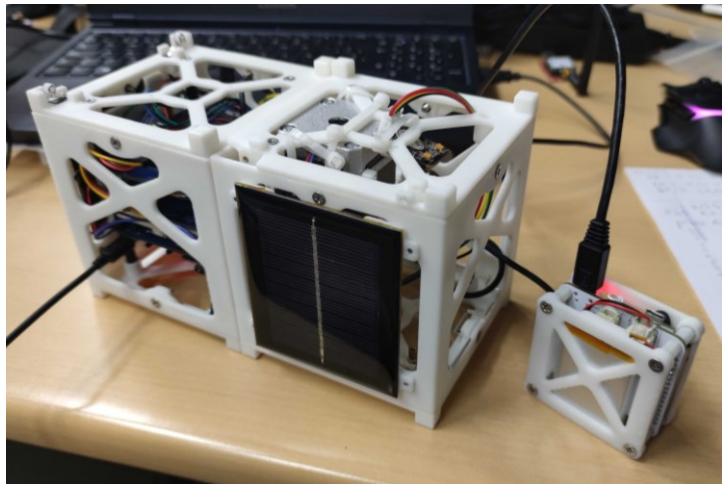
CLTP13 Experience



Maximilien Berthet

The University of Tokyo, Japan

49th Virtual UNISEC-Global Meeting

Outline

- Introduction: Background and research
- CLTP Experience: “Challenge and understanding”
- Future plans based on completion of CLTP

Outline

- Introduction: Background and research
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Short bio

Education

- **Master of Engineering**, Aeronautics
  - *University of Durham*, UK
  - One-year exchange: *University of Hong Kong*, China
- **Master of Engineering**, Aeronautics & Astronautics
  - *University of Tokyo*, Japan
- **Doctor of Engineering**, Aeronautics & Astronautics
  - *University of Tokyo*, Japan
  - Two-month placement: *Kyutech*, Japan

Employment

- **Assistant Professor**, Aeronautics & Astronautics
  - University of Tokyo, Japan

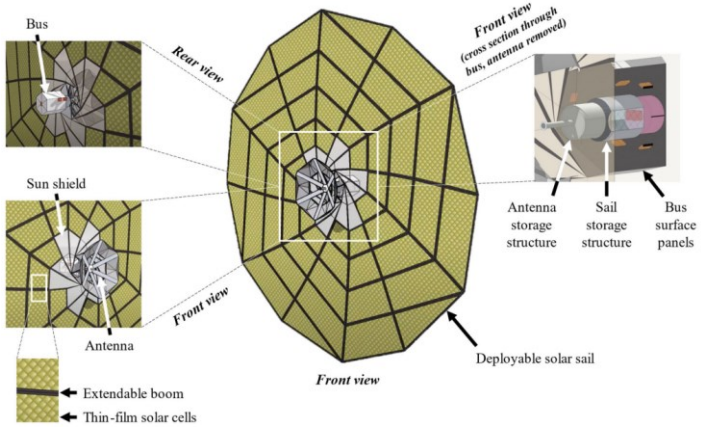
(Source: Durham University)

(Source: HKU)

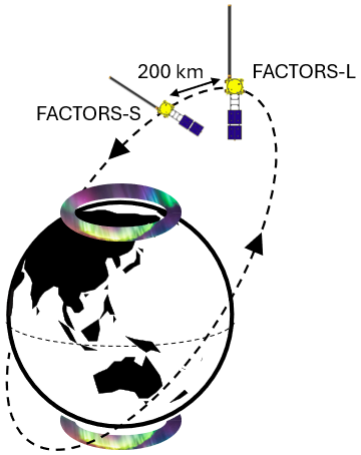
(Source: Kyutech)

(Source: UTokyo)

Research interest: Small satellite mission design

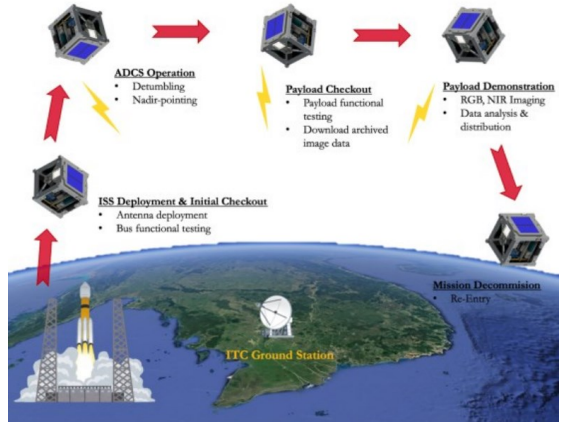


Enceladus plume sampling mission concept with small satellite (Berthet, García, et al., *JESA*, **1**, 100, 2023)

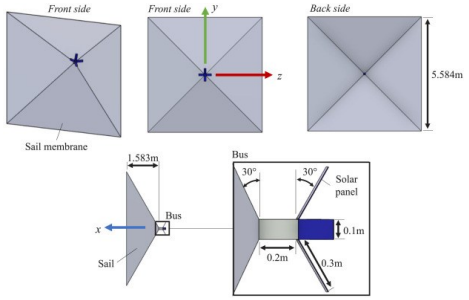


Small satellite formation flight for study of Earth aurora (Berthet, Maru, et al., Astrodynamics Symp., 2024)

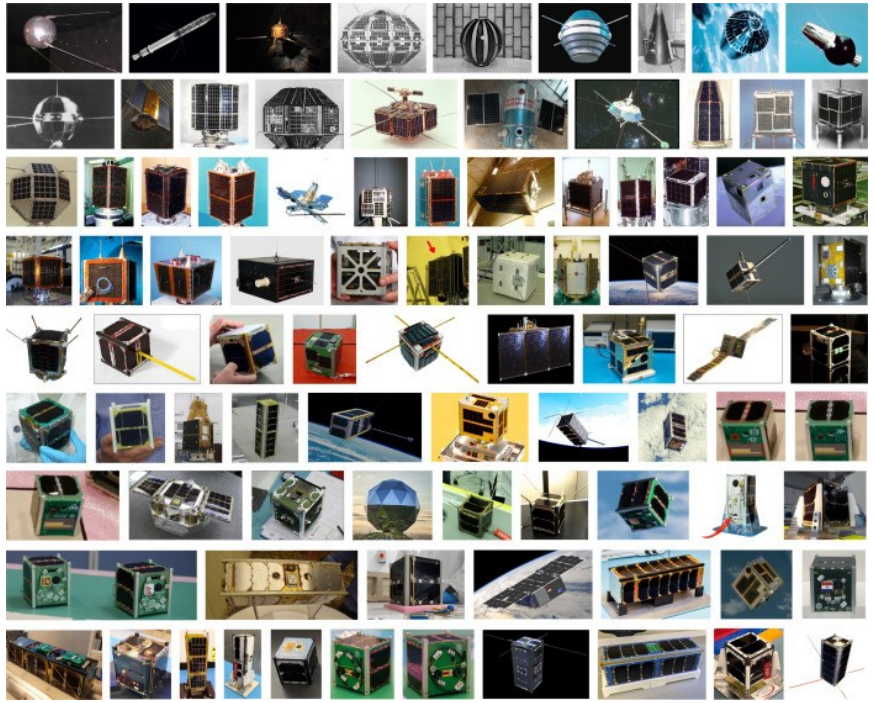
Collaborative CubeSat mission concept between Japan and Cambodia (Berthet, Sakal, et al., 35th Small Sat. Conf., 2021)



Sunflower type solar sail mission concept for Earth observation (Berthet & Suzuki, *Acta Astronaut.*, **213**, 2023)

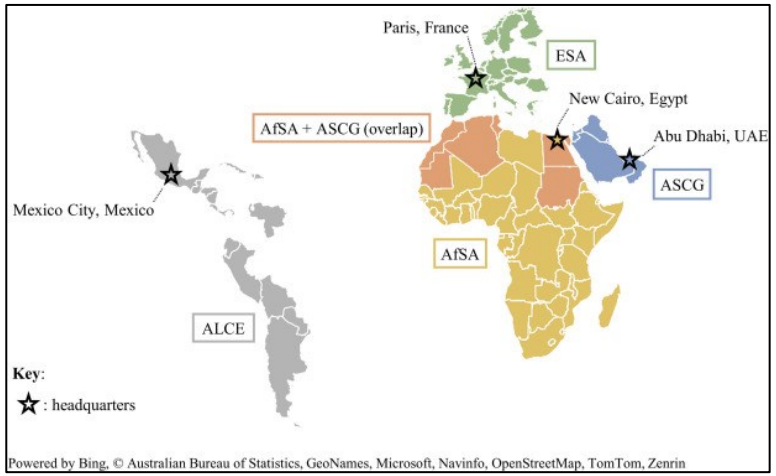


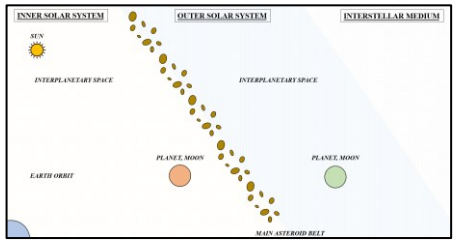
Research interest: Space history and policy



History of country-first satellites (Berthet et al., *PAS*, **146**, 2024)

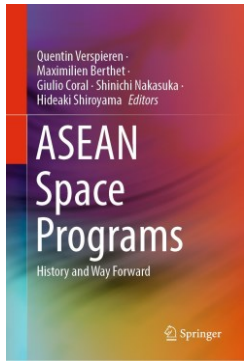
Regional space agencies (Berthet & Corrado, *Space Policy*, **68**, 2024)





History of space sails (Berthet et al., *PAS*, accepted, 2024)

History of space development in ASEAN (Verspieren, Berthet, et al., *ASEAN Space Programs*, 2022)



Outline

- Introduction: Background and research
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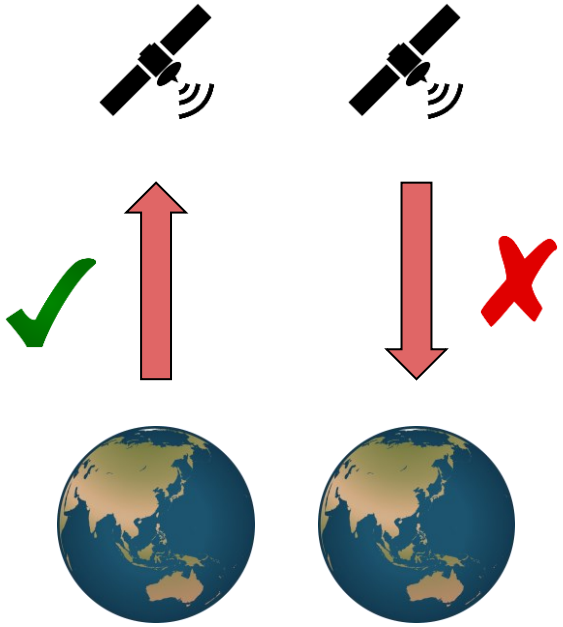
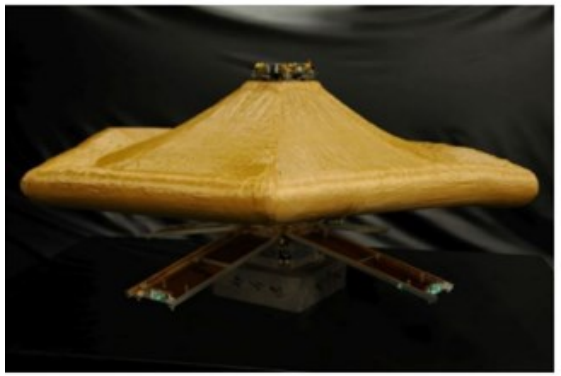
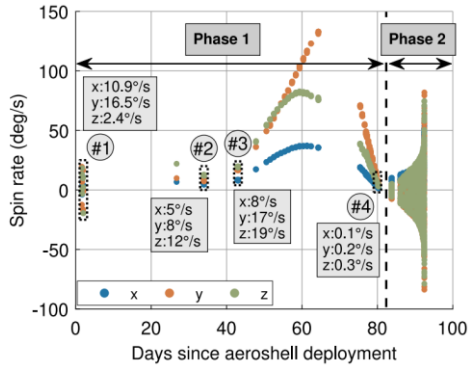
- Future plans based on completion of CLTP

Mission concept: Background

- Satellite recovery from orbit is one of biggest unsolved challenges in space. Especially for small satellites. “It’s easy to get it up, hard to get it back.”
- Success or not depends on understanding of satellite aerodynamics.
- Needed for unlocking new frontiers in various space industries:
  - *Present*: active debris removal, in-orbiting servicing, etc.
  - *Future*: entry, descent and landing; interplanetary cargo transfer, etc.







Example: unexplained attitude spin motion of EGG 3U nanosatellite with deployable aeroshell during atmospheric entry in 2017. Left: Yamada et al., 2024. Right: Berthet et al., 2020.

Mission concept: Background

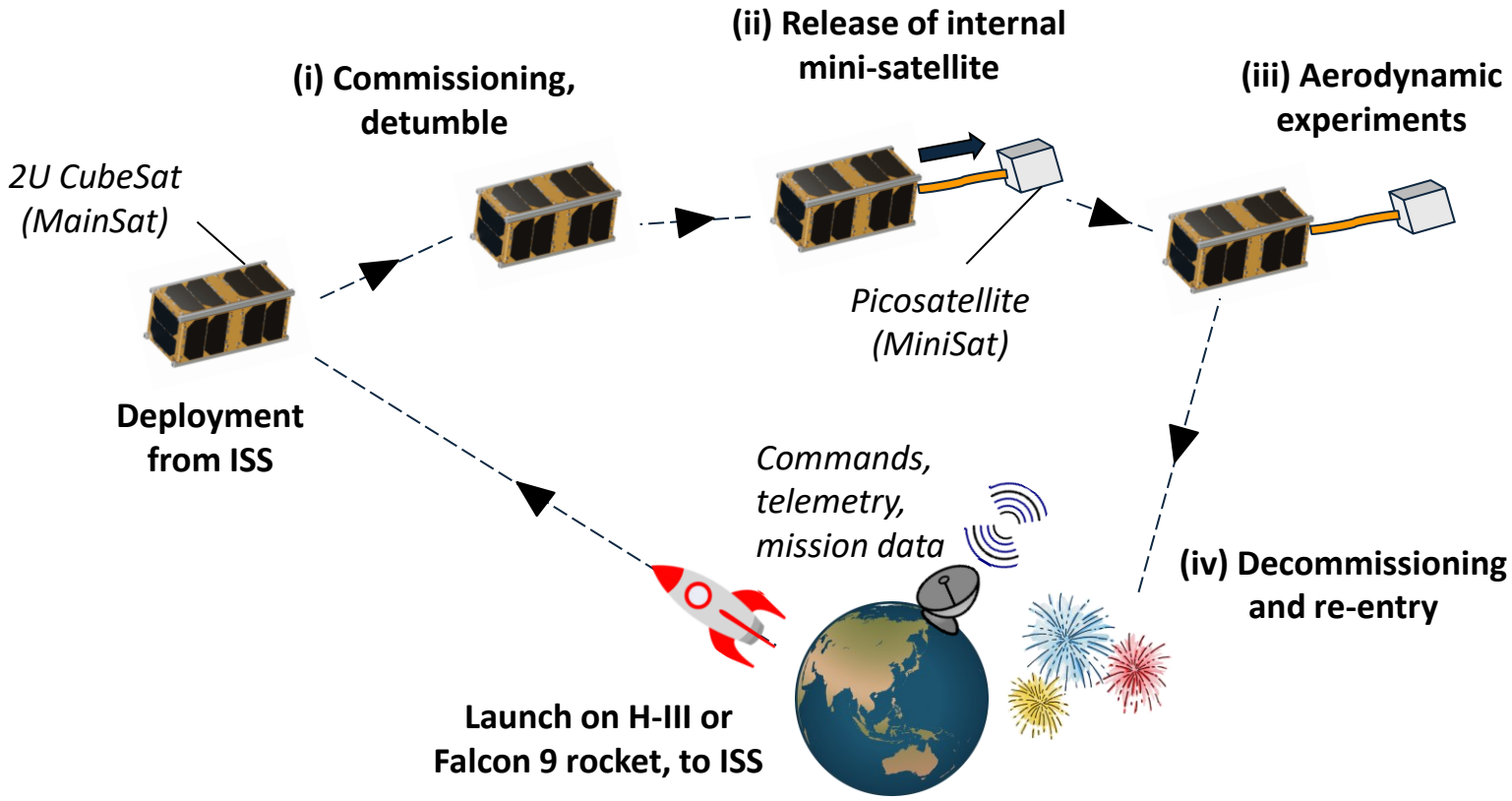
- Example: Atmospheric “skip entry” of Artemis-1 spacecraft (large mass, propulsion available).

Source: Space.com

Mission concept: Operations

Mission goals

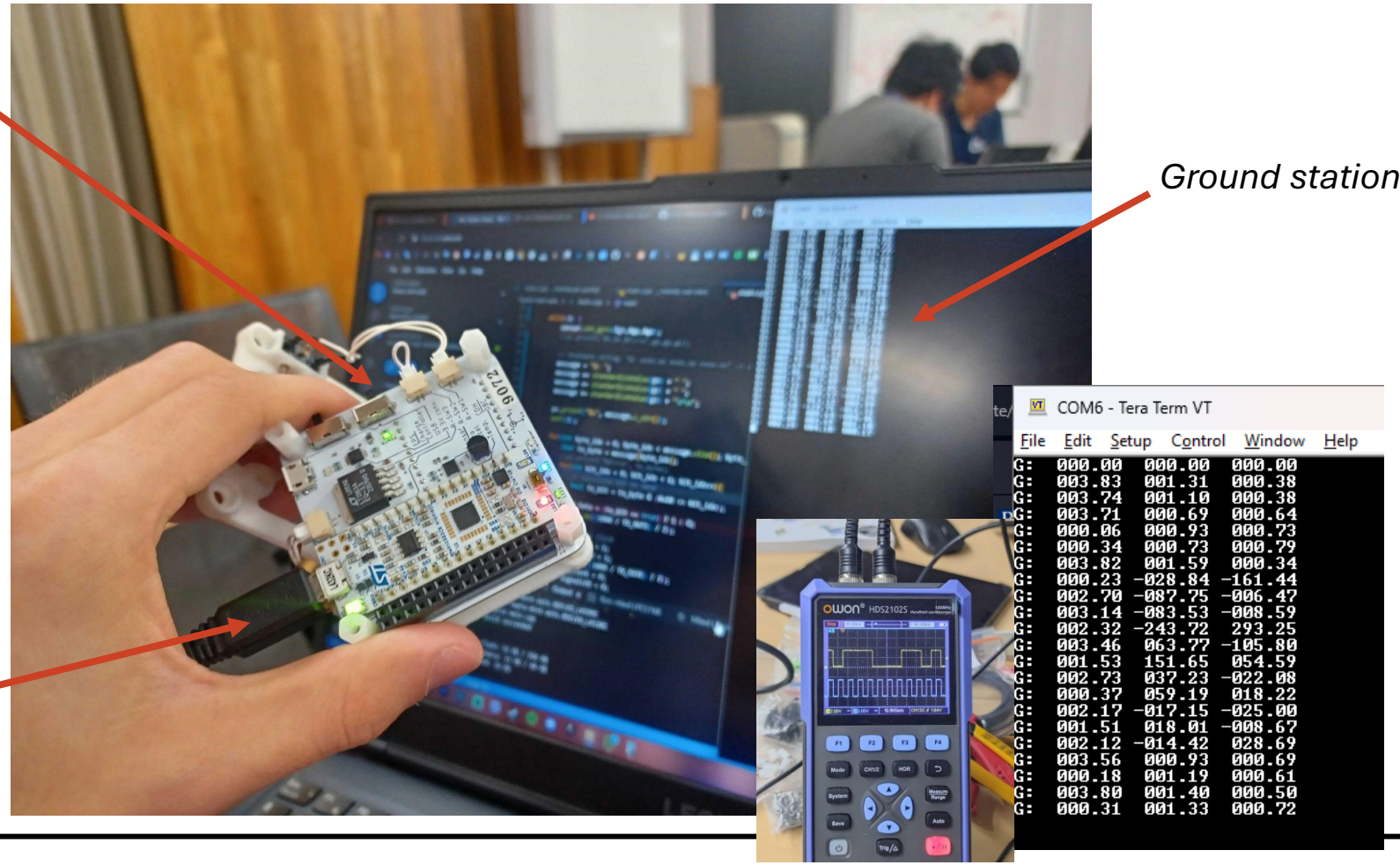
- [MG-1] Visualise aerodynamics of nanosat. in rarefied atmosphere
- [MG-2] Release tethered object from nanosatellite
- [MG-3] Gather scientific data on atmosphere in LEO via nanosatellite



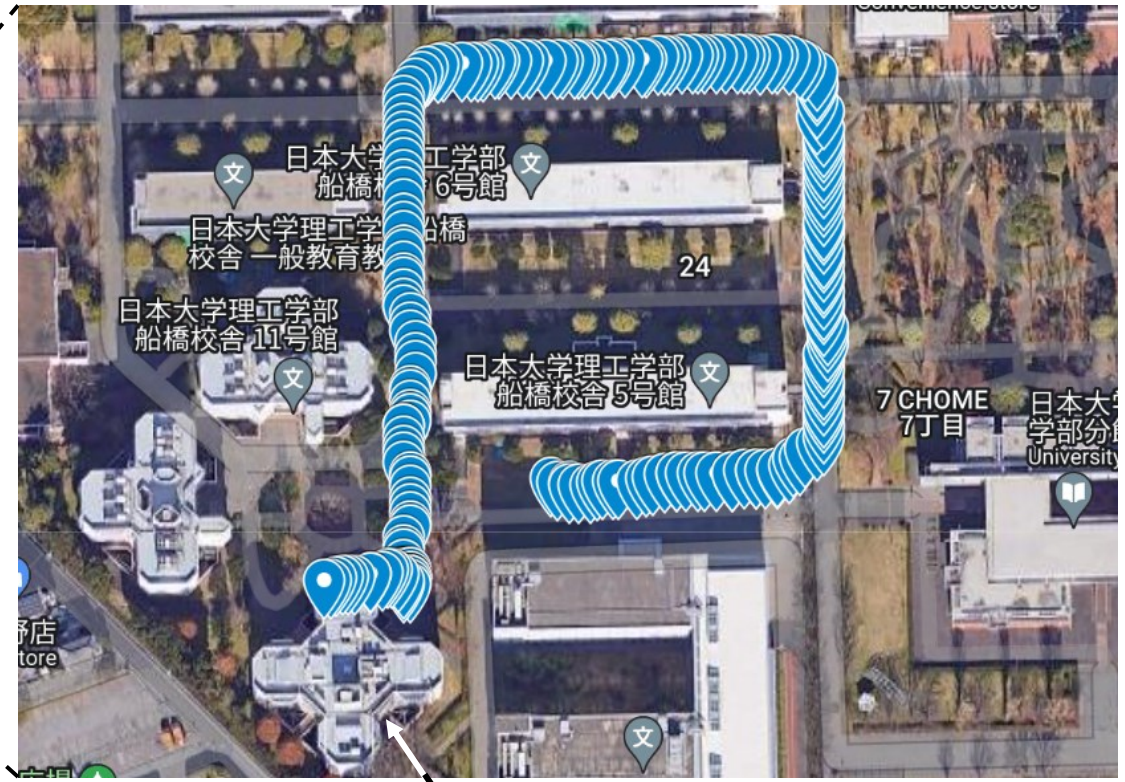
Experimental result: Data transfer

Result

- Mission data transfer: Successful custom wired serial communication between MiniSat, MainSat: sensing, reception of gyro data. Downlink to ground station (PC).



Experimental result: GPS testing

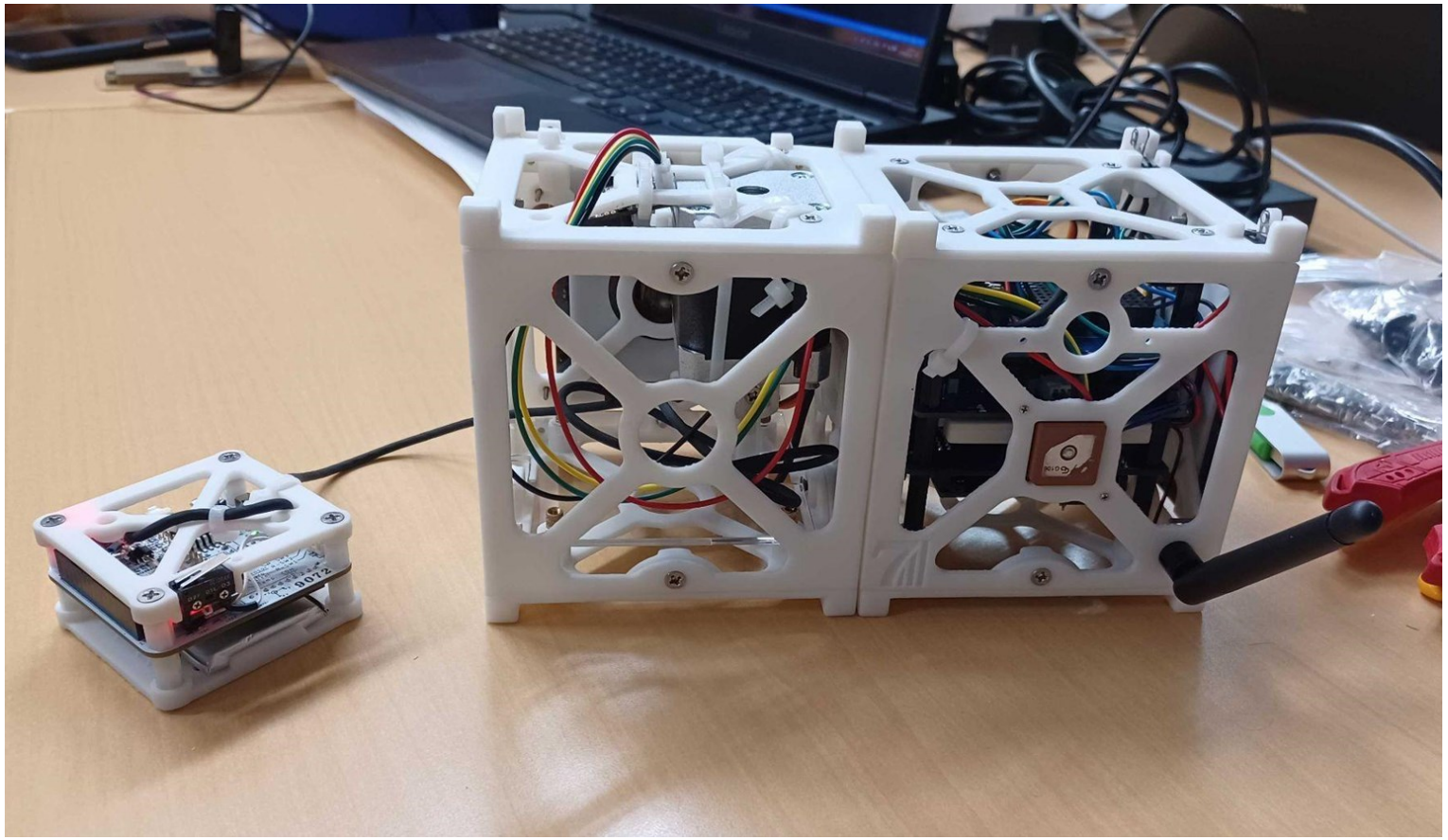


Training centre

Experimental result: Hardware

Result

- MiniSat release mechanism: Successful design and assembly of tether spool, mounting of stepper motor and servo motor.



Reflection

“Challenge”

- Importance of allocating sufficient time for unexpected contingencies.
- Challenge of integrating complete CubeSat system.
- Motivation for expanding knowledge about small satellite development, especially C&DH.
- Intense daily schedule.

“**Understanding**”

- Intercultural communication.
- Friendship: lunches, dinners, ice-cream breaks, city tour.

Outline

- Introduction: Background and research
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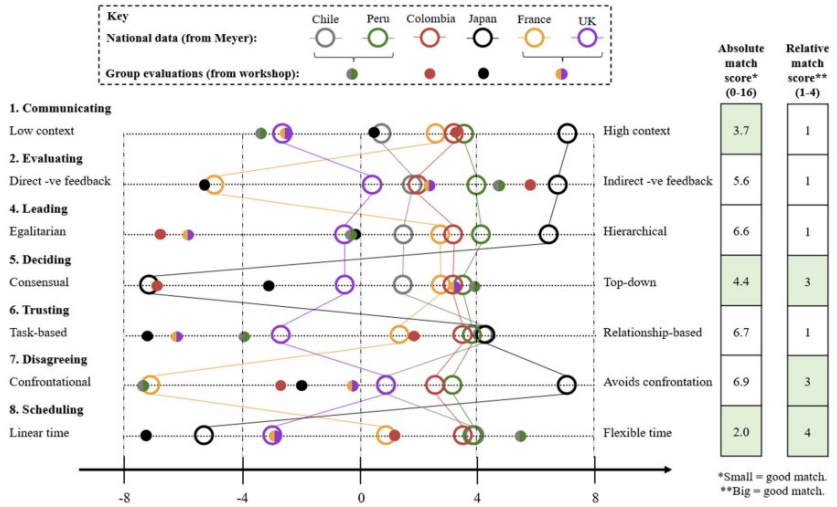
“Pass it on”

- Transfer the knowledge gained in the training to new generation of students, in Japan and overseas.
- Incorporate the learning it into own, collaborative satellite development projects.



Study on teamworking in small & diverse space projects (Berthet, García, et al., *JESA*, **2**, 127, 2024)

Thank you for your attention

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