

## Communications System and Antennas for Kanazawa-SAT3 Microsatellite

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Kanazawa University is developing the first Kanazawa University's microsatellite, named as Kanazawa-SAT3. Kanazawa-SAT3 is planned to be launched within FY2019, and its observation mission is to identify the source of gravitational waves by detecting the occurrence time and arrival direction of the X-rays and gamma rays observed simultaneously with gravity waves from distant astronomical objects.

In this research, we are developing a communications system for Kanazawa-SAT3. Kanazawa-SAT3 has three different communication systems using S band, UHF band and Iridium, and the link design of each of them has generally been completed. We summarize each communication system in detail as the following.

The S-band communication system, will use 2-GHz frequency band. Kanazawa-SAT3 is equipped with two types of antennas: S-band patch antennas and S-beacon antennas. S-band system is a main communication system between the satellite and a ground station, and plays a role of high speed data communication and beacon transmission. On the satellite side, two S-band patch antennas designed for both transmission and reception are mounted on the front and rear panels of the satellite. Two S-beacon antennas for transmission are also mounted on the front and rear panels of the satellite. On the ground side, we will send and receive by the signals using a 2.4-m parabolic dish installed at Kanazawa University.

The UHF communication system will use 400-MHz frequency bands. This system transmits commands from the ground to the satellite and telemetry information from the satellite to the ground. On the satellite side, four inverted-F type antennas we developed are mounted (two for receiving and two for transmitting) on the front and rear panels of the satellite. On the ground side, we will send and receive data by using a Yagi antenna with 14 crossed elements installed at Kanazawa University. We have also constructed an automatic satellite tracking system using the Yagi antenna.

A communication system using the Iridium satellite network uses a frequency band around 1.6 GHz. In this system, communications are performed via Iridium satellite, so that the communication can be established even when our ground station is not visible from the satellite. The data is exchanged between the satellite and the ground by using e-mail. This system can transmit and receive data in almost real time so emergency command and data transmission will be available. On the satellite side, two antennas for both transmission and reception are mounted on the front and rear panels of the satellite. A system has been constructed that exchanges data between a laptop computer simulating an onboard computer (OBC) mounted on a satellite and an iridium satellite.

From now on, for the communication systems using the S band and the UHF band, it is necessary to develop the communication software. For In addition, we need to improve the automatic satellite tracking

system of Kanazawa-SAT3. For the communication system using Iridium satellite, it is necessary to implement a system on the OBC and conduct a communication experiment.

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