

## Surface roughness effect on KAGUYA LRS surface echo observation and its calibration

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KAGUYA Lunar Radar Sounder (LRS) was an HF (5MHz) radar whose primary mission was to explore subsurface of the Moon. Its footprint covered whole surface of the Moon in its operation period. All the data was processed by applying Synthetic Aperture Radar (SAR) algorithm so that the signal-to-noise ratio of target echoes as well as the spatial resolution was improved.

The data was further processed to extract nadir surface echoes so that the surface property of the Moon was studied in a spectral range of the HF band. The physical property that can be known directly from the data was the apparent reflectivity of the lunar surface in the frequency range of the HF band: The data contains scattering effect of surface roughness due to the surface terrain. We need to separate this scattering effect from the data so that we can make quantitative evaluation of the surface reflectivity. In order to meet this requirement, we carried out simulation of KAGUYA LRS observation to evaluate the surface scattering effect due to the lunar surface terrain.

The simulation was based on Kirchhoff approximation method. The Lunar Imager/SpectroMeter (LISM) Digital Elevation Model (DEM) data was utilized to simulate actual lunar surface terrain. Flat surface observation was simulated as the reference case before the simulation of actual LRS observation was carried out. We assumed that the dielectric constant of the lunar surface material was 4.0.

Our simulation revealed that even a mare surface where the surface is often regarded to be flat certainly behaved as a rough surface which gave a rise to decrease of the nadir echo intensities for a few decibels in comparison to the flat surface reflection. This effect gives a significant influence on estimation of regolith thickness in maria. Newly estimated regolith thickness was approximately a meter smaller than previously estimated value: it turned out to be 6 - 7 m in Mare Imbrium.

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