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Estimation of the Lunar physical libration accuracy in the Japanese Lunar Space project based on Inverse VLBI

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After successful realization of the first stage of the Lunar space mission SELENE - Kaguya the Japanese researchers plan to carry out the second stage of the mission SELENE II, including observations in the near surface space and on the surface of the Moon. One of these experiments propose to place two landers - Lander and Rover - on the Lunar near side and to launch one Orbiter on the low Lunar orbit (Kikuchi et al., 2008). The Rover will able to move around the Lander on the certain distance. The difference of the distances Lander - Earth and Rover - Earth will be is assumed to be measured by the methods of Inverse VLBI: radio-signal from the Lander and the Rover will be sent to Earth antenna using the Orbiter. It is expected that the accuracy of the measurement will be 0.1 - 0. 3 mm.

It is important to find optimal configuration of the Lander and Rover for accurate determination of the Lunar physical libration. Estimation of the accuracy of libration angles was done for various location and configuration of the Lander and Rover. Appropriate approximation was taken into account: calculations were carried out in Cassini's coordinate system, orbital motion of the Moon and diurnal rotation of the Earth were not considered. In this approach it was estimated that the best theoretical accuracy ($\sim$60 milliseconds of arc for the length of base between Lander and Rover of 1 km – only this distance may be supported by the power system of the planned project) will be achieved in the near Sub-Earth-point of the Moon, where radio beacons can be located. The predicted accuracy of the physical libration of multilayer Moon will not allow detecting fine effects of Lunar rotation, such as, for example, geometrical, dynamic and geochemical structure of a liquid core of the Moon. Because of this it will be necessary to increase the distance between Landers till 60-100 km for the accuracy of 1 milliseconds in physical libration angles.

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