Image Classification with Texture and Spectral Features for Lunar Geological Mapping

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Geologic mapping is a result of image segmentation and classification in the field of remote sensing. A geological unit is characterized as a congenetic surface area with some image properties such as rocks (materials), topographical/geological structures, relative age in crater chronology, and other geological features. Previous lunar and planetary geological mappings were established on the basis of photogeological interpretation with texture and topographic features. On the other hand the recent lunar geologic researches have remarked surface rock types and mineral composition based on spectral features of Clementine multiband images. The current Lunar Geologic Mapping Program has integrated all information. We try to consider a capability of automatic mapping with both texture and spectral features from a viewpoint of computer science. Texture features are emphasized in traditional photogeology.

Texture pattern is controlled by topographic undulation in subpixel scale and illumination conditions. Currently its available data sets are digitized high resolution images of Lunar Orbiter and Apollo, and soon Japanese Lunar mission Kaguya (˜10 m/pixel). Spectral features as indices of surface materials are derived from image calculations of multiband data. Currently their available data sets are mainly Clementine band-registration one (˜100 m/pixel). Thus, texture feature tends to give more detailed boundaries than spectral one does. Because boundaries of geological units are characterized by their spatial discontinuity, possible combinations of the two features‘s discontinuity are the following three; 1) discontinuity in both features (topographic undulation and surface materials), 2) discon-tinuity of only texture features such as lava flow units in the same composition, 3) discontinuity of only spec-tral features such as highly evened or modified surface by impacts.

The purpose of this research is attempts to create vision of automatic mapping with both texture and spectral features in lunar geology. We adopt the vari-ance of pixels as a statistical index of texture information. The larger variance means the larger degree of surface undulation because of distribution of their shadow areas. The most popular spectral features are derived from ratio operations. Material properties mean the progress of space weathering and the contents of mafic minerals. The 750 to 415 ratio is sensitive to the progress of space weathering. The 750 to 950 ratio is sensitive to the presence of mafic minerals. The 415 to 750 ratio is sensitive to fresh soils.