30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

Author: Mr. Yutaro Ito
University of Tokyo, Japan, yito@space.t.u-tokyo.ac.jp

Mr. Yoshinari Gyu
University of Tokyo, Japan, gyu@space.t.u-tokyo.ac.jp
Dr. Ryo Suzumoto
University of Tokyo, Japan, suzumoto@space.t.u-tokyo.ac.jp
Mr. Tomoki Mochizuki
University of Tokyo, Japan, mochizuki@space.t.u-tokyo.ac.jp
Mr. Masaki Tsutsui
University of Tokyo, Japan, tsutsui@space.t.u-tokyo.ac.jp
Mr. Shoichi Seto
University of Tokyo, Japan, seto@space.t.u-tokyo.ac.jp
Dr. Yosuke Kawabata
University of Tokyo, Japan, kawabata@space.t.u-tokyo.ac.jp
Mr. Akihiro Ishikawa
University of Tokyo, Japan, ishikawa@space.t.u-tokyo.ac.jp
Prof. Ryu Funase
University of Tokyo, Japan, funase@space.t.u-tokyo.ac.jp
Prof. Shinichi Nakasuka
University of Tokyo, Japan, nakasuka@space.t.u-tokyo.ac.jp

STREAMLINING OF THE ROUTINE TASKS OF SPHERE-1 EYE OPERATION REALIZED BY ITS FLIGHT SOFTWARE FUNCTIONS

Abstract

SPHERE-1 EYE is a 6U CubeSat developed in collaboration with Sony Group Corporation, the University of Tokyo, and JAXA, launched in January 2023, which is currently in operation. Its challenging mission is to build a system that allows ordinary users to freely choose the angle of view and take pictures of the earth and space. While each pass is less than 10 minutes because it is a LEO satellite, the satellite has to complete many operational tasks such as the checking of the bus system, establishment of fine three axis attitude control using STT and RW, and the end-to-end mission rehearsal with mission components and X-band transmitter. In order to accomplish this many operational items in a limited time and number of passes, it is essential to shorten the routine tasks common to each pass.

To answer this need, the following two functions are implemented on the flight software. The first is the *Pass Recorder*. This function keeps the next ten pass start times at unixtime and turns STx on only during the pass. When the pass time arrives, a block command, which is a set of several specific commands including STx power-on commands, is executed. Since the contents of a block command can be edited easily in orbit, other commands required for regular processes during pass can also be incorporated into the block command in response to the change of satellite situation, which enables the automation of the routine tasks of pass.

The other is the *Telemetry Manager*. To manage the satellite telemetry, it is necessary to generate real-time telemetry while visible, store telemetry in non-volatile memory while not visible, and replay

stored telemetry during pass. *Telemetry Manager* manages all of these three processes at once, enabling flexible changes to the telemetry configuration in accordance with the operational tasks and STx bitrates. In addition, the telemetry configuration settings can be stored in non-volatile memory and read out to reflect the settings, which significantly reduces the time required for telemetry reconfiguration compared to previous satellites operated by the University of Tokyo.

One month has passed since the launch, and we have confirmed the soundness and effectiveness of both functions. Routine tasks of the pass have been significantly reduced, and time can be allocated to main operational items. This paper reports the concept, details and benefits of these functions, and their further scalability for future missions.