SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (5)

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LANDING AND MOBILITY CONCEPT FOR THE SMALL ASTEROID LANDER MASCOT ON ASTEROID 1999 JU3

Abstract

At present there are two ongoing studies on asteroid sample return missions: MARCO POLO being in competition of ESA's Cosmic Vision Program and in addition a HAYABUSA follow-on mission is being investigated by JAXA. To enhance these sample return missions by long-duration in-situ science the Institute of Space Systems of the German Aerospace Center (DLR) is in lead of a proposal for a lander called MASCOT (Mobile Asteroid Surface Scout). Its mass of 10 kg lies in between those of the HAYABUSA small lander MINERVA (1 kg) and the legged ROSETTA comet lander PHILAE (100 kg).

In the successfully completed feasibility study the design of the MASCOT converged to a landing package with 10 kg total mass, 3 kg of payload and the capability of hopping. As a result of its reduced size and the highly demanding constraints regarding e.g. mobility the design as well as the landing and mobility cannot be adapted from MINERVA and PHILAE.

This paper is intended to give an overview over the demanding landing and mobility concept for MASCOT. The current MASCOT baseline design is presented which has to deal with tight budgetary limitations leading to a consolidated and widely integrated design while still offering excellent performance in terms of mobility and resulting science. The focus lies on the mission analysis tasks and the mobility concept, which is studied in detail during the ongoing preliminary design phase. The general mission constraints including the parameters of the target asteroid (162173) 1999 JU3 are presented, while emphasis is put on the modelling of the asteroid's inhomogeneous gravity field. Therefore different gravitational models are implemented and their effects on the descent trajectory are compared. Of equal importance is the design support by investigating the two major mobility aspects, i.e. the self-uprighting mechanism analysis and hopping over the asteroid's surface. These two issues are studied by applying both multi-body system and contact dynamics approaches. Moreover, this analysis will support the design of the actuator system for uprighting and hopping. After a presentation of the surface modeling and simulation approach an overview over first results and a short outlook on future landing and mobility analysis and test activities for MASCOT is given.