Shape Modeling for the Asteroid (25143) Itokawa, AMICA of Hayabusa Mission.

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Introduction: Hayabusa established Earth-swingby a success in May 12, 2004 and the spacecraft is on course to the target asteroid Itokawa. Hayabusa mission is a sample return program of ISAS/JAXA. The spacecraft is going to arrive at Itokawa and to touch down on the surface for sampling materials in autumn of 2005.

Our science team requires 3D shape model of the asteroid, which provides fundamental information for making a decision on selecting landing sites. Nowadays, image-based modeling is the favored method of shape recognition of asteroids. For example, Wild 2 was recognized its irregular shape by stereo images [1]. We found following problems make it difficult to develop the precise shape model by stereo method; First Hayabusa is equipped a single-eyed camera, Second Hayabusa doesn't know own exact position. Here we report the procedures and results of this modeling with AMICA (Asteroid Multiband Imaging Camera [2]) and attitude of spacecraft, and distance between target asteroid and the spacecraft.

Dummy Input Data and Preliminary plan of Hayabusa Operation: Last year our ground simulations bring dummy input images. These images were captured by scanning asteroid around rotational axis (3 deg/photo) [3].

Preliminary plan around the target is categorized into 7 phases. In the gate position (GP), altitude of the spacecraft is 20-50 km and the image resolution is 2m/pixel. Our developed tool process polygonal shape model with 20m polygons in diameter.

Procedures for shape modeling: Our image-based modeling adopted stereo method with multiple view epipolar geometry. Each set of stereo images brings pieces of DTM model, and integration of DTM pieces gives a global shape model.

The procedures consist of following sections; (1) Extracting topographic features as Ground Control Points (GCPs) with SUSAN operator, (2) Matching points on the basis of correlation coefficient, (3) Reconstructing 3D positions of GCPs based on disparity between images, (4) Spreading polygonal surfaces over the 3D points by Delaunay triangulation, (5) Integrating the DTM pieces to the global shape model.

Current Status: We upgraded our algorithm from two view system to three view one that bring stability of solutions [4]. This tool will be built onto the visualization software for Hayabusa operation. This tool includes a function that verify accuracy of the shape model by residual error between outline of the shape and source images [5].

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