Takeru Nakamura

Space Structure Systems Laboratory

College of Science and Technology,
Nihon University

Address 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan

Phone +81-47-469-5430

Email cstk15082@g.nihon-u.ac.jp

Education

Master of Engineering, Nihon University, Chiba, Japan, 2019-current
Bachelor of Engineering, Nihon University, Chiba, Japan, March, 2019
Kumamoto Daini High School, Kumamoto, Japan March, 2015

Professional Society

2018 – present The Japan Society for Mechanical Engineers

Research Keyword

Starshade, Occulter, Self-Deployable Membrane Truss(SDMT), Exoplanet,

Research And Development Experience

CubeSat **"NEXUS"**

I participated in CubeSat "NEXUS" project as member of C&DH subsystem group from 2016. The launch succeeded in May 2019, I carried out satellite operation, demonstration of high speed transmitter and high performance camera system on orbit. I belong to space structure systems laboratory since 2016 and I have studied on design method of Starshade. I presented my research at a conference sponsored by the Japan Society of Mechanical Engineers in March, 2019.

Research Overview

Theme : "Design Method of Starshade System Using SDMT"

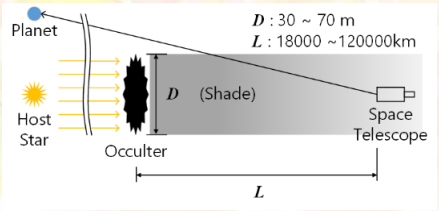
I am resarching on the design method of the Starshade system which is one of the observation methods of the exoplanets. Below is a detailed explanation of my research.

1. Exoplanet and Strashade

We call the planets outside the solar system "exoplanets", which orbit around the stars. One of the problems of exoplanet observation is too high intensity ratio between the host star light and the planetary light, and the Starshade system has been proposed as solution to this problem.

Staeshade concept image
https://www.spaceanswers.com/futuretech/new-worlds-mission-hunting-for-alien-life-using-a-starshade/

The Starshade system is a system that directly observes exoplanets by putting large stellar light shield called occulter between the space telescope and the star proposed by NASA/JPL.



Staeshade system overview

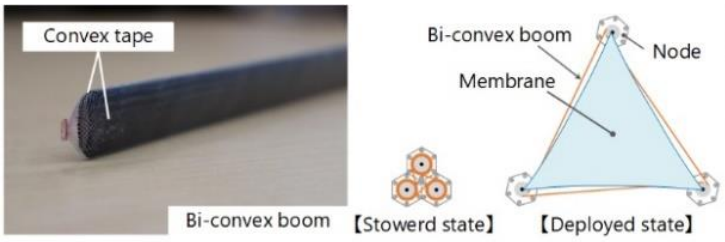
2. Currently Proposed Occulter

The shape of the currently proposed occulter is a petal shape which suppresses the diffraction of the stellar light as much as possible. Since this shape has a curved outline unsuitable for the deployment structure, the occulter is a very complex deployment style and its cost is expensive.

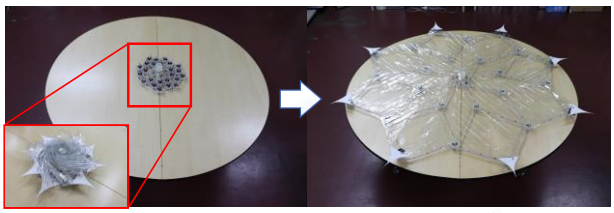
Occulter deployment, https://www.jpl.nasa.gov/habex/mission/

3. SDMT and Polygonal Shape Occulter

In order to solve the above problemes, we are working on applying Self-Deployable Membrane Truss (SDMT) to the occulter structure. SDMT is lightweight, and has superior storage and deployment capability, so that we consider it is the optimal structural form for composing occulter. We proposed a new polygonal shape for applying to SDMT structure.



↑ Convex tape and SDMT, Starshade small model →



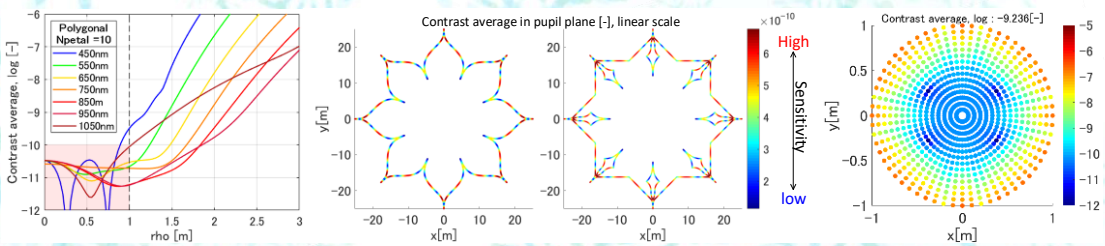
Steward state
ϕ0.47m

Deployed state
ϕ2.32m

4. Performance evaluation of occulter

Our final goal is to design and develop a starshade system using SDMT in the occulter structure, and to directly observe exoplanets. In order to realize that, it is necessary to clarify the requirement for the shape accuracy of the occulter and that for the attitude control.

For that purpose, we evaluate the performance of the occulter by analyseing the contrast distribution when the observation wavelength is changed, or the shape is deformed, or the attitude changes.



Contrast analysis result for wavelength, shape deformation and attitude change