Influence on illumination condition by analysis altitudes

*井上 博夏[1]、大嶽 久志[1]、大竹 真紀子[1]、山本 光生[1]、星野 健[1]、嶋田 貴信[1]、田中 智[1]、増田 宏一[1]、森本 仁[1]、若林 幸子[1]、橋本 樹明[1]
*Inoue Hiroka[1], Hisashi Otake[1], Makiko Ohtake[1], Mitsuo Yamamoto[1], Takeshi Hoshino[1], Takanobu Shimada[1], Satoshi Tanaka[1], Koichi Masuda[1], Hitoshi Morimoto[1], Sachiko Wakabayashi[1], Tatsuaki Hashimoto[1]

1. 宇宙航空研究開発機構
1. Japan Aerospace Exploration Agency

The Japan Aerospace Exploration Agency (JAXA) launched a Moon orbiter, Kaguya, in September 2007 and succeeded in putting it into an orbit approximately 100 kilometers above the Moon in October. This Moon orbiter has provided us with a significant amount of scientifically valuable Lunar data. Besides Japan, various other countries all over the world have succeeded in obtaining Lunar observation data using Moon orbiters such as NASA’ s Lunar Reconnaissance Orbiter (LRO). The future objective of Moon exploration is to investigate the existence of volatiles such as water and sodium, and to search their potential usefulness. Since valuable resources are likely to exist in the lunar polar region, some countries are currently planning landing missions around the lunar poles. JAXA is also considering a Moon polar exploration mission whose purposes are to investigate the existence of lunar resources and to study their potential. For such a mission, we must select a landing site with long-term desirable sunlight conditions because the mission period is expected to be long due to the observation at the site. Illumination condition analysis of the south pole has been well studied, but that of the north pole is insufficient even though a superiority of the south pole for a landing site has not fully examined. Landing site selection is critical for the mission accomplishment in the polar region, so much previous work has well analyzed illumination conditions in the Moon polar region. The Moon has more undulating terrain than the Earth, so sunshine conditions change remarkably with the altitude or sunshade. Hence, we determine an appropriate landing site and calculate the illumination conditions for the landing site assuming three different altitudes.

We employed Digital Elevation Model (DEM) data obtained by the Lunar Orbiter Laser Altimeter (LOLA) of LRO and the Terrain Camera (TC) of Kaguya. In addition, we used the SPICE toolkit to calculate the position of the Sun. By combining the DEM data and Sun position, we can calculate the ratio of solar disc occulted by the horizon. We first conducted the simulation of illumination condition over a 60 km square around the lunar north pole. Within the good illumination condition area, there are especially favorable sites that satisfy the conditions for landing that the surrounding area also has good sunshine and smaller differences in height. For the candidate landing sites, we did not regard the Sun as one light source but separated it into 52 sun discs, and simulated illumination for altitudes of 0, 2, and 5 meters.Figure represents changes of sun visibility with each altitude. The colorbar shows the number of sunshine days in two years.

We present the illumination simulation results of an especially favorable landing site using LRO and Kaguya data. We can obtain the detailed sunshine conditions or its difference with altitude by conducting simulation with changing altitude. Future work will focus on the illumination simulation for a wider range of regions for precise landing site selection. In addition, we must evaluate the influence of resolution of input DEM data on illumination conditions.

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