Pre- Mission Idea Contest 10

# “Orbit Change“ Without Using a Propulsion System”

# Mission Statement for MIC10

- In order to ensure the sustainability of outer space, the avoidance of collisions with other satellites and space debris is expected to become an increasingly critical requirement.
- In Europe, discussions are progressing toward rules under which satellites that do not possess the capability to maneuver away from a collision trajectory when debris approaches may not be permitted to launch.
- On the other hand, the primary method of debris avoidance, i.e.”orbit change using a propulsion system,” is challenging because
  - it is difficult to equip a satellite with an appropriate propulsion system
  - precise attitude control is also required to direct thrust in the desired direction.
- Mission Idea Contest 10 invites proposals for methods and devices that enable orbital change without using a propulsion system, as defined above.

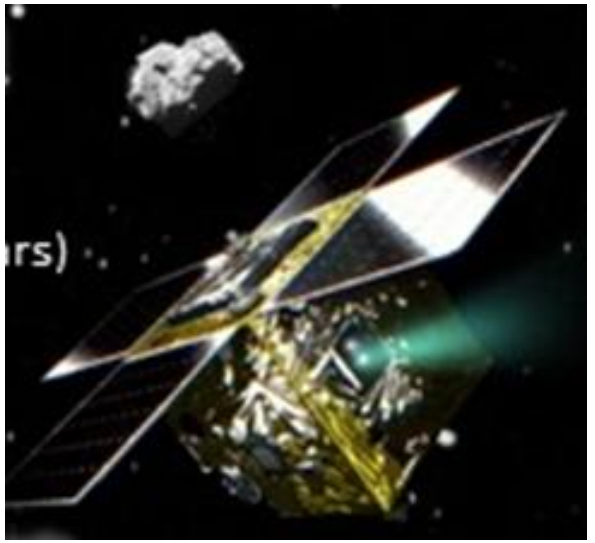
# Evaluation Criteria

- We assume a specific satellite size, mass, and orbit.
- Under the scenario that debris is predicted to collide with your satellite in X hours, propose a device capable of shifting your satellite's orbit as much as possible before the X-hour deadline.
- The proposed device must be appropriately sized relative to the satellite.
- Evaluation:
  - First, consider the concept of device
  - Model the magnitude and direction of the force that the device can generate, and submit the model in software form.
  - The submitted software will be integrated into a general-purpose orbital simulator prepared by the organizers.
  - The resulting orbital deviation and the ability to restore the orbit will be visualized.
  - The team whose device achieves the most effective results will be declared the winner.

# Assumptions of Your Satellite

- Satellite size: 50 cm × 50 cm × 50 cm  Mass: 50 kg
- Attitude control: Three-axis stabilization with pointing accuracy of 1 degree which can be maintained for an arbitrary duration
- The proposed device must:
  - be no more than 20% of the total satellite size and mass, which can be installed either inside or outside of your satellite
  - operate with a maximum power supply of 20 W from the satellite bus
- Orbit: Typical Sun-Synchronous Orbit (SSO, same as ALOS-4)
  - Altitude: 628 km, Inclination: 97.9 degrees, Circular orbit
- Communication:  Assume communication between the usual SSO satellite and a single ground station.

Hodoyoshi 4 (2014)



PROCYON (2014)

# Debris Approach and Post-Avoidance Recovery

- Debris Approach Assumption:
  - It is assumed that information is received indicating that your satellite has entered a collision trajectory with other object that will result in impact in X = 48 hours.
  - The approaching object is assumed to have no orbital maneuvering capability.

- After shifting the orbit to avoid debris, participants must propose methods or ideas for:
  - Returning to the original orbit; or
  - If full restoration is not possible, recover at least the altitude as close as possible to the original altitude (in order to extend orbital lifetime before reentry. )

# Primary evaluation criteria

- Orbital Deviation After X Hours
  - The degree of deviation (in kilometers) from the original orbit after X hours.
- The coordinate system shall be defined as follows:
  - Using the Orbital Frame:
    - z-axis: Toward the center of the Earth
    - x-axis: Along the direction of orbital motion
    - y-axis: Normal to the orbital plane

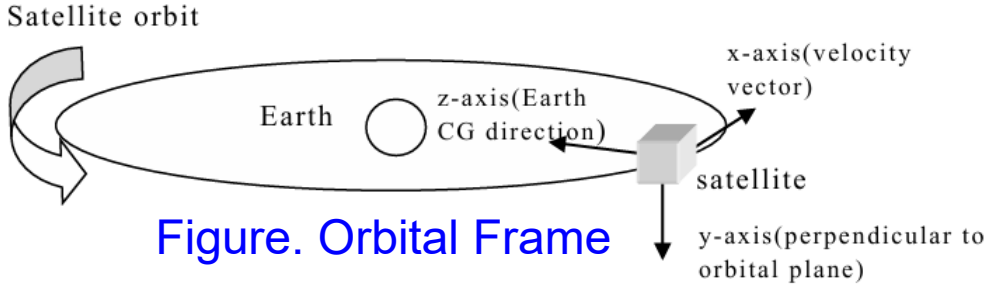


Figure. Orbital Frame

- Deviation in any direction will be evaluated. You must present calculation results indicating how far, and in which direction(s), the orbit can be shifted.

- After the debris avoidance, how close your satellite can return to the original orbit

# You should submit design document as….

- The device concept
- The physical principle by which force is generated
- Detailed calculations
- Detailed device design
- Integration with the satellite
- Ground command operation strategy during communication opportunities

- Particular emphasis will be placed on the explanation of the force-generation principle and calculation methodology.
- The design of the satellite bus itself will not be evaluated.

# You should also submit software

- Participants must submit software (detailed specifications to be announced later) that calculates the force generated at each time step as a function of time and/or position (x, y, z), expressed in the Orbital Frame (x, y, z components).
- The software will be incorporated into the organizer's general-purpose orbital simulator to:
  - Visualize orbital changes
  - Evaluate the amount of deviation achieved
  - Assess the degree of orbital restoration

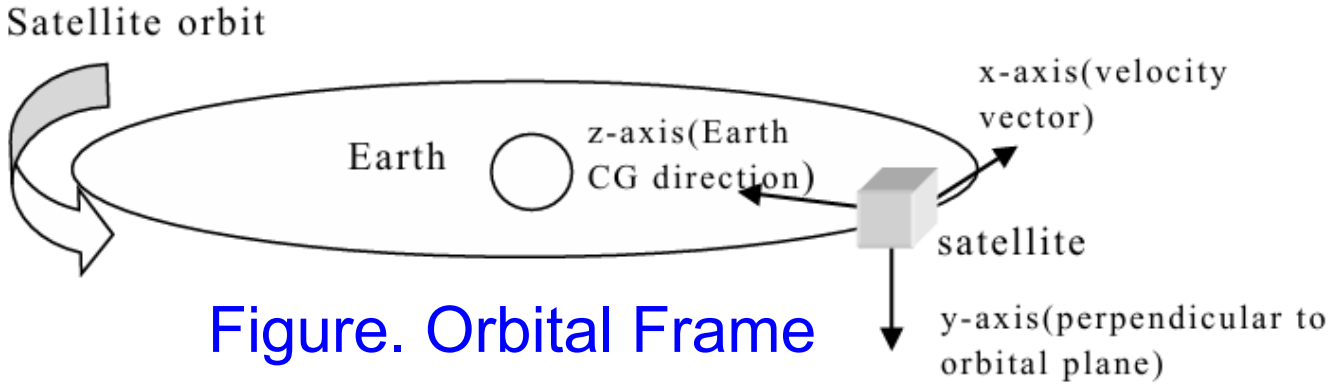



Figure. Orbital Frame

# Overall Judgement

- Final evaluation will be based on a comprehensive assessment of:
  - Quantitative performance (amount of orbital deviation and degree of recovery),
  - Qualitative factors including:
    - Novelty of the device concept
    - Feasibility
    - Compatibility with the given satellite size
    - Validity of force calculations
    - Effectiveness of the post-avoidance recovery strategy

Please join us and create an effective debris mitigation method !

# Winners of Previous Mission Idea Contests

| | Proposed idea | Country |
|---|---|---|
| MIC 1 (2011,Tokyo) (constellation) | Integrated Meteorological / Precise Positioning Mission Utilizing Nano-Satellite Constellation | Japan (professional) |
| MIC 2 (2012,Nagoya) (Satellite Design) | SOLARA/SARA:Solar Observing Low-frequency Array for Radio Astronomy/ Separated Antennas Reconfigurable Array | USA (student) |
| MIC 2 (2012,Nagoya) (Business model) | Underground and surface water detection and monitoring using a microsatellite | South Africa (student) |
| MIC 3 (2014, Tokyo) | Clouds Height Mission | Germany, Italy, Slovenia (professional) |
| MIC 4 (2016, Bulgaria) | CubeSat constellation for monitoring and detection of bushfires in Australia | Australia (student) |
| MIC 5 (2018, France) | Smallsat Ionosphere Exploration at Several Times and Altitudes, | Taiwan, USA, India (student) |
| MIC 6 (2019, Tokyo) (ISS-IceCube) | MUSA: An ISS Experiment for research of a dual culture for Panama Disease | Costa Rica (student) |
| MIC 6 (2019, Tokyo) (ISS-iSEEP) | Spectrum Monitoring from Space with i-SEEP (SMoSiS) | Philippines (professional) |
| MIC 7 (2022, Tokyo) | PARS: Precursor Asteroid Remote Surve | Turkey (student) |
| MIC 8 (2023, Tokyo) | MOTHS: Moon Observation Through Hyperspectral Satellites | Italy (student) |
| MIC 9 (2025, Tokyo) | CubeSat Mission Concept for TREED (The REceiver Exploring Darkages) | Japan (student) |

# Process and Timeline

**Application Submission: Deadline June 18, 2026**

Submitted abstracts will be evaluated by review team

**Notification of Finalist: September 3, 2026**

Title of paper and finalist(s)' name and affiliation will be published on the website.

Software Submission by End of September

**Presentation in Taiwan: November 9, 2026**
**at the 10th Mission Idea Contest Preliminary Workshop**
**(in-person)**