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DEVELOPMENT OF A CAMERA CONTROLLER SYSTEM THAT ENABLES AUTONOMOUS IMAGE ACQUISITION FROM MULTIPLE VIEWPOINTS

Abstract

Due to recent advances in space development, spacecraft missions have become highly complicated and require high levels of autonomy. One of the best examples is the sample return mission of the asteroid probe "Hayabusa," launched in 2003. In this mission, Hayabusa captured particles of an asteroid and returned them to earth. The capsule containing samples returned to earth in 2010. For such missions, it is necessary for the spacecraft to perform highly complicated operation under both expected and unexpected situations.

In order to realize such complicated missions, the importance of visual information has increased. Visual images can be utilized for various objectives, such as situation monitoring and motion analysis, and also play an important role in GO/NO-GO determination at critical stages of a particular mission. For deep space missions in particular, the transmission bandwidth is highly limited for the transmission of visual information.Therefore, an image acquisition system is needed to perform image processing capabilities. To achieve this, we developed a High Performance Image Acquisition and Processing System (HP-IMAP), and its performance was successfully demonstrated in the small solar electric power sail demonstrator "IKAROS," launched in 2010. In the IKAROS mission, we also succeeded in acquiring entire images of the space craft, using an ejecting camera probe. Led by this success, there is a growing expectation for the realization of images of multiple viewpoints by using both the separation probe and the fixed camera.

Based on the HP-IMAP technologies, we developed an image acquisition system to realize image acquisition for multiple viewpoints. Utilizing commercial-off-the-shelf (COTS) devices, this system can simultaneously acquire images from up to six cameras. In addition, this system is expected to be utilized in the "Hayabusa2" mission. Because the image acquisition system for this mission will be distant from the earth, it is necessary to autonomously acquire images with respect to the situation, process, and response, but the computer that controls the spacecraft is unable to manage the image acquisition process.

Thus, the camera controller is expected to autonomously acquire images according to the situation. To meet such requirements, we also expanded HP-IMAP's software technologies and implemented an autonomous sequence control capability in the camera controller system. In addition to this platform expansion, we developed a software designing tool that automatically generates sequence control software from sequence documents.

This paper reports the development of a camera controller system that enables autonomous image acquisition from multiple viewpoints.