A model of Phobos and its application to simulation study for asteroid imaging

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We have been investigating exploration methods of asteroids for future asteroidal resource explorations. For simulation study of asteroid imaging from spacecraft, we built a model of Phobos of 1:75,000 scale based on images by previous missions. Here, we report an outline of the model and preliminary result of simulation study using this model.

Introduction

We have been investigating exploration methods of asteroids as the first step of designing a mission plan for space resource explorations in the future. To investigate exploration methods, the system for simulation study of observation of minor bodies is required. For this purpose, we built the 1:75,000 scale model of Phobos for simulation study of observations from spacecraft. Since Martian satellites are thought to be captured asteroids, the simulation study using this model can be applied to that of asteroid missions.

Here, we report the outline of building the model and the preliminary results of simulation study using this model.

The model and simulation system

We referred to previous report of building a model of Phobos by Turner[(1)] for our modeling. He used the image data obtained by Mariner-9 for sculpture of surface relief, and showed his shape model of this satellite. We used this shape model for the original form of our model, and image data of Viking orbiter and PHOBOS-II for sculpting surface relief. Our model of Phobos is shown in Fig. 1.

After building the model, we constructed the simulator for imaging Phobos. The model is placed to center of the simulator, rotating along two axes (one is the pole, and the other is included in equator plane). The camera mounted on the simulator can move forward and backward to the model for simulating observations from both circular and elliptical orbit.

The simulation study using this model

We have been examining the method to measure shape of minor bodies using this model. At the first stage of the simulation study of imaging, the condition of observation from spacecraft was simplified: the spacecraft stands still outside the gravity field of the target body, right above the equator. We took images of the model every five degrees of

revolution, and digitized limb profiles. The wireframe picture of the model obtained by this procedure is shown in Fig. 2.

However, this procedure requires many images (72 images in this case) of asteroids to digitize limb profiles, and cannot detect large depressions on the surface, so that it is not realistic to use only this procedure for measuring the shape. We think other methods such as observation using stereograph may be combined for saving numbers of images required and detect the large depressions.

Further investigation of methods to measure shapes and volumes by simulation study using this model is going on, and we will develop the method for measuring volumes of asteroids for future missions.

Reference: Turner, R. (1978) ICARUS **33**, 116-140

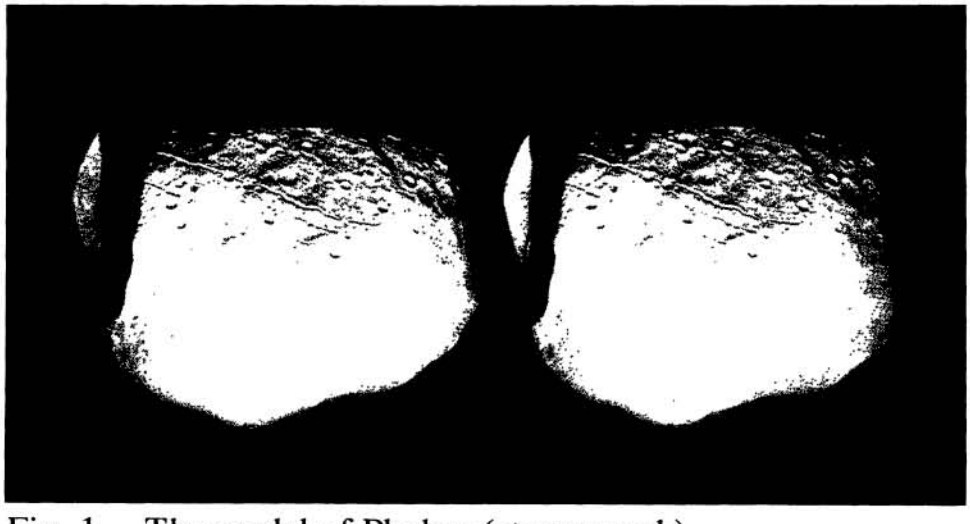

Fig. 1. The model of Phobos (stereograph).

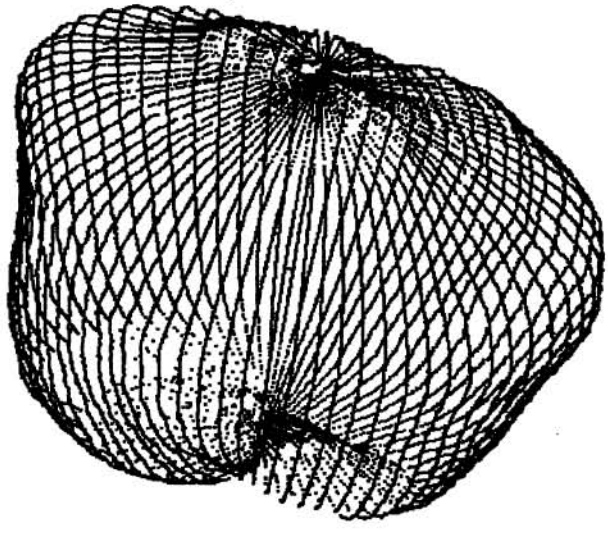

Fig. 2. The wireframe picture of the model.