KILOMETER SCALE ROUGHNESS ANALYSIS OF LUNAR DIGITAL TERRAIN MODEL. Y. Yokota[1], J. Haruyama[1], M. Ohtake[1], T. Matsunaga[2], C. Honda[1], T. Morota[1], H. Demura[3], N. Hirata[3], and LISM Working Group, [1]Institute of Space and Astronautical Science / Japanese Aerospace Exploration Agency, 3-1-1 Yoshinodai, Sagamihara, Kanagawa, Japan, yokota@planeta.sci.isas.jaxa.jp, [2]National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba-City, Ibaraki, 305-8506, Japan, [3]University of Aizu, Aizu-Wakamatsu, Fukushima, 965-8580 Japan.

Introduction: The lunar terrain reflects its impact and volcanic histories. Since meteoroid impact has been a major process in forming the topography of the lunar highlands, quantifying surface roughness might be useful in distinguishing the ejector unit of the highland and may contribute significantly to the stratigraphic study of the Moon.

The lunar explorer, SELENE, will be launched in FY 2007. SELENE has three cameras for scientific observation, and they compose one system, called the Lunar Imager and SpectroMeter (LISM) [1]. The Terrain Camera (TC) is one of the LISM instruments. From orbit, it will capture stereoscopic images of the lunar surface with a spatial resolution of 10m [2]. Recently, the Digital Terrain Model (DTM) system for LISM TC data has developed [3]. This system will provide a relative DTM for the entire lunar surface. Accordingly, it is important to prepare automatic processing methods, which suit for such a large DTM dataset.

We demonstrate an indicator of topographic roughness on a kilometer scale, using a DTM dataset made from stereoscopic images of the Apollo Mapping Camera, and compare the roughness of several regions in the lunar highlands.

Target Region and DTM data: We have prepared DTMs of three regions in the Apollo observation area (Figure 1). To produce the DTM, we used multipurpose Digital Elevation Model software, produced by CCS (Central Computer Service Co., Japan). This is a prototype of the DTM producing system for the LISM TC data. Detail of the procedure has been reported in our previous report [4].

Roughness Parameters: We adopted the RMS deviation (Allan deviation) method [5] to quantify the roughness of lunar surface. The RMS deviation is given by

$$v(\Delta x) = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[h(x_i) - h(x_i + \Delta x)\right]^2}\ , \qquad (1)$$

where n is the number of sample points, $h(x_i)$ is the height of the surface at point xi, and Δx is the step size in the horizontal direction. It often follows a power-law trend with a horizontal scale,

$$v(\Delta x) = v_0(\Delta x)^H , \qquad (2)$$

where v_0 is the RMS deviation at the unit scale [5].

We selected a 1°×1° cell in the map as the unit area for the analyses.To simplify computation of the RMS deviation, we sampled the DTM data only in the latitudinal direction because this direction has a fixed scale in the simple cylindrical projection map. The RMS deviation was computed for each cell, after subtracting the average slope of the cell in the latitudinal direction. The RMS deviation was determined for step sizes ranging from 0.3 to 3km, then the parameters $\log_{10}(v_0)$ and H were fitted using Eq. (2). Fitted results are shown in Figure 1 by color of each cell (lower $\log_{10}(v_0)$ is bluer, higher H is redder).

The fitted parameters appear to vary between the regions.In the Apollo 16 region, H distributes over a wide range, 0.52 to 0.91, and correlates with log10 (v_0). The likeliest reason for this variation is that the two units (Smooth Cayley Plains and Descartes material) are randomly mixed in the cells. Theoretically, H is expected to range between 0 and 1 [5]. The mean H values in regions 2 and 3 are relatively high (0.90 and 0.86).Therefore, the RMS deviation plot of #2 and #3 might be expected to have breakpoints with much larger step sizes, and at that scale, the value of H might decrease. Future work is needed to test these expectations.

References: [1] Haruyama, J., et al. (2000) *LPS XXXI*, Abstract #1513. [2] Haruyama, J., et al. (2006), *Adv. in Geosci., 3: Planetary Science, World Scientific Publishing*, 101-108. [3] Haruyama, J., et al., (2006) *LPS XXXVII*, Abstract #1132. [4] Yokota Y., et al. (2007) *Adv. Sp. Res.* (Submitted). [5] Shepard, M. K., et al. (2001) JGR 106, E12, 32777-32796.

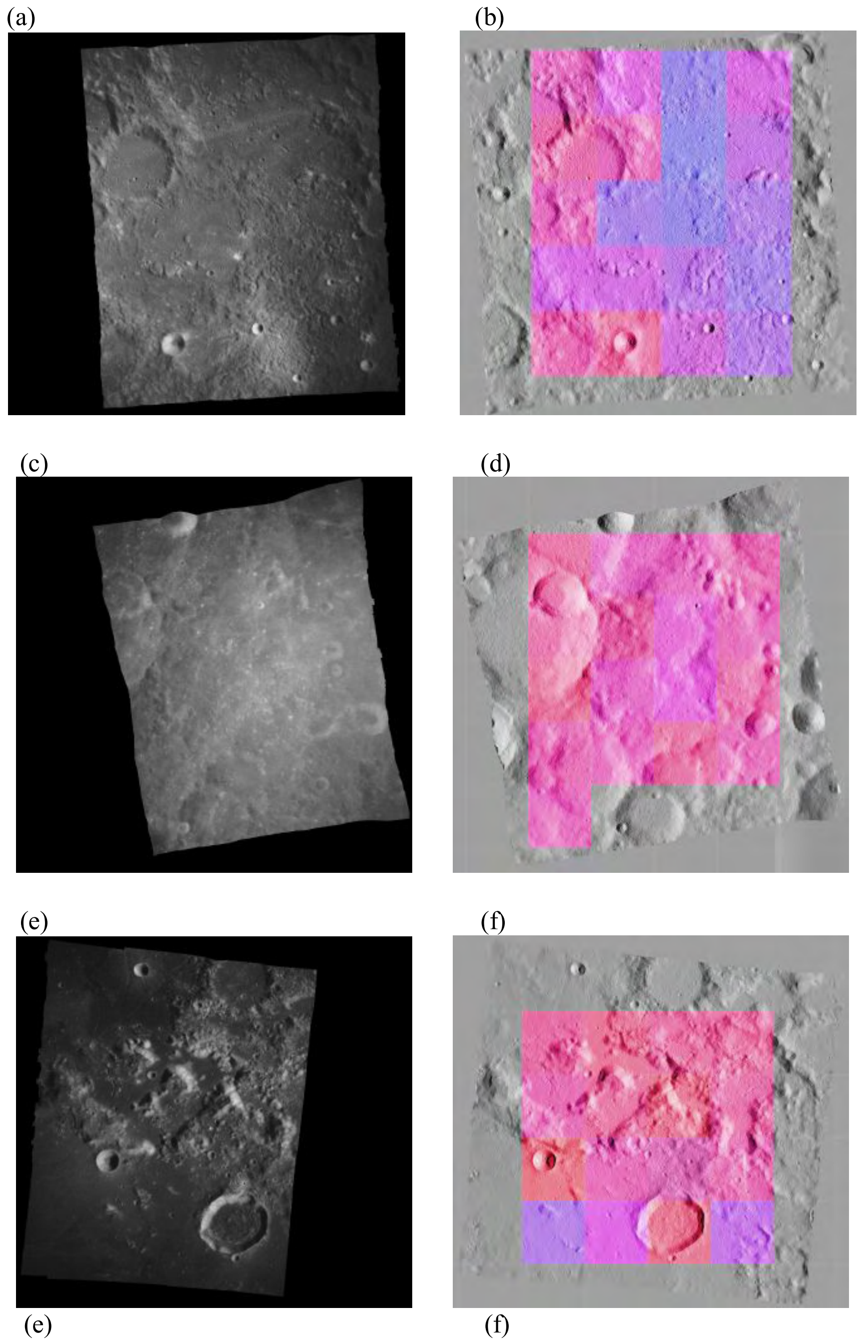

Figure. 1. Left: Orthorectified images of the Apollo mapping camera. Each maps covers About 180x180 km area. Orthorectification was performed by using DTM made from pair images. (a) Apollo 16 site region (15°E, -8°N). (c) Far side highland region (105°E, 5°N). (e) Apollo 17 site (31°E, 19°N). **Right:** Shaded relief maps made from DTMs. Each map are mosaiced using overlapped two DTMs. Color of the cell shows degree of roughness. See text for ddetails.