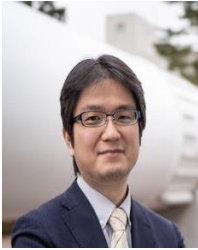


## 【Grant-in-Aid for Transformative Research Areas (B)】

### Section II



#### Title of Project : Agile and Frequent Solar System Exploration with Innovative Microsatellite

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Number of Research Area : 20B206 Researcher Number : 70509819

#### 【Purpose of the Research Project】

In space development activities conducted in the vicinity of the Earth, CubeSat, the world's first successful nano-satellite in 2003, was ridiculed as a "toy" due to its insignificant functions and performance at the time. However, such small satellites have developed explosively by extending their features of low-cost and short-term development. As a result, not only space agencies but also universities and venture companies are now using small satellites for space development, resulting in a situation where thousands of small satellites are orbiting the earth.

The purpose of this research project is to extend this active world to the deep space region outside the Earth's gravitational field by developing the small satellite technology cultivated in the near Earth region for deep space exploration, and to make the deep space region more easily accessible.

#### 【Content of the Research Project】

Currently, there are three barriers to the realization of frequent and flexible deep-space exploration by small satellites: (1) limited opportunities for deep-space launches, (2) issues with the small satellite system itself, such as the reliability of the spacecraft for long-term missions, and (3) limited number of ground stations for spacecraft control.

In order to overcome these barriers, this research project aims to enable small spacecraft that can escape from Earth orbit on their own by kick motors and have the capability to carry out long-term deep space missions to perform orbit determination and control operations quasi-autonomously. This research area will be promoted by the following three research projects.

Project I: Research on kick motors to improve the accessibility to deep space

Project II: Research on small spacecraft systems that can carry out long-term deep space missions

Project III: Research on quasi-autonomous orbit determination and planning to reduce dependence on ground stations

#### 【Expected Research Achievements and Scientific Significance】

The goal of this research project is to break through the limitations that prevent frequent deep space exploration, thereby paving the way for the realization of the ultimate goal of this area, namely, frequent and flexible exploration of the solar system. The results of this research will make it possible to increase the number of exploration missions

currently carried out by space agencies to at least several dozen and is expected to bring new horizons to the world of solar system exploration.

If this research project is further promoted, it will lead to the integration of many fields other than aerospace engineering, including process engineering for designing and manufacturing a large number of spacecraft at low cost and in a short period of time, artificial intelligence technology for the spacecraft to act autonomously, and technology for semi-automatic trajectory design for deep space exploration without the need for a limited number of experts in orbital mechanics. The ultimate goal, a world in which an overwhelming number of ultra-small spacecraft can freely explore the solar system, is expected to be realized.

#### 【Key Words】

Nano/Micro-satellite: Satellites that generally weigh from about 1 kg to less than 100 kg. Conventional satellites can weigh more than several tons, but small, lightweight, and low-cost nano/micro-satellites that incorporate the latest commercial technologies have been developed since the 2000s.

Kick motor: A propulsion device (engine) that accelerates a satellite launched into space by a rocket into a farther orbit. There are no examples of kick motors mounted on nano/micro-satellites yet.

【Term of Project】 FY2020-2022

【Budget Allocation】 102,400 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<https://www.isas.jaxa.jp/home/smallsat/tra-b/>