IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Communication Systems and Services, Part 2 (3)

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ON-ORBIT DEMONSTRATION OF LASER LIGHT SOURCE FOR COMMUNICATION USING CUBESAT

Abstract

In recent years, the communication rate between satellites has been increasing, and development of optical communication between satellites as a high-capacity communication line has been progressing. On the earth, optical communications have been widely practiced in long-distance transmission using optical fibers, as typified by submarine cables. These optical communications often use a wavelength of 1550 nm, and communications using digital coherent technology are widely used in long-distance, high-capacity communications. Digital coherent technology is a technology that uses phase/polarization diversity homodyne detection, and digital signal processing to estimate the carrier phase and polarization separation of the signal light. When laser light is used for inter-satellite communications, its short wavelength causes a larger Doppler shift than that of radio waves, depending on the orbit of the satellite. In applying digital coherent communications to inter-satellite communications, it is necessary to cope with the Doppler shift in order to maintain homodyne detection. Therefore, it is desirable to use a laser module that can control the wavelength according to the Doppler shift for inter-satellite optical communications.

In this paper, the authors report on an in-orbit wavelength tunable control mission using a nanosatellite to realize inter-satellite optical communications using a 1550nm laser. By using 1550nm light, which is commonly used in optical communications, it is expected to divert and reduce the cost of optical fiber communication technology in the 1550nm band, which is under rapid development. The satellite carrying this mission is a 3U-sized Cubesat called Optimal-1, and its launch was conducted in December 2022. It was then released from the ISS in January 2023 to orbit in low orbit. The onboard optical module includes a 1550nm laser, laser driver, MCU, etalon, photodiode, and temperature sensor. The laser wavelength can be tuned by control from the MCU. To confirm the tunability of the wavelength, the change in the attenuation of the etalon output is detected, allowing measurement of the tunable width of the wavelength. In this paper, we report on the successful operation of the onboard optical module in orbit and confirmed that the wavelength tunability of more than about 60 GHz can be achieved.