Preliminary Shape Modeling for the asteroid (25143) Itokawa, AMICA of Hayabusa mission. H. Demura[1], S. Kobayashi[1], Y. Murai[1], K. Nishiyama[1], T. Hashimoto[2], and J. Saito[3], [1]Dept. Computer Software, Univ. of Aizu, Aizu-wakamatsu City, Fukushima 965-8580, JAPAN, demura@u-aizu.ac.jp, [2]Inst. Space and Astronautical Science, Japan Aerospace Exploraton Agency, [3]Technical Research Inst., NISHIMATSU Construction Co., Ltd.

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-Feburuary. 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 (Fig. 1), which changes following parameters; [green] solar phase angle, [blue] angle of depression (the degree of exposing a rotation pole), [red] intervals of imaging (rotation pitch), and trajectories of spacecraft.

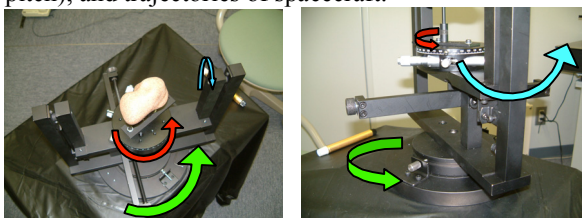

Fig. 1 An asteroid model on the turn table

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 (Fig.2), #2 Image-based Matching with dynamic search windows, #3 Shape modeling for matching results (Fig.3), which are based on epipolar geometry popularized in the computer vision.

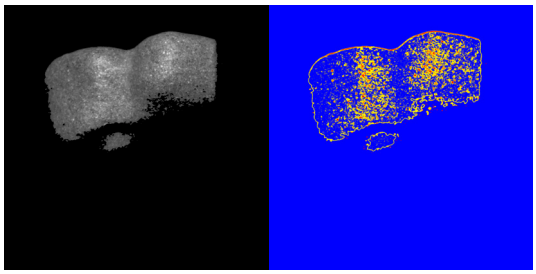

Fig.2 Input image and extracted GCPs

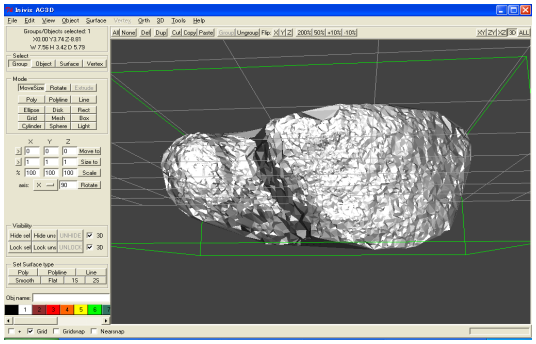

Fig. 3 A sample of shape modeling (Castalia)

We also show determination of rotation poles, recommended imaging operations, and effect of incorrect matching GCPs (Fig. 4)

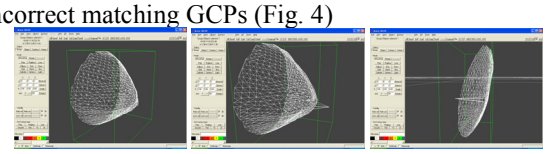

Fig.4 Comparison among perfect matching, 3/1000 of incorrect matcings, and an extreme matching

References:

[1] http://www.isas.jaxa.jp/e/enterp/missions/muses-c/index.shtml. [2] T. Nakamura et al. (2001) *Earth, Planets and Space, 53,* 1047-1063.