**Department of Electrical, Electronic and Computer Engineering** | **Key words** | Satellite remote sensing, satellite data utilization, satellite ground station

Doctor of Science / Professor

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### Education

Department of Geophysics, Faculty of Science, Tohoku University
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### Professional Background

Lecturer, Associate professor, Fukui University of Technology Professor at Fukui University of Technology

### Consultations, Lectures, and Collaborative Research Themes

satellite operation using satellite ground station in Fukui University of Technology, Utilization of satellite data

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## Main research themes and their characteristics

### 「Development of space communication ground station to enable operation of satellites and explorers from Earth orbit to around Lunar orbit」

In recent years, human space activities have been expanding from the vicinity of the Earth (altitude of about 500 km) to the Moon (distance of about 400,000 km), and many missions by artificial satellites and explorers are being planned. On the other hand, there is a lack of ground antenna systems (space communication ground stations) to control these satellites and explorers, and the development of such systems has become an issue. Against this backdrop, Fukui University of Technology installed a 3.9-meter-diameter parabolic antenna system (Figure 1) at the Awara Campus in August 2022, mainly for the operation of satellites orbiting near the Earth, and is currently developing a 13.5-meter-diameter parabolic antenna system mainly for the operation of lunar explorers (Figure 2, to be completed in August 2023). The space communication ground station consisting of these antenna systems will be the only space communication ground station in Japan other than JAXA that is capable of operating satellites and explorers from Earth orbit to lunar orbit.

Due to the limited number of antennas, the existing large antennas alone cannot provide the necessary communication and operational opportunities required to meet the increasing demand for future lunar exploration missions. This is a unique initiative to develop a low-cost, compact space communication ground station that is suitable for multiple deployments and can create the necessary communication and operational opportunities, ahead of the rest of the world.

### 「Measuring the local environment and creating social value using satellite data」

The importance of shifting to a data-driven society, i.e., one in which various decisions are made based on the collection, accumulation, and analysis of data with the goal of creating social value, has been recognized. In recent years, the utilization of Earth observation data by Earth-orbiting satellites has been attracting attention, and we are conducting research on the measurement of the local environment that leads to the creation of social value using satellite data.

As an example, we are developing a light pollution effect visualization system using satellite data. Japan is one of the most light-polluted countries in the world, and 70% of its citizens live in areas where the Milky Way is not visible. In recent years, efforts to utilize the beautiful starry skies for regional revitalization have been gaining momentum, and there is a need to promote measures against light pollution, but progress has not been made because it is difficult to understand the effects of light pollution and the effectiveness of light pollution countermeasures. As a solution to this problem, we are working on the development of a visualization system for light pollution effect that combines satellite data with data from ground-based instruments. So far, we have (1) developed a 2.5-dimensional light propagation model to derive the effect of light pollution effect on night sky brightness, and (2) Simulations combining this model with data from satellites and ground-based instruments showed that the value of the starry sky in the Ouketsu region of Fukui Prefecture could be upgraded from the current silver to gold if the upward light leakage from outdoor lighting in the region could be reduced by 30%.

Fig.1 Aperture 3.9m parabolic antenna system

Fig.2 Aperture 13.5m parabolic antenna system (under construction)

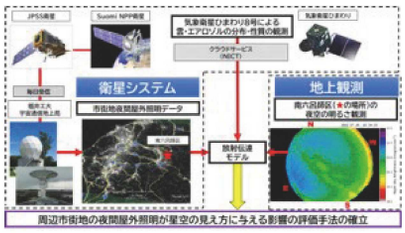


Fig.3 Overview of Light Pollution Visualization System

## Major academic publications

T. NAKAJO, S. YAMAURA, F. ONOMA, M. SHIBAYAMA, T. AOYAMA, Y. KATO, Y. ITO and H. KATO, A project useful for starry sky protection by collaboration between night time artificial light observation from space and night sky brightness observation on the ground, TRANSACTIONS OF THE JAPAN SOCIETY FOR AERONAUTICAL AND SPACE SCIENCES 19 ( 6 ), pp. 845 – 854, 2021.

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Y. SAKAMOTO, Y. TANABE, H. YAGISAWA, N. SUGIMURA, K. YOSHIDA, M. NISHIO, T. NAKAJO, and H. AKIYAMA, Operation Results of Cubesat RAIKO Released from International Space Station, The proceedings of the 29th International Symposium on Space Technology and Science (29th ISTS), 2013.