Shoichi Shitara

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Education

- 2018 – 2020 Master of Engineering in Aerospace Engineering
  Nihon University, Funabashi, Chiba
- 2014 – 2018 Bachelor of Engineering in Aerospace Engineering
  Nihon University, Funabashi, Chiba
- 2010 – 2013 Morioka Daiichi High School, Morioka, Iwate

Qualification

- Amateur Third-Class Radio Operator, 2018
- Driver's License, 2015

Professional Society

- 2017 – present The Japan Society for Aeronautical and Space Sciences

Presentation

1. M. Fukunaga, Y. Miyazaki, **S. Shitara**, D. Kousaka, D. Kawarabayashi, Design Method of Self-deployable Truss to Prevent Jamming of Stored Booms, AIAA Scitech 2019 Forum, AIAA 2019-1525, pp.1-13, 7-12 January 2019, California, USA. (Oral)
2. **S. Shitara**, Y. Miyazaki, T. Nakamura, D. Kousaka, M. Fukunaga, Shape of Starshade using Self-deployable Membrane Truss, The 62nd Space Proceeding of the Space Science and Technology Conference, P74, JSASS-2018-4962, pp.1-6, 24-26 October 2018, Fukuoka, Japan. (Poster)
3. M. Fukunaga, Y. Miyazaki, **S. Shitara**, D. Kousaka, T. Nakamura, Application of Self-Deployable Truss to Starshade, 69th International Astronautical Congress, IAC-18-C2.2.2, pp.1-8, 1-5 October 2018, Bremen, Germany. (Oral)
4. **S. Shitara**, Y. Miyazaki, Effect of Shape of Starshade on High-Contrast Imaging, The 26th Space Engineering Conference, 1A4, pp.1-8, 22-23 December 2017, Kanagawa, Japan. (Oral)

Award

1. The JSASS Most Excellent Presentation Award for Student at the 62nd JSASS Space Sciences and Technology Conference, 25 October 2018.
2. Honor prize of College of Science and Technology, Nihon University 2018, 18 March 2017.

Research Keyword

- Starshade, Occulter, Self-deployable membrane truss, High-contrast imaging

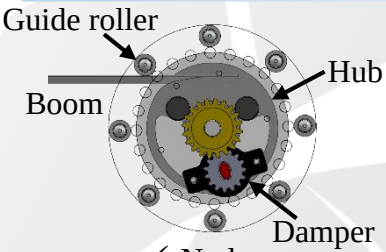
Research Overview

“ Space Demonstration of Occulter using SDMT ”

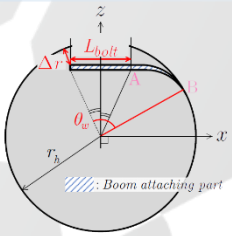
1. Self-Deployable Membrane Truss (SDMT)

We have been studying on a self-deployable membrane truss (SDMT) consisted of self-extensible booms that have high spring back effect and can be rolled-up into small volume. The proposed SDMT does not use any powered actuator, and is a simple structure compared with the conventional deployable structures. In addition, we has proposed a theoretical design method of the self-deployable truss in previous studies, and validated the theory experimentally

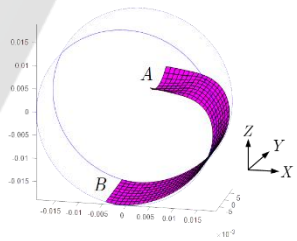
➢ *Theory*



✓ Node



✓ Mathematical model



✓ Analysis result

✓ Optimal hub

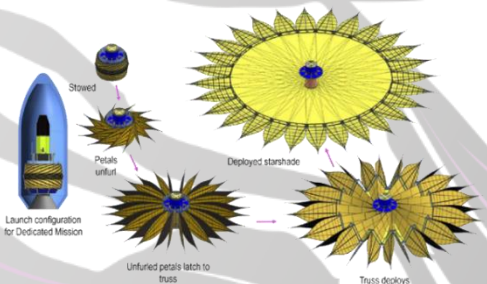
➢ *Experiment*

Ground ⟶ ***Micro Gravity***

2. Occulter of Starshade System

The starshade system has been proposed that allows direct observation of the exoplanet by blocking the stellar light using a large membrane shield called ***occulter*** placed between the star and the space telescope. NASA is considering the starshade mission Exo-S, but the proposed occulter structure seems to be complicated.

✓ Starshade

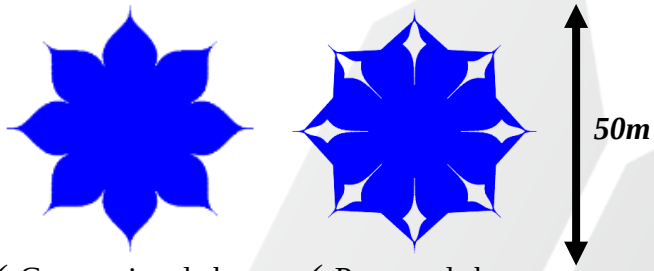


✓ Deployment sequence in Exo-S

3. Application of SDMT to Occulter

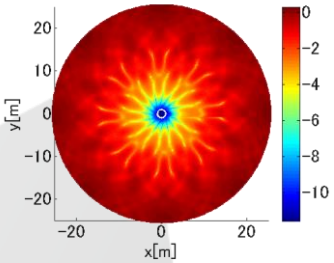
We consider that the starshade mission can be more reliably achieved at lower costs by using SDMT. The conventional occulter has a curved shape like a petal, but I proposed a novel occulter suitable for SDMT that is consisted of straight booms and a non-transmissive membrane with several high-transmissive area. I found that the proposed occulter has the equivalent performance to the conventional occulter by the numerical calculation. In addition, it was confirmed by deployment experiments using the proposed occulter scale model that the proposed occulter deploys surely.

➢ Occulter Shape

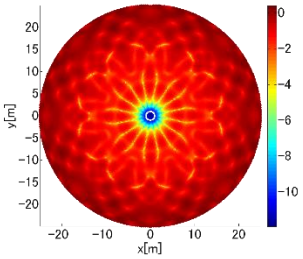


✓ Conventional shape ✓ Proposed shape

➢ Performance Evaluation

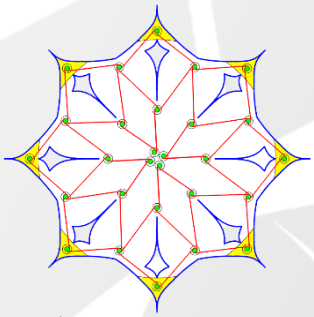


✓ Contrast
(Conventional occulter)



✓ Contrast
(Proposed occulter)

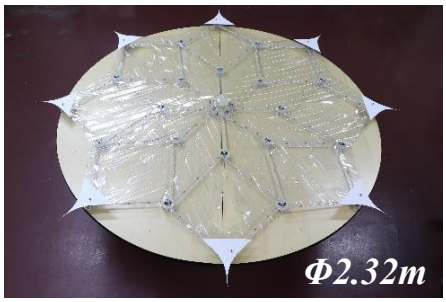
➢ Deployment Experiment



✓ Layout of truss

✓ Stored state

Deploy



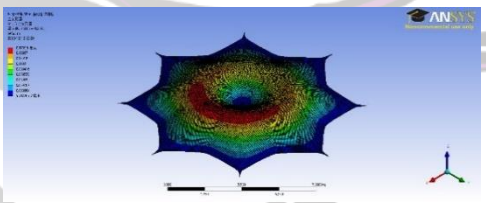
✓ Deployed state

4. Space Demonstration

We are planning to demonstrate the deployment of the occulter using a SDMT on orbit as the next step. In the space demonstration, SDMT is consisted of CFRP BCON booms and metallic hubs. A CFRP BCON boom is lighter than a steel measure that we used in the deployment experiments on the ground and have sufficient stiffness. A metallic hub is integrated a shaft, a flange, and a hub so it allow the number of parts to decrease. I will be shown that the proposed occulter has enough stiffness to maintain occulting performance through the structure analysis, and design procedure, assembly procedure, and deployability will be evaluated through the deployment experiment.

✓ CFRP BCON boom

✓ Metallic hub



✓ Structure analysis

5. Future Plan

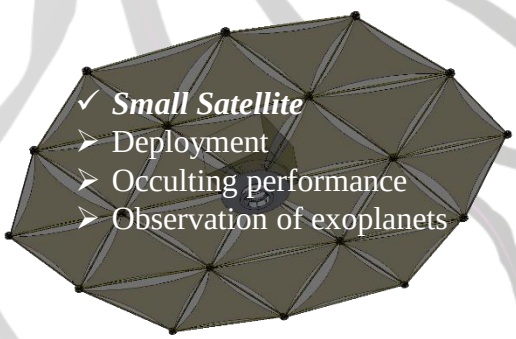
We are planning the following process of achieving starshade mission.

Demonstration → ***Mission***

✓ ***Deployment Experiment in 1G and μG environment***
- ➢ Deployment
- ➢ Shape accuracy
- ➢ Angular velocity of a hub

+

✓ ***Optical Experiment***
- ➢ Occulting performance



✓ ***Small Satellite***
- ➢ Deployment
- ➢ Occulting performance
- ➢ Observation of exoplanets

✓ ***Starshade Mission***
- ➢ Observation of exoplanets
- ➢ Characterization of exoplanets
- ➢ Detection of extraterrestrial life and habitable planets!!