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MASCOT: OVERVIEW OF THE FRENCH CONTRIBUTION AND MISSION ANALYSIS OF DESCENT TRAJECTORY STUDIES AND PERSPECTIVES

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As a follow-up of the first asteroid sample return mission Hayabusa-1, the Hayabusa-2 Japanese spacecraft is on its journey to its target, a C-type near-Earth asteroid called 1999 JU3. Hayabusa-2 carries a small lander called MASCOT (Mobile Asteroid surface SCOuT) developed by the German Aerospace Centre (DLR) in collaboration with the Centre National d'Etudes Spatiales (CNES).

The probe will reach its target in summer 2018, and will use a low thrust ion propulsion system. Hayabusa-2 is expected to collect samples from three different sites on the asteroid. Moreover, an impactor experiment will be performed on the third site, in order to create a crater and collect subsurface samples. The return of these collected samples to the Earth is planned for the end of 2020.

With a weight of 10kg, MASCOT carries four payloads for in-situ measurements on the asteroid surface: a near infrared hyperspectral microscope MicrOmega, a wide-angle visible camera CAM, an infrared radiometer MARA and a magnetometer MAG. After the separation from the mother-spacecraft, MASCOT will descend to the asteroid without any propulsion system or attitude control. It will touchdown on the surface of the small body and most likely bounce afterwards. As soon as it comes to rest, thanks to its mobility mechanism, it will upright in the right attitude and then the scientific in-situ experiments will be performed on this first location. Once scientific measurements have been completed at one site, MASCOT is also capable of hopping to a new investigation site thanks to its mobility mechanism and to go on with its scientific mission as long as there is some energy left on its non-rechargeable battery. The mission duration is estimated to about 15 hours.

The present paper will first give a brief overview of the French contribution to MASCOT. It will then focus on the studies performed for MASCOT descent trajectory computation, including the bounces and contact motion. Emerging from these studies, some perspectives for operational mission analysis activities to be carried out at CNES can be envisaged (such as the evaluation of the landing accuracy, the prediction of the duration of the bouncing trajectory). These operational activities may lead to the formulation of recommendations to include in the landing site selection process. Such analyses have been successfully performed last year to prepare for PHILAE landing, and operational activities conducted in the scope of the PHILAE Landing Site Selection Process will be presented as examples.