QUALIFICATIONS

- CATIA V5R18 Part Design Specialist
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EDUCATION

- Bachelor of Engineering, Nihon University, Tokyo(2015)
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RESEARCH KEYWORD

Large Space Structure, Space Structure, Structural Design, Self-extension, Micro-gravity

RESEARCH OVERVIEW

1. Large Space Structure

In recent years, large scale space structures of several ten meters or several kilometers has been receiving much attention from all over the world (Fig.1). For example, there has been proposed many types of space solar power generation system SSPS^[1], large reflector of observation satellite or communication satellite^[2-3], sun shield and star shade for space telescope^[4].

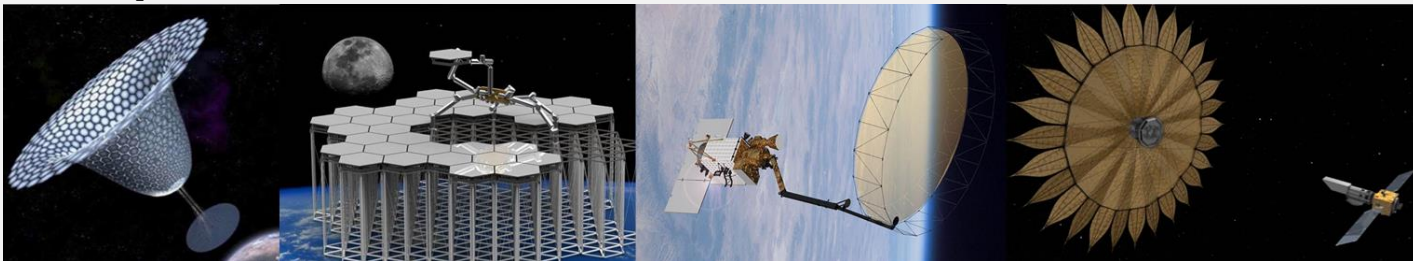


Fig.1 Example of Large Space Structure : SPS-ALPHA, Large reflector ,SMAP, Starshade

Therefore, I establish a method for constructing a large space structure which requires a certain degree of shape accuracy and complex shape. What is the requirement for constructing such a large space structure?

1.2 Requisition of large space structures construction

- Deployment structure (High storage efficiency)
It is necessary for payload to have a highly storage efficiency.
- Adaptation to complex shapes with curved surfaces
It is necessary for large space structure to deal with complex shape.
- Maintenance of developed shape (High rigidity structure)
The proposed structure requires a relatively high rigidity because the shape after deployment is retained.

[1] SPS-ALPHA: https://www.nasa.gov/pdf/716070main_Mankins_2011_PhI_SPS_Alpha.pdf

[2] Large reflector: <http://www.pellegrino.caltech.edu/in-space-telescope>

[3] SMAP: <http://www.northropgrumman.com/BusinessVentures/AstroAerospace/Pages/SMAP.aspx>

[4] Starshade: <https://exoplanets.nasa.gov/resources/1015/flower-power-nasa-reveals-spring-starshade-animation/>

RESEARCH OVERVIEW

2. Concept of Self-deployable Structure

I proposed an Self-deployable structure that meets the requirements of such a large space structure.

2.1. Three-Dimensional Self-Deployable Truss (3DBCON)

3DBCON is a regular tetrahedral structure (Fig.2). 4 triangle sides of the 3DBCON has 3 nodes and 3 BCON booms as shown in Fig.2. BCON boom is self-deployable member.). This regular triangle plane truss module is called 3N3B (3Nodes-3Booms).The 3DBCON is made up by pasting 3N3Bs on the pyramid joint (Fig.2).

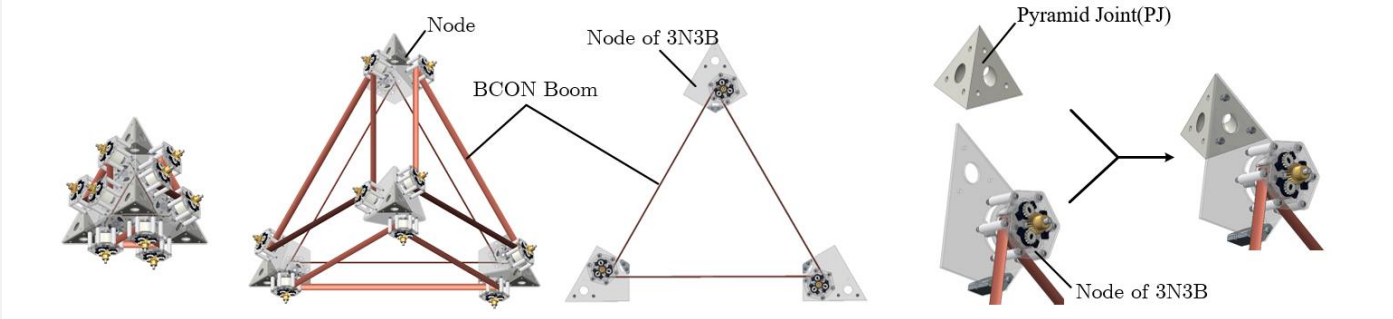


Fig.2 Stored configuration (left), Deployed configuration (right) , Node and BCON-boom and Attachment of node to Pyramid Joint. (*BCON boom is self-deployable member.)

2.2. Deployment of 3DBCON in Microgravity Environment

The deployment motion of 3DBCON is strongly affected by the gravity because it deploys spatially. Therefore, we have to conduct the experiment under microgravity environment. Thus we conducted the experiment using the parabolic flight of small airplane. Fig.3 shows the overview of the experiment.

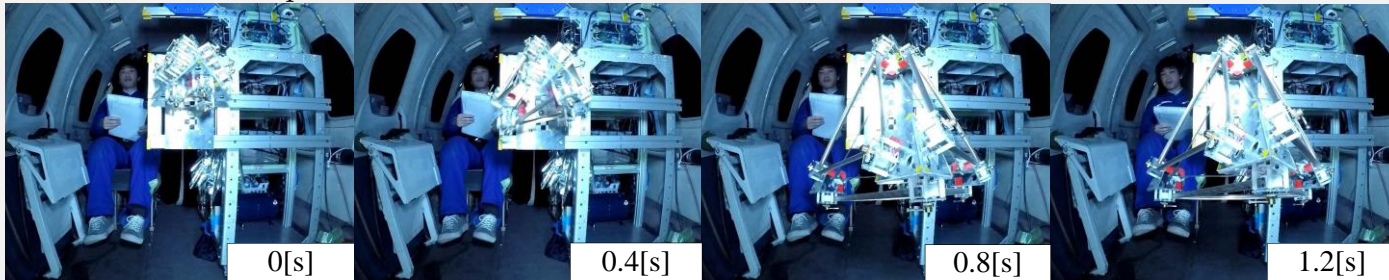


Fig3. Time history of Deployment Test of 3DBCON in Micro-gravity Environment by Airplane

2.3. Characteristics of 3DBCON

3DBCON stores the energy of the BCON booms which are wound, and it releases this energy to deploy itself. The shape of 3DBCON is fixed by putting 3N3B, a simple module, to the Pyramid Joint(PJ). Hence, various kinds of 3DBCON can be made by changing the shape of PJ and module. The example of self-deployable truss are as below.

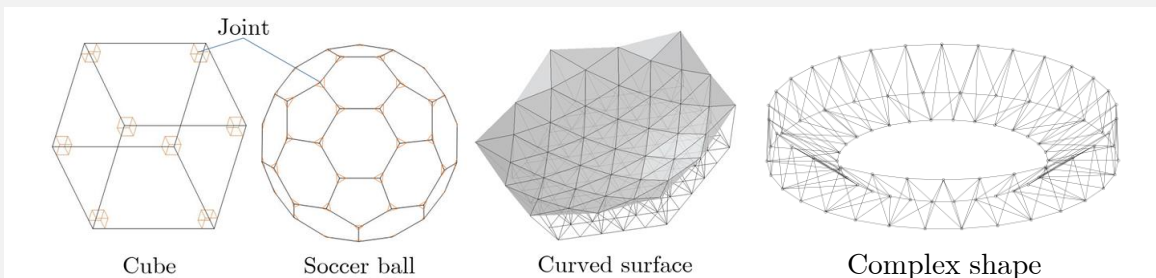


Fig.4 Example of self-deployable truss

As noted in Section 2.1, a line of the truss is composed of 2 booms as 3DBCON is made up to modules. As examples of this advantages are as below.

- It is easy to change the components. (We can change a module which causes problem without breaking down a structure.)
- It has a redundancy when a component is broken.
- It can be made by changing the shape of Pyramid Joint and module.