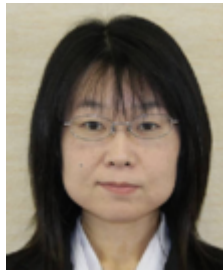


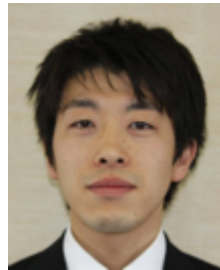
## Space and Planetary Informatics Laboratory



Hirohide Demura  
Senior Associate Professor



Yoshiko Ogawa  
Associate Professor



Kohei Kitazato  
Associate Professor



Chikatoshi Honda  
Associate Professor

### Space and Planetary Informatics Laboratory

Our laboratory is newly established in April 2015. Lab members are a part of CAIST/ARC-Space, Profs. Demura, Ogawa, Honda, and Kitazato. We have served concurrently as this lab and CAIST/ARC-Space cluster.

We contribute to deep space exploration for insighting the origin and evolution of our Solar System, and for expanding activities of human beings to space, according to the philosophy of the university 'to Advance Knowledge for Humanity'.

Aim to serve as a hub institute which provides software for geoinformatics, geographic information system (GIS) and remote sensing used for frontier projects in the field of space development of Japan, by utilization of our University's innovativeness in information science. This cluster contributes to space development/exploration programs in cooperation with other agencies/universities, on the basis of the MOU between JAXA and UoA 'Promotion of Solar System Science by means of archived data'. Additional activity is researches/developments for monitoring Azuma volcanoes in Fukushima by means of SAR (Synthetic Aperture Radar) analysis with Earth Observation Satellite as members of the satellite analysis group of the Meteorological Agency Eruption Predictive Liaison Committee.

### Joining Projects

1. Hayabusa2 to the asteroid 162173 Ryugu
2. TANPOPO on International Space Station
3. MMX (Martian Moons eXploration)
4. JUICE (JUperiter ICy moons Explorer)

## Division of Information and Systems

5. The next lunar lander mission (SLIM)
6. The next Mars lander mission (MELOS)
7. Monitoring project for Azumayama volcano in Fukushima
8. PIXEL (PALSAR Inter-ferometry Consortium to Study our Evolving Land surface)

## Refereed academic journal

- [chonda-311-017-01:2015] H. Suzuki Y. Cho S. Koga M. Yamada T. Nakamura T. Hiroi H. Sawada R. Honda T. Morota C. Honda A. Takei T. Takamatsu Y. Okumura M. Sato T. Yasuda K. Shibasaki S. Ikezawa S. Sugita Kameda, S. Detectability of hydrous minerals using ONC-T camera on-board the Hayabusa2 spacecraft. *Advances in Space Research*, 56:1519–1524, 2015.

The Hayabusa2 spacecraft has three framing cameras (ONC-T, ONC-W1, and ONC-W2) for optical navigation to asteroid 1999 JU3. The ONC-T is a telescopic camera with seven band-pass filters in the visible and near-infrared range. These filters are placed on a wheel, which rotates to put a selected filter for different observations, enabling multiband imaging. Previous ground-based observations suggesting that hydrous materials may be present on the surface of 1999 JU3 and distributed in relatively limited areas. The presence of hydrous minerals indicates that this asteroid experienced only low to moderate temperatures during its formation, suggesting that primordial materials are preserved. In order to find the best sampling sites, we will perform reflectance spectroscopic observations using the ONC-T near the asteroid after arrival. Finding regions rich in hydrous minerals is the key for this remote sensing observation. In preparation for this, we conducted ground-based experiments for the actual ONC-T flight model to confirm the detectability of the absorption band of Fe-rich serpentine. As a result, we detected the absorption band near 0.7  $\mu\text{m}$  by reflectance spectroscopy of CM2 chondrites, such as Murchison and Nogoya, which are known to contain the Fe-rich serpentine, and did not detect any 0.7  $\mu\text{m}$  absorption in Jbilet Winselwan CM2 chondrite with decomposed Fe-rich serpentine.

- [demura-311-017-01:2015] Y. Hayashi, Y. Yamamoto, Y. Ogawa, N. Hirata, H. Demura, J. Terazono, and T. Matsunaga. Web Processing Catalog : Web interface for distribution of the appropriate and advanced environment for the data processing - A case study for the data from the Spectral Profiler on board Japanese satellite Kaguya. *Journal of Space Science Informatics Japan*, 5:111–122, 3 2016.

In the planetary science, many observation data are available via internet. To get some information from the observation data, a lot of steps of data processing are necessary. Either the data providers or users have to handle such processes. For the case where the providers are responsible, the data processing is a black

## Summary of Achievement

box for the users usually, so the potential of the data could not be fully utilized. On the other hand, for the case the users themselves follow the processes, the data usability would be the problem, because the users need to know many technical things and they sometimes could not afford that. We focus on the importance of the relationship between the data and data processing. We propose a new protocol 'Web Processing Catalog' for developing web interface to distributing the metadata and desirable programs for data processing. Finally, we also implement a preliminary system and conduct verification where we use the actual data from the spectral profiler onboard Japanese lunar orbiter, Kaguya.

## Refereed proceedings of an academic conference

[demura-311-017-02:2015] Y. Hayashi, Y. Ogawa, N. Hirata, J. Terazono, H. Demura, T. Matsunaga, M. Ohtake, and H. Otake. GEKKO for Hyperspectral Data Distribution: A New Method for Utilizing the Advantages of a Web Map Service. In *47th Lunar and Planetary Science Conference, held March 21-25, 2016 at The Woodlands, Texas*, pages LPI Contribution No. 1903, p.1920, March 2016.

We developed a web GIS GEKKO, moonlight in Japanese, which specializes in handling hyperspectral data. We present the technical details of the system.

[demura-311-017-03:2015] T. Arai, T. Okada, S. Tanaka, T. Fukuhara, H. Demura, and Y. Ogawa. Earth and Moon Observations with TIR Onboard Hayabusa2 Spacecraft. In *47th Lunar and Planetary Science Conference, held March 21-25, 2016 at The Woodlands, Texas*, pages LPI Contribution No. 1903, p.1801, March 2016.

TIR is an infrared thermal imager onboard the Hayabusa2 spacecraft. In this study, current performances of TIR are introduced by Earth and Moon observations.

[demura-311-017-04:2015] T. Okada, T. Fukuhara, S. Tanaka, M. Taguchi, T. Iamura, T. Arai, H. Senshu, Y. Ogawa, H. Demura, K. Kitazato, R. Nakamura, T. Kouyama, T. Sekiguchi, S. Hasegawa, T. Matsunaga, T. Wada, J. Takita, N. Sakatani, Y. Horikawa, K. Endo, J. Helbert, T. G. Mueller, and A. Hagermann. Thermal-Infrared Imager TIR on Hayabusa2 and Its In-Flight Performance and Calibration Using Earth and Moon Thermal Images. In *47th Lunar and Planetary Science Conference, held March*

21-25, 2016 at *The Woodlands, Texas*, pages LPI Contribution No. 1903, p.1407, March 2016.

The Earth-Moon thermal infrared images will promise the future determination of thermo-physical properties of the surface of asteroid Ryugu by TIR on Hayabusa2.

[kitazato-311-017-01:2015] K. Kitazato, T. Iwata, M. Abe, M. Ohtake, K. Tsumura, T. Ichikawa, N. Takato, Y. Nakauchi, T. Arai, H. Senshu, N. Hirata, Y. Takagi, and Hayabusa2 NIRS3 team. Near-Infrared Spectroscopy of the Earth and Moon During the Hayabusa2 Earth Swing-By. In *Lunar and Planetary Science Conference*, volume 47, page 2158, March 2016.

[kitazato-311-017-02:2015] K. Kitazato, S. Abe, M. Ishiguro, Y. Ishibashi, Y. Takagi, and M. Abe. Photometric Follow-up of Asteroid 4660 Nereus and Reanalysis of its YORP Effect. In *AAS/Division for Planetary Sciences Meeting Abstracts*, page 307.13, November 2015.

### Unrefereed proceedings of an academic conference

[chonda-311-017-02:2015] C. Honda N. Hirata T. Morota Ito, R. Global spatial distribution of the lunar craters characterized by the Voronoi tessellation. In *Japan Geoscience Union Meeting 2015*, 2015.

[chonda-311-017-03:2015] S. Kameda H. Sawada H. Suzuki M. Yamada R. Honda-T. Morota C. Honda K. Ogawa K. Shirai Y. Iijima Y. Cho A. Takei H. Okumura T. Yasuda K. Shibasaki M. Sato S. Ikezawa T. Nakamura T. Hiroi S. Kamata S. Koga ONC science team Sugita, S. Pre-launch calibration and the first image data of the optical navigation camera of Hayabusa2. In *Japan Geoscience Union Meeting 2015*, 2015.

[chonda-311-017-04:2015] Y. Ishihara M. Ohtake C. Honda T. Morota Lunar Geological-map Working Group of Japa Hareyama, M. Unsupervised Classification of Lunar Surface Spectrum obtained by Kaguya (SELENE) Spectral Profiler. In *47th Lunar and Planetary Science Conference*, 2016.

[chonda-311-017-05:2015] M. Yamada H. Sawada S. Kameda T. Kouyama H. Suzuki-R. Honda T. Morota C. Honda K. Ogawa K. Shirai E. Tatsumi

## Summary of Achievement

N. Ogawa Y. Iijima Sugita, S. and ONC Team. EARTH-MOON IMAGING WITH HAYABUSA2 OPTICAL NAVIGATION CAMERA (ONC) DURING THE EARTH SWING-BY. In *47th Lunar and Planetary Science Conference*, 2016.

[demura-311-017-05:2015] Y. Ogawa, Y. Hayashi, N. Hirata, J. Terazono, H. Demura, T. Matsunaga, S. Yamamoto, Y. Yokota, M. Ohtake, and H. Ootake. A Web-GIS for the Kaguya/Spectral Profiler data, GEKKO (moonlight in Japanese): toward comprehensive mapping of the surface minerals on the Moon. In *European Planetary Science Congress 2015, held 27 September - 2 October, 2015 in Nantes, France*, 2015.

## Writing a part of textbook or technical book

[demura-311-017-06:2015] The Union of Japanese Societies for Natural History. *Wonderful stories 365 for children (in Japanese)*, chapter Column Articles. Seibundo Shinkosha, Tokyo, 2015.  
ISBN 978-4-416-11500-8

## Research grants from scientific research funds and public organizations

[chonda-311-017-06:2015] T. Morota J. Kimura N. Kobayashi Y. Karouji M. Hareyama N. Hirata Y. Ishihara H. Nagaoka S. Kamata M. Ohtake, C. Honda. Grants-in-Aid for Scientific Research -KIBAN B-, 2014-2016.

## Academic society activities

[chonda-311-017-07:2015] Morota T. C. Honda M. Nishino Nagaoka, H., 2015.  
Theme Chair, Lunar sciences and exploration

## Patent

[demura-311-017-07:2015] H. Demura and S. Aita. Electronic Goniometer for two lines in 3D by means of Gyros and Accelerators on Tablet PC, etc., 2015.

**Advisor for undergraduate research and graduate research**

[kitazato-311-017-03:2015] Tomoki Inasawa. Graduation Thesis: Fundamental Development of Scanning Telescope towards Jupiter Trojan Exploration, University of Aizu, March 2016.

Thesis Advisor: K. Kitazato

[kitazato-311-017-04:2015] Satoshi Yoshida. Graduation Thesis: Improvement of microgravity rover simulator (MuROS), University of Aizu, March 2016.

Thesis Advisor: K. Kitazato

**Others**

[demura-311-017-08:2015] H. Demura, K. Okudaira, Y. Ogawa, J. Terazono, , and N. Hirata. Public outreach of Deep Space Exploration through Science Cafes and Lectures, April 2015.

The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (Prizes for Science and Technology: Public Understanding Promotion Category), Public outreach of Deep Space Exploration through Science Cafes and Lectures