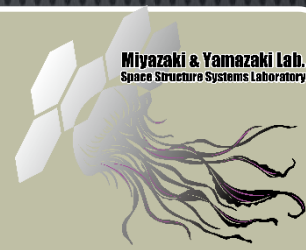




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◆ Education

- Apr. 2019-current Nihon-University, Japan Master of engineering
- Apr. 2015-Mar. 2019 Nihon-University, Japan Bachelor of engineering

◆ Qualification

- Amateur Third-Class Radio Operator

◆ Research Keyword

- Modular structure, Docking, Large and High precision space structure

◆ Research Overview ~ Bachelor ~

1. Modular Structure

In recent years, along with the enhancement of space missions, large, lightweight, and high precision space structures have been proposed.



Figure1.SSPS^[1]



Figure2.Star shade^[2]

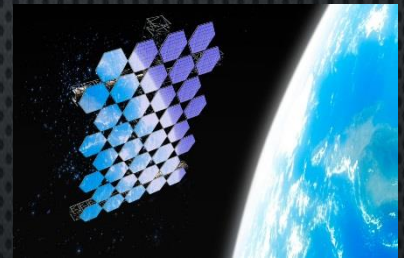


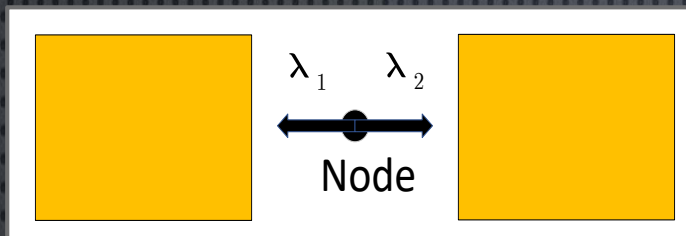
Figure3.Space telescope^[3]

There are various problems to realize a large space structure. In order to solve the problems, it is effective to modularize the structure. It is important for the design the modular structure to investigate the interaction between the modules by estimating the joint load during the mission.

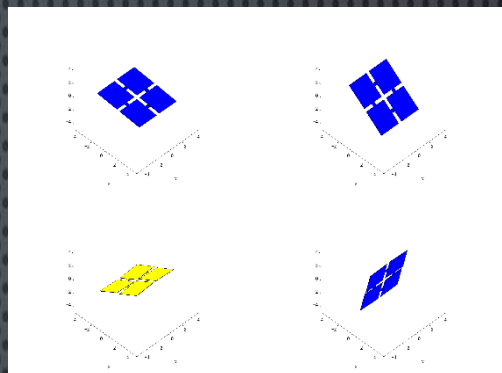
2. Dynamics of Modular Structure

When applying a modular structure to a high precision large space structure, it is necessary to correctly analyze the force applied to the joint. In this study, the force applied to the joint is analyzed by EMM (energy momentum method) and EMM applied LLM (localized lagrangian multipliers) to the restraint point, and confirmed that LLM is suitable for analysis of joints. The weight reduction and simplification of the structure can be made because it is possible to correctly select the shape adjustment actuator necessary for maintaining the accuracy of the high-precision large space structure to which the module structure is applied by estimating how much force is applied to the joint of the module structure. When constraining elements and elements, if constraints can be hierarchized, analysis is possible using only EMM, but if module structure diversifies, hierarchization will be difficult.

Set a virtual node at the junction of elements and elements, and let λ be the constraint between nodes and elements. This method is called the localized Lagrangian multipliers (LLM). Because each constraint can be calculated independently, it is suitable for parallel computing. It is also suitable for model calculations where three or more elements are constrained to one point. By applying LLM to EMM, we show its superiority.



Localized lagrangian multipliers



Rotation of point constrained rigid body

◆ Research Overview ~ Master ~

Development of docking mechanism

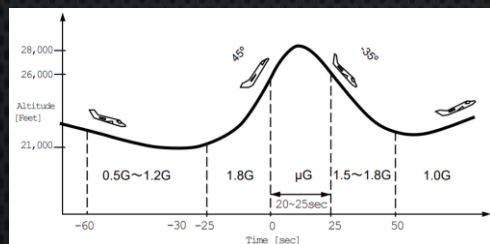
In order to realize a super large space structure, it is necessary to divide the structure into several elements (modules), launch separately with rockets, and assemble them in orbit.

However, in order to realize it, it is necessary to solve various problems. The following shows the advantages of applying modularization to the structure and the issues to be realized.

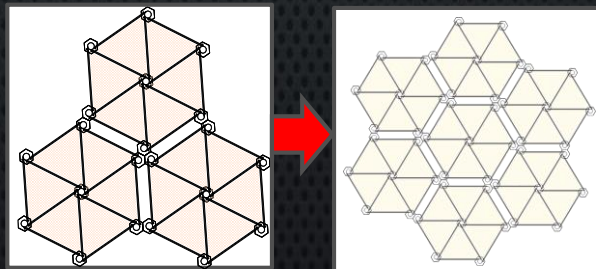
Advantages and issues

Advantage	Issue
The structure can be easily enlarged.	No establishment of accuracy maintenance method for the entire structure.
Ground experiment is easy.	The structure of the module has not been decided
Small-scale organization can develop.	Docking mechanism has not been developed.
Structural flatness can be adjusted at module joints	Not established scenario for realization.
Expected to extend the life of the entire structure	Method of formulation of joint has not been established
	An analysis method that takes into consideration the binding force has not been established

I would like to develop a docking mechanism that solves the above issues. Next year, We plan to prepare for microgravity experiments using aircraft.



Parabolic flight^[4]



Future plan

Reference

- [1] John C. Mankins, "SPS-ALPHA: The First Practical Solar Power Satellite via Arbitrarily Large Phased Array", NASA Innovative Advanced Concepts Program, September, 2012
- [2] NASA, "Exo-S: Starshade Probe-Class Exoplanet Direct Imaging Mission Concept", <https://exoplanets.nasa.gov/exep/about/exos/>, 2015.
- [3] Devin Coldewey, "Exo-S: Starshade Probe-Class Exoplanet Direct Imaging Mission Concept", <https://techrunch.com/2019/01/04/swarms-of-tiny-satellites-could-act-like-one-giant-space-telescope/>, 2018
- [4] 福島玄三 "航空機による微小重力実験", Jpn.Soc.Biol.Sci.space, 2001