DEVELOPPMENT OF A NEW LUNAR RADIOMETRIC CALIBRATION MODEL BASED ON SELENE/SP FOR JAPANESE FUTURE HYPER SPECTRAL MISSION HISUI Y. Ishihara[1], T. Kouyama[1], R. Nakamura[1], S. Tsuchida[1], T. Matsunaga[2], F. Sakuma[3], Y. Yokota[2] and S. Yamamoto[2], [1]National Institute of Advanced Industrial Science and Technology (Umezono 1-1-1, Tsukuba, Ibaraki 305-8568, Japan, ishihara.yoshiaki@aist.go.jp), [2]National Institute for Environmental Studies (Onogawa 16-2, Tsukuba, Ibaraki 305-8506, Japan), [3]Japan Space Systems (Shibakouen 3-5-8, Minato-ku, Tokyo 105-0011, Japan)

Introduction: Radiometric calibration and validation is one of the most important task for multi-spectral and hyper-spectral observation of the Earth. There are two methods for conducting the radiometric calibration of satellite sensors, i.e., pre-flight and in-flight calibration. The pre-flight calibration is conducted in laboratory before launch. However, because of difficulty of adjust harsh environmental conditions during and after launch, instruments performance are degrading at launch and during on orbit. Therefore, in-flight calibrations are needed. Generally, in-flight calibration conducts by four methods, i.e., onboard, vicarious, cross, and lunar calibration. Although many satellite sensors are equipped with onboard calibration devices, the onboard calibration is not absolutely reliable due to degradation and/or placement of device itself. Therefore, the vicarious calibration using terrestrial targets, cross calibration using other satellite sensors, and lunar calibration using the Moon have been developed to monitor the long-term degradation trend of satellite sensors. To this day, lunar calibration is conducted based on the ROLO lunar model [1, 2, 3] developed by Robotic Lunar Observatory of USGS. The ROLO model is based on ground base telescopic observation and is disk integrated model with limited spectral bands.

SELENE/SP based Lunar Cariblation Model:

Hyperspectral Imager Suite (HISUI) is a Japanese next-generation Earth observation project, that is composed of a hyperspectral imager and a multispectral imager, which will be launched on Advanced Land Observation Satellite 3 (ALOS-3). HISUI will provide the earth observation data for environmental monitoring and forestry as well as for global energy and resource issues. HISUI sensors have lots of spectral bands and ability of high spatial resolution. The ROLO model is not sufficient for HISUI's lunar calibration.

We developed a new lunar calibration model for radiometric calibration of HISUI's hyper and multispectral sensors using the lunar reflectance model developed from SELENE Spectral Profiler (SP) data [4]. SP surveyed entire lunar surface and developed lunar reflectance model with the wavelength of 500 nm – 1600 nm [5], which involves the lunar surface photometric properties depending on incident, emission and phase angles. The information of reflectance and photometric properties enables to simulate a lunar observation of HISUI from any position around the Earth. The model resolution reaches 0.5 x 0.5 degree in longitude and latitude which is comparable to the resolution of lunar observation by a hyper spectral imager of HISUI. This new SP based lunar calibration model is useful for not only HISUI but also other ongoing and future multi-specral and hyper-specral mission, and will be opened public.

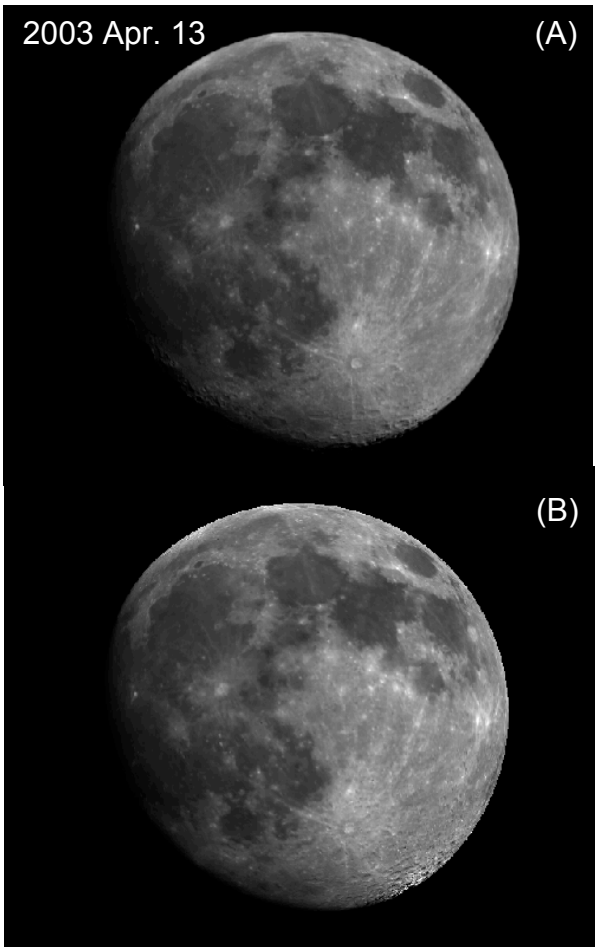

Figure 1 (A) Lunar image taken by TERRA/ASTER at Apr. 13, 2003. (B) A simulated lunar image based on SP lunar reflectance, photometric function model [5].

For demonstrating the utilization of the model, we simulated a lunar observation by Advanced Spacebor-

ne Thermal Emission and Reflection Radiometer (ASTER) onboard Terra using its three bands (Band 1: 560nm, Band 2: 660nm and Band 3: 810 nm) conducted on April 13, 2003 (Figure 1), and we compared observed and modeled radiance at every pixel. Since correlation coefficients of observed and modeled radiance exceed 0.99 for all bands, we confirmed the model describes the lunar surface photometric properties correctly, although absolute radiance in Band 1 show some discrepancy between the observation and the model (observed/simulated ratio is 1.27 +/- 0.05). ASTER band 1 is located shortermost wavelength of the SP/VIS band sensor, so one possible reason of this discrepancy is the calibration accuracy of SP/VIS sensor. Comparing radiance values between SELENE Multiband Imager (MI) and SP [6] at Apollo 16 standard site, shortermost wavelength of SP/VIS sensor is darker than MI. To improve model performance for shortermost bands, further investigations are needed.

In this presentation, we show the advantage of SP lunar reflectance model for radiometric calibration of Earth observation sensors and we demonstrate current SP based lunar calibration system (lunar observation simulator). In addition, we will discuss comparisons of other lunar reflectance models and future development plan (e.g., incorporation of SP/NIR2 band data and topographic effects) for improving the absolute accuracy of the SP model.

References: [1] Lunar Calibration ROLO - Robotic Lunar Observatory, http://www.moon-cal.org/ [2] Eplee, R. et al. (2004) *Proc. SPIE, 5542*, 1-13. [3] Eplee, R. et al. (2009) *Earth Observing Systems XIV*, *Proc. SPIE*, *7452*, 74520X. [4] Matsunaga, T. et al. (2001) *Proc. SPIE Int. Soc. Opt. Eng.*, *4151*, 32-39. [5] Yokota, Y. et al. (2011) *Icarus*, *215*, 639-660. [6] Ohtake, M. et al. (2010) *Space Sci. Rev.*, *154*, 57-77.