A study on surface roughness in thermo-physical modeling of asteroid for the estimation of thermal inertia

*Jun Takita[1], Hiroki Senshu[2], Satoshi Tanaka[3]

1.Graduate School of Science, Tokyo University, 2.Chiba Institute of Technology/PERC, 3.JAXA/ISAS

This study reports preliminary results of our study about the effect of rough surface on thermal inertia from thermal phase delay using thermo physical model (TPM). In the thermal modeling of asteroid, information on the surface topography and surface roughness is indispensable for thermophysical estimation, which is especially important to deduce thermal inertia of an asteroid. This is one of the preparations for the thermo-physical observations of asteroid Ryugu using the thermal infrared imager in Hayabusa2 mission.
For numerical approach using TPM, we produced rough surface models by deforming a spherical surface mesh. We considered the effect of surface roughness on surface temperature as a function that changes only the effective emissivity of the planetary surface, following the works of Davidsson et al. (2009) and Leyrat et al. (2011).
We fitted the surface temperatures that were generated by the rough surface models to determine whether the thermal phase delay can still be retrieved under rough surface topographies. We picked only the surface temperatures on the equatorial zone. Quadratic least-square fitting is applied to the data to deduce thermal phase delay.
We evaluated uncertainties in the estimation of the phase delay based on a series of data generated in the diurnal motion. As a result, we found that the feasibility of thermal inertia from the diurnal phase delay depended greatly on the observational geometry in terms of solar illumination over the asteroid surfaces. The thermal phase delay could be determined without being strongly affected by local topography under low solar phase angles. Considering the errors of phase shift, the uncertainty of thermal inertia will be greater than 50% if the rough scale is greater than 9.6° (RMS surface slope angle) from the case of low solar phase angle.

Keywords: asteroid, thermal inertia, surface roughness

