

Image-based Modeling of asteroids

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Introduction:

Hayabusa mission is a sample return program of ISAS/JAXA. The spacecraft was renamed from MUSES-C, which was launched to the target asteroid (25143) Itokawa at May 9, 2003. Scheduled arrival is summer of 2005[1]. We are a group of shape modeling for selecting landing sites, for characterizing geologic context on the basis of a telescope (AMICA: Asteroid Multiband Imaging Camera[2]) and a laser range finder (LIDAR: Light Detection And Ranging). We show preliminary results of a type of image-based one by means of ground experiments with proto-model of AMICA. Input Data and Experiments: Input data sets for verifying our tools of shape modeling are categorized into two; one is image files generated from Proto-Model of AMICA, another is 3D digitized model asteroids. The former is captured in ISAS on September and in Univ. of Aizu during November-February. The latter is digitized at Univ. of Aizu.

The captured image files are composed of a data set of views changed by rotation (3deg/photo) from each lattice point of the home position box. These settings are simulated along scheduled operations around the asteroid. Asteroid models are set on a gyrocompass-like turn table, which changes following parameters; solar phase angle, angle of depression (the degree of exposing a rotation pole), intervals of imaging (rotation pitch), and trajectories of spacecraft.

Procedures for shape modeling:

Preprocessing includes calibrations (the offset and dark current removal, flat-field correction, and smear removal) and masking for background removal. Main processing is divided into three; #1 Automatic extractions of ground control points (GCPs), a type of Susan operator with a filter in 7 square pixels, #2 Image-based Matching with dynamic search windows, #3 Shape modeling for matching results, which are based on epipolar geometry popularized in the computer vision. We also show determination of rotation poles, recommended imaging operations, and effect of incorrect matching GCPs .

References:

[1] <http://www.isas.jaxa.jp/e/enterp/missions/musesc/index.shtml>.

[2] T. Nakamura et al. (2001) Earth, Planets and Space, 53, 1047-1063.