Status report of study about albedo observation using the Hayabusa2 LIDAR

（はやぶさ 2LIDAR によるアルベド観測検討報告）

Ryuhei Yamada[1], Hiroki Senshu[2], Noriyuki Namiki[3], Kazuyoshi Asari[3], Hiroshi Araki[3], Shoko Oshigami[3], Fumi Yoshida[2,4], Hirotomo Noda[3], Shinsuke Abe[5], Naru Hirata[1], Yoshiaki Ishihara[6], Koji Matsumoto[3], Takahide Mizuno[6],

[1]The University of Aizu
Tsuruga, Ikki-machi, Aizu-Wakamatsu, Fukushima 965-8580, Japan
[2]Chiba Institute of Technology
2-17-1, Tsudanume, Narashino, Chiba 275-0016, Japan
[3]National Astronomical Observatory of Japan
2-21-1, Osawa, Mitaka, Tokyo 181-8588, Japan
[4]Kobe University
1-1, Rokkodai-cho, Nada-ku, Kobe, Hyogo 657-8501, Japan
[5]Nihon University
7-24-1, Narashinodai, Funabashi, Chiba 274-8501, Japan
[6]Institute of Space and Astronautical Science
3-1-1, Yohinodai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan

ABSTRACT

The Japanese asteroid explorer Hayabusa2 was launched at the end of 2014, and it will arrive at near-Earth C-type asteroid 162173 Ryugu at 2018 summer. It is equipped with Light Detection and Ranging (LIDAR) instrument for laser ranging which can be used to measure the intensities of transmitted and received pulses. The intensity data can be used to estimate the normal albedo of Ryugu at a laser wavelength of 1064 nm. The normal albedo estimated from the LIDAR data does not on the solar incident angle

because it is measured at constant zero phase angle, and the well-calibrated laser transmitter can be applied. Through the albedo observation by the Hayabusa2 LIDAR, a first global normal albedo map of the C-type asteroid with good accuracy will be constructed.

In this study, we have firstly investigated the performance of the LIDAR and studied about the method to derive normal albedo using the LIDAR intensity data. We determined the transfer functions of the laser module and receiver to convert the intensity data into pulse energies, along with the utilization ratio of the returned pulse energy, through verification tests of the LIDAR flight model. Then, we evaluated the error of the normal albedo due only to the instrument error. It will be 18.0 % in an observation at a nominal altitude of 20 km.

Secondary, we study effect of the surface terrain on the normal albedo estimation. The shape of the returned pulse is deformed as a result of the slope and roughness of the topography within a laser footprint. Then, the received pulse intensity can vary due to variation of the shape because the signal processing unit has the frequency response, even if the normal albedo is constant. Currently, we prepare for the experiment to investigate the frequency response of the unit using the LIDAR-EM. The programing code to simulate the shape of the returned pulse has been also developed to apply the experiment and the albedo observation.

We have also constructed the experimental setup to measure the reflectance of samples using 1064 nm laser at phase angles from 0 over 30 degrees. This experiment is required to investigate the phase curves of carbonaceous chondrites at 1064 nm to fit to the albedo observed by other onboard instrument at different phase angles. Then, we will also study about albedo variation depending on surface condition such as degree of aqueous alternation. The opposition effects of the powder samples of five carbonaceous chondrites could be detected using our equipment.