SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 1) (4A)

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HAYABUSA2-RYUGU PROXIMITY OPERATION PLANNING AND LANDING SITE SELECTION

Abstract

The asteroid explorer Hayabusa2 is aimed at the sample return mission to a C-type asteroid 162173 Ryugu. Hayabusa2 was launched by the Japan Aerospace Exploration Agency in December 2014 and will arrive at the asteroid vicinity in the summer of 2018. Hayabusa2 will explore Ryugu for 1.5 years and return to the Earth in winter 2020. As well as past asteroid exploration missions, current measurements of Ryugu are limited due to the capability and opportunity of the ground-based observation and thus, most of the asteroid information are unknown until the arrival.

In consequence, highly robust planning of Ryugu proximity phase operation is required to adapt to the uncertain asteroid environment and the spacecraft constraints. Since the spacecraft configuration is optimized to be operated in a vicinity of the Earth-asteroid line, the visible and accessible region varies dramatically due to the asteroid rotation state.

Therefore, the in-situ observation of Ryugu drives the proximity operation. Hayabusa2 cannot collect samples on the asteroid surface without detail observations. Since the sampling operation includes the direct contact between the spacecraft and the asteroid, the surface condition of the sampling site need to satisfy certain threshold for the safe sampling. Moreover many spacecraft parameters need to be optimized to the asteroid surface for the successful sampling procedure. However, the evaluation time of the asteroid environment is limited because of the change of the observable and accessible latitude belt.

Consequently, the landing site selection of Hayabusa2 aims to select an optimal sampling site satisfies both the operational constraints and the scientific requirements within a limited period. Moreover, the landing site selection is not only the sampling site selection of Hayabusa2, but also the exploration site selection of the carry-on surface robots, MINERVA-II rovers and MASCOT lander. This is the one of the main complexity which was not occur in past small body explorers, like Hayabusa and Rosetta/Philae. Since the optical navigation and guidance system of Hayabusa2 conflict with the surface robots, the landing sites cannot be selected independently.

This paper presents the robust planning of the Hayabusa2-Ryugu proximity operation and landing site selection process considering the unknown asteroid environment and the spacecraft constraints. The

proximity operation scenario are described together with the relationship between the selection process and the in-situ observation. The mission constraints are summarized for the possible asteroid environment, including the rotation state, thermal condition and gravity.