

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation, and Control (2) (6)

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TRAJECTORY RECONSTRUCTION OF HAYABUSA'S ATMOSPHERIC REENTRY

Abstract

The Japanese Hayabusa mission will end in June, 2010, with the planned atmospheric reentry of the main spacecraft and asteroid sample return capsule. These objects will reenter the atmosphere at night, creating bright fireballs in the sky over the Australian desert. The main spacecraft will break up in the atmosphere, whereas the sample return capsule is designed to survive the reentry and land safely. This research, which is conducted by Kyushu University in collaboration with JAXA, has the following objectives: to design and operate a trajectory estimation system to observe the reentry; to distinguish the sample return capsule from the fragments of the main spacecraft; and to predict the landing point of the capsule. This paper describes the design and testing of this system based on simulation results, as well as the detailed results from the evaluation of the actual data from the reentry that will occur in June, 2010.

The authors have previously presented simulation results used for the design and validation of the trajectory estimation system[1][2]. The system consists of 4 ground sites located around the capsule's targeted landing point. Each site will use low-light CCD video cameras to record image sequences of the reentry objects against the night sky. The angular positions of the objects will be measured relative to the known star positions, and GPS receivers will be used to time-stamp the images. These angle-only measurements will then be processed by an Extended Kalman Filter to estimate the position and velocity of Hayabusa and its reentry capsule.

The focus of this paper will be on presenting the data obtained from the actual reentry mission scheduled for June, 2010, such as: comparing the targeted, estimated, and actual landing positions; and presenting and evaluating the reconstructed trajectories of the capsule and main spacecraft fragments.

[1]. M.A. Shoemaker, J.C. van der Ha, "Trajectory Estimation of the Hayabusa Sample Return Capsule Using Optical Sensors", 60th International Astronautical Congress, Daejeon, Republic of Korea, Oct. 2009, paper no. IAC-09.C1.11.9.

[2]. M.A. Shoemaker, G. Chamboredon, M. Dittmar, J.C. van der Ha, K. Fujita, "Design and Validation of a Trajectory Estimation System for the Hayabusa Sample Return Capsule", 20th AAS/AIAA Space Flight Mechanics Meeting, San Diego, California, Feb. 2010, AAS 10-125.