Space Structure Systems Lab.

Hayate MATSUURA

Miyazaki Group, Dept. Aerospace Engineering,
Col. Science and Technology, Nihon Univ.

csha19028@g.nihon-u.ac.jp (+81)-047-469-5430

Profile

- Master Course of Engineering, Graduate School of Science and Technology, Nihon Univ., Funabashi, Chiba [Apr. 2019 – now]
- Bachelor of Engineering, College of Science and Technology, Nihon Univ., Funabashi, Chiba [Apr. 2015 – Mar. 2019]
- Kanagawa University High School, Yokohama, Kanagawa [Apr. 2011 – Mar. 2014]

Extracurricular Activity

- **Satellite Project in Miyazaki / Yamazaki Lab.**
  Since I was a freshman to junior in university, I studied general small-sat systems using HEPTA-Sat. It is a small-sat Training kit, which is used for HEPTA-Sat Hands-on Training. In this training, my team mission was “Propose and Design the Structure system of HEPTA-Sat and Making the Text for HEPTA-Sat Training”. My team finished this mission, so I think we could contributed to improve HEPTA-Sat Training.
- **CLTP 8 at Nihon Univ., Funabashi in 2017**
  CLTP 8 is the 8th Can-Sat Leader Training Program. Every year, CLTP was Can-Sat training in order to train the foreign leaders. CLTP 8 was the first attempt that Japanese students and overseas trainees studied together. At the same time as learning Can-Sat, it was a good opportunity to train practical English skills, intercultural communication skills and system engineering skills through learning with overseas trainees. Actually, I attended it as the teaching assistant, so I think it was a good opportunity to feel the difficulty, enjoyment, and reward of communicating to people with different languages and cultures. Furthermore, I think it was a very important experience in my life.
- **Space Structure Society “TNL”**
  TNL is space structure society by mainly students in Japan. Students in various majors and grades want to learn one subject of space architecture from various interests in various ways and to make space architecture better known. Also, It hold events with the theme of space architecture at academic conferences and science museums in Japan and gradually increase the number of members. I was the 2nd student representative, and put together those activities. Then, we also helped to edit the book about 1st & 2nd Space Architecture Prize under Dr. Akito Sogame (Tokai Univ.).

Qualification

- Amateur Third-Class Radio Operator, 2015
- Chinese proficiency test Grade 4 (The society for Testing Chinese Proficiency, Japan), 2015

Paper & Presentation

- **Hayate Matsuura**, Akito Sogame, Yozan Takahashi, Activities for Development of Space Architecture Field and Their Consideration, The 61st Space Sciences and Technology Conference, 1B05, JSAS-2017-4045, 25th - 27th October 2017, Toki Messe, Niigata. (Oral)
- Shoma Nagai, **Hayate Matsuura**, Akito Sogame, Activities for Development of Space Architecture Field and Their Consideration, The 62nd Space Sciences and Technology Conference, 2D14, JSAS-2018, 24th -26th October 2018, Kurume City Plaza, Fukuoka.
- Daishi Kawarabayashi, **Hayate Matsuura**, Yasuyuki Miyazaki, Structural Characteristics of 3D Truss Using Self-Deployable Boom, The 62nd Space Sciences and Technology Conference, JSASS-2018-4280, pp.1-6, 24th -26th October 2018, Kurume City Plaza, Fukuoka.
- **Hayate MATSUURA**, Yasuyuki MIYAZAKI, Daishi KAWARABAYASHI, Contact Analysis of Debris Capture Device Using 3D Self-Deployable Truss, The 32nd International Symposium on Space Technology and Science, 20 June, 2019, AOSSA, Fukui, Japan. (Oral) (Expected in June, 2019)
- Daishi KAWARABAYASHI, **Hayate MATSUURA**, Yasuyuki MIYAZAKI, Concept of Debris Capture Device Using 3D Self-Extensible Boom and Net for ADR, The 32nd International Symposium on Space Technology and Science, 20 June, 2019, AOSSA, Fukui, Japan. (Expected in June, 2019)

Award

- Student Doctor Award, College of Science and Technology, Nihon Univ., 2017

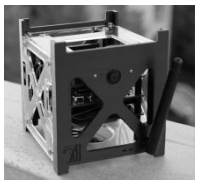

Fig.1 HEPTA-Sat

Fig.2 Space Architecture Prize Book

Research Summary

Keyward

Contact Analysis, Space Debris Capture, Active Debris Removal, Self-Deployable, Space Structure, Gossamer Multi-Body Dynamics

Theme

“Contact Analysis of Debris Capture Device using 3D Self-Deployable Truss with Net”

Background

In recent years, space debris are being left on LEO, and they threaten the spacecraft on orbits because of the risk of collision increasing. In this situation, along space development, further utilization such as low orbit is considered. Among them, satellite constellations have a large impact on the number of on-orbit debris. Also, many methods and techniques for orbital environment repair have been proposed as Active Debris Removal (ADR).

When we consider ADR, we first considered which orbital environment needs to be improved. Collision between debris leads to a dramatic increase in the number of debris on the orbit. According to Fig. 3, it can be understood that a large amount of debris with a mass of about 1 kg to 100 kg and about 700 kg to 1000 kg is densely packed between about 400 km and 1200 km.

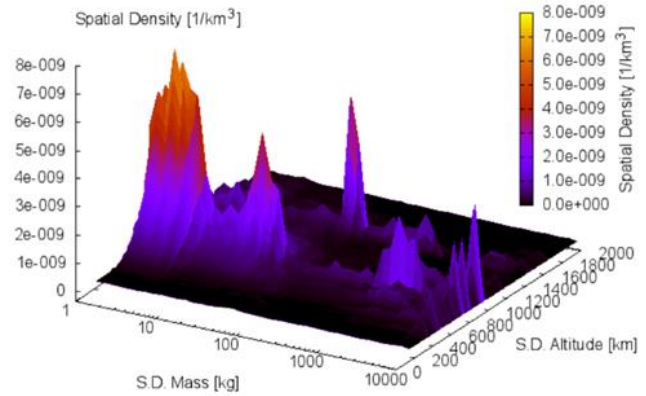

Fig.3 3D spatial density distribution vs. S.D. Mass and S.D. Altitude (ESA-MASTER v8.0.0)

The authors study debris removal equipment applying the net and 3D self-deployable truss as shown in Fig. 4.

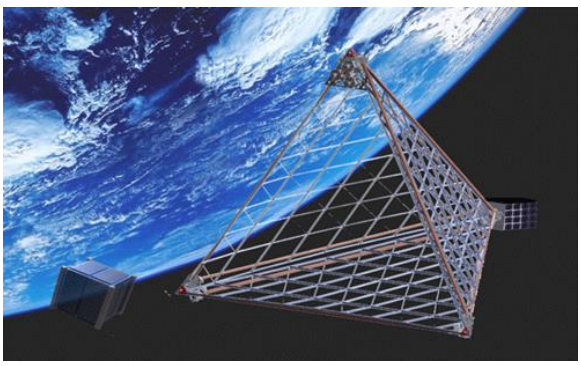

Fig.4 Debris Capture Device using 3D Self-Deployable Truss

Purpose

It is essential to understand of the contact / collision motion of the chaser satellite equipped with the debris removal device and the target debris is necessary when designing the structure of DCD-3DSDT as described later. In order to consider how much the member deforms, how the deformation affects the entire structure, and what structural parameters work, depending on the movement related to the contact during debris capture movement. We conduct contact analysis including modeling of the contact area of DCD-3DSDT including the node and the target debris. Therefore, it is necessary to understand and predict the motion of debris and capture, and the purpose of this research is to model the contact part of members (net, boom, etc.) and debris with DCD-3DSDT, and analyze the contact In this way, we evaluate and consider structural parameters that are effective for design.

Progress

Simple model between Capture (mass point) and Debris (rigid body) was finished for coding. For simplicity, let the shape of the target debris be a rigid rectangular solid. The contact is considered only at the nodes of the net, but the net itself is considered by the cable element (distributed mass). For analysis, define symbols as in Nomenclature. Also, the positional relationship between the rigid body and the mass point is shown in Fig. 5. At this time, EMM (Energy Momentum Method) is used for this modeling.

Simple model between Capture (cable) and Debris (rigid body) was the way the authors make it. The contact models created at this stage are as follows Fig. 5.

Plan

We would like to complete the analysis code of the debris capture motion under development, such as developing the modeling of the network from mass points to cable elements (distributed mass), and also analyze the results for other designs. Based on this, I would like to repeat the discussion and discussion, and show the design and proposal of DCD-3DSDT, which has a better effect on debris reduction.

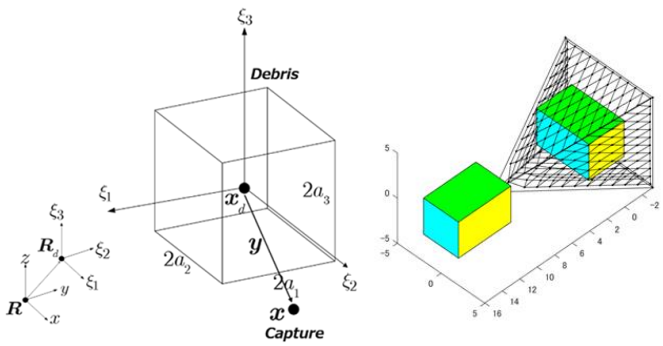

Fig.5 Contact Analysis Model

Edited By **Hayate Matsuura** on 18th Apr. 2019