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Author: Mr. Ten Arai
The University of TOKYO, Graduate school, Japan

Mr. Isamu Moriai
The University of TOKYO, Graduate school, Japan
Prof. Hokuto Sekine
University of Tokyo, Japan
Mr. Hayato Nakamura
University of Tokyo, Japan
Prof. Hiroyuki Koizumi
University of Tokyo, Japan
Prof. Kimiya Komurasaki
University of Tokyo, Japan

THE FULLY WIRELESS SIX-DEGREE-OF-FREEDOM THRUST MEASUREMENT FOR CUBESAT CLASS PROPULSION SYSTEMS

Abstract

In recent years, the number of small spacecraft launches has increased and missions have become more complex. As missions become more complex, the demand for small propulsion systems is increasing. Propulsion systems are the components that are responsible for governing the mobility of a spacecraft. To achieve accurate spacecraft control, thrust measurement of propulsion systems is essential before launching to space.

Conventionally, thrust measurements have been conducted in 1-degree-of-freedom (DOF), which is the principal component of thrust, but there is a growing demand for thrust measurements in 6-DOF for more precise spacecraft control.

One of the common issues in thrust measurement is the disturbance caused by harness connections to propulsion systems. The harnesses are used to supply power to and data communication with propulsion systems. As the number of harnesses increases, the disturbance becomes larger. The disturbance also varies depending on the harness type and connection method. This disturbance could be suppressed by devising harness connections in the 1-DOF thrust measurement, however, interference to any of the axes could not be avoided even if harness connections were devised in the 6-DOF thrust measurement. Some previous studies used liquid metal for electrical connection to eliminate disturbance caused by harness connections, but the viscosity of the liquid metal changes depending on the experimental environment, which affects the thrust measurement result.

Based on the above background, we developed the module in which power supply and data communication to propulsion systems completely wirelessly and succeeded in eliminating the disturbance caused by harness connections to the measurement. The power to propulsion systems was supplied by a Wireless Power Transmission system (WPT) based on magnetic field resonance type. The WPT charges batteries mounted on propulsion systems and then supplies power from batteries to propulsion systems during operation. 10 Wh of power can be supplied. The data communication can be carried out via Wi-Fi from outside of a vacuum chamber. Our wireless module can be adapted to any thrust measurement system. In this study, as a demonstration, 6-DOF measurement was successfully conducted with the wireless module

we developed. At the conference, we will explain the detailed specifications of the wireless module we developed and present the results of actual 6-DOF thrust measurements.