Geophysical Research Abstracts
Vol. 12, EGU2010-5696, 2010
EGU General Assembly 2010

The study of lunar rotation by Japanese lunar landing missions

Fuyuhiko Kikuchi (1), Hideo Hanada (1), Hirotomo Noda (1), Sho Sasaki (1), and Takahiro Iwata (2)
(1) RISE Project Office, National Astronomical Observatory of Japan, Mizusawa, Japan (fuyuhiko@miz.nao.ac.jp), (2) ISAS, JAXA, Sagamihara, Japan

The internal structure of the planet is one of the important clues to know its origin and evolution. So far, gravity, rotation, seismic wave, electro-magnetic wave, and heat flow observations have been carried out. In these methods, we plan to load rotation estimation instrument for next Japanese lunar exploration project SELENE-2 and SELENE-3.

LLR:
The Lunar Laser Ranging (LLR) is the method to measure the distance between the Earth and the Moon using laser beam. For more than 30 years since the Apollo and the Lunokhod mission placed retrograde reflectors on the Moon, LLR produced data on the lunar rotation as well as the lunar orbital evolution. On the basis of LLR data, the state of lunar interior is discussed. Williams discussed the dissipation between the solid mantle and a fluid core from LLR data. LLR observation has also provided information of moment of inertia and tidal Love number of the Moon. We are proposing a new LLR on board SELENE-II. Instead of conventional corner cube reflector (CCR) array, we are planning to use a larger single reflector. This has an advantage over the conventional CCR array, because a single cube should have smaller distance variation within the reflector upon monthly libration of the lunar rotation. We are proposing that a new reflector should be somewhere in the southern hemisphere on the nearside Moon. Then in combination with a powerful A15 CCR, latitudinal component of lunar libration and its dissipation can be measured precisely.
We also prepare the inverse-VLBI and ILOM (In situ Lunar Orientation Measurement) missions for post-SELENE-2 mission.

ILOM:
ILOM is a selenodetic mission to study lunar rotational dynamics by direct observations of the lunar physical libration and the free librations from the lunar surface with an accuracy of 1 millisecond of arc in the post-SELENE project. Year-long trajectories of the stars provide information on various components of the physicallibrations and we will also try to detect the lunar free librations in order to investigate the lunar mantle and the liquid core. The PZT on the moon is similar to that used for the international latitude observations of the Earth is applied. The measurement of the rotation of the Moon is one of the essential technique to obtain the information of the internal structure. As the result of thermal analysis of the ILOM system, it is difficult to attain such an accuracy on the lunar surface if we use an objectives with combination of conventional lenses. We are developing a new system with diffractive lense and adaptive optics which can be used on the lunar surface.

iVLBI:
In the inverse VLBI mission, two or more artificial radio sources are loaded on multiple landers. These transmit radio signals and the differences of the distance between landers and ground VLBI station are measured. This differential range measurement is sensitive to the rotation of the Moon. This new lunar rotation estimation method will contribute to investigate the internal structure of the Moon and can be used to confirm the conventional LLR results.

In the presentation, the detail of the instruments, scientific target, and recent status are presented. We also introduce the latest results of the Japanese lunar exploration project Kaguya, especially new SELENE gravity model (SGM), k2 value, and moment of inertia in particular are shown.