Simulation study for crossover orbit analysis of Hayabusa2 (2)

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The asteroid explorer “Hayabusa2” launched in 2014 is currently sailing towards the target asteroid, Ryugu, and will arrive there in the middle of 2018. Hayabusa2 will stay there for one and a half years, and perform various observations.
For mapping of acquired observation data, precise orbit determination of Hayabusa2 is very important. Further, Ryugu’s geodetic parameters, which will be simultaneously estimated with Hayabusa2 orbit, are also required to be determined in high precision for understanding of Ryugu. However, such precise determinations are difficult by using radiometric tracking data only, because of current limited knowledge of Ryugu’s ephemeris and physical parameters. To overcome this problem, in Hayabusa2 mission, crossover orbit analysis using laser altimeter (LIDAR) data between Hayabusa2 and Ryugu is planned, in addition to radiometric tracking data analysis.
In this study, we performed offline simulation of Hayabusa2 orbit analysis. We developed a simulation program for Hayabusa2 orbit analysis, including crossover orbit analysis. Test data of Hayabusa2 orbit, Ryugu ephemeris, and Ryugu shape model were also created for the simulation. From these test data, input observation data to the simulation program were prepared. After adding some errors to Ryugu ephemeris and the observations, recovery of “true” Hayabusa2 orbit from these data sets were simulated in the following order: 1) Hayabusa2 orbit determination with range and range rate observations from ground tracking stations to Hayabusa2, 2) Determination of Hayabusa2 orbit with respect to Ryugu center by crossover orbit analysis using LIDAR-observed ranges between Hayabusa2 and Ryugu, 3) improvement of Ryugu ephemeris using 1) and 2) results, 4) improvement of Hayabusa2 orbit by performing 1) again with updated Ryugu ephemeris, and 5) iteration of 1) to 4). We discuss how much the precision of determined Hayabusa2 orbit changes by changing error magnitudes of each observations and Ryugu ephemeris.

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