1. Title

FY 2001 Ground-based Research Announcement for Space Utilization Research Report

2. Research Term

FY 2001-2003

3. Research Fields

Earth Science

4. Research Categories

Phase IA Research

5. Research Theme

Development of telescopic imaging spectrometers for establishing the moon as a spectral radiance standard of space-borne imaging instruments

6. Investigators

Kazuto Saiki
Hiroshi Takeda

7. Organization

Department of Earth and Space Science, Graduate School of Science, Osaka University, 560-0043 Osaka, Japan.

Research Institute, Chiba Institute of Technology, 275-0016 Chiba, Japan.

8. Summary of Research

Objective/Significance: ALIS (Advanced Lunar Imaging Spectrometer) is a telescopic imaging spectrometer which we developed for Space Station Lunar Observatory project. A future purpose of this project is to establish the photometric model of the moon as a spectral radiance standard of space-borne imaging instruments by repeated observation of the moon with VIS/NIR (Visible and Near Infra-red light) from the International Space Station. Methods: A ground-based model of ALIS has been developed through a phase-IA research. Within this near-term project, telescopic imaging spectrometers have been developed and examined through ground-based observation of the moon. ALIS has two spectrometers; Visible (VIS) one and Near Infrared (NIR) one. Each spectrometer is composed of an imaging sensor and a prism-grating-prism unit. These spectrometers take “1-line spatial resolution” x “wavelength resolution” image as one shot. Line images are assembled by scanning image on a slit of the spectrometer with rotating mirror (Fig. 1). The mirror is also used to switch VIS-system and NIR-system. The design drawing of ALIS is shown in Fig. 2. The visible imaging spectrometer of ALIS can be mounted on a microscope. For microscopic analysis, a sliding stage is used for scanning in place of rotating mirror.

Fig. 1. The interior of ALIS showing scan and camera-switch system

Fig. 2. Design drawing of ALIS

Results: Jupiter and Galileo satellites were observed to check the ALIS optics (Fig. 3). Spatial resolution of ALIS-VIS is
6.188’/pixel and that of ALIS-NIR is 6.435’/pixel. ALIS-VIS is available for spectroscopy of these dark satellites by adjusting exposure time. NIR is not suitable because of high dark current. Lunar data taken by VIS is shown in Fig. 4 and 5. All pixels on the lunar image have spectral data such as Fig. 5. Absorption bands owing to H$_2$O and O$_2$ in the air are clearly detected. The know-how of ALIS operation such as calibration using an integrating sphere was accumulated. Basic spectroscopic researches such as the relation between surface roughness and spectral features progressed using ALIS microscope. Several results showing the diversity of lunar geology were obtained from mineralogical study of lunar rock and analyses of remote-sensing data.

Fig. 3. Jupiter and its satellites taken by ALIS monitor camera

Fig. 4. Lunar image generated from 450 nm intensity of ALIS data

Fig. 5. Raw spectrum of the center of Tycho

Potential for space experiment: ALIS was proved to have suitable performance for making the photometric model of the moon. ALIS user group was organized in cooperation with SELENE members. The group performs scientific study of the moon using ALIS data and plan to employ the data for the calibration of lunar imagers onboard SELENE.

Fig. 6. Specifications of ALIS

Fig. 7. Observation meeting with user group

9. Publication List


10. URL