Proposal of fisheye lens configuration on MINERVA2 for topographic recognition

Yoshio Hamada[1]; Hirohide Demura[1]; Noriaki Asada[1]

[1] Univ. of Aizu

MINERVA2 is the successor rover to MINERVA which was boarded on HAYABUSA. Its considerations of specification and development of elemental technology is making progress at the working group for next asteroidal exploration mission. Both rovers show a policy of design without any variable parts on their external surfaces, and they display migratory mechanism peculiar to microgravity environment. MINERVA2 is assumed about triple the size of MINERVA that is about 10 cubic centimeter. Diameter of MINERVA2 is three times as large as that of MINERVA, and hight of point of view changes from 5 to 15 centimeters. Then distance to horizon on a sphere of 150 meters in radius is extended to about 1.2 times, 5.5 meters to 6.7 meters.

The purpose of MINERVA2 are 1) to set a seamless resolution images of orbiter and MINEREVA2 micro camera, 2) to make of a point for material sampling and to get surface packing information which would be lost at sampling, 3) to determine the location of sampling site, 4) to calibrate orbital instruments. MINERVA2 has to carry a macro camera system for self-positioning and suppressing blind areas.

The concrete functions of positioning and its application are to match global mapping by orbiter camera and the locally surrounding features, to search the best traversing path, and to check predicted panorama and obtained one as a feedback system.

Fundamentally, navigation procedures are categorized into active ranging and passive image-based one. The former is hard to be installed in such small rover because of shortage of electric power for driving radar and lidar. The latter is shape form shading and stereo-vision.Albedo heterogeneity prevents from measuring gradient in case of shape from shading. On the contrary, stereo-vision is the most robust method. Because the most popular stereo-vision technique is parallel type, which shows a narrow viewing area, hemispherical three-dimensional recognition requires sweeping camera head for mosaicking. This property obstructs automatic processing because of allowance of gears. Thus this research adopts unique type of stereo vision with fisheye lens.

A configuration of clustered fisheye lens is arranged each center of a side of MINERVA2. Coverage of view consists mostly of five cameras simultaneously. The three-dimensional topographic model around the rover is reconstructed with matching results of features, because geometry of corresponding pixels is given. This research detail detail is demonstrated in our poster.