IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 2) (4B)

Author: Mr. Martin Lingenauber
DLR, German Aerospace Center, Germany, martin.lingenauber@dlr.de

Mr. Florian A. Fröhlich
DLR (German Aerospace Center), Germany, florian.froehlich@dlr.de
Mr. Christian Nissler
DLR (German Aerospace Center), Germany, christian.nissler@dlr.de
Dr. Klaus H. Strobl
DLR (German Aerospace Center), Germany, klaus.strobl@dlr.de
Dr. Katharina Otto
DLR (German Aerospace Center), Germany, katharina.otto@dlr.de

# ONE-SHOT DEPTH IMAGING FOR SMALL BODY LANDING MISSIONS WITH A SINGLE PLENOPTIC CAMERA

**Abstract**

The successful MASCOT mission with its on-board camera MasCam provided astonishing images from the surface of the asteroid Ryugu. Nevertheless, the analysis of the data is complicated due to the lack of high resolution depth information which makes it difficult to provide an exact scale of the scenes. This examples shows that the tight constraints on mass, volume and power for landers targeting small bodies require a new technology for in-situ imaging with small and passive devices. We propose to use plenoptic cameras for future small body lander missions as they can provide high resolution depth and 2-D images with a single camera, from a single exposure, and over an extended depth range. A plenoptic camera is a passive imaging sensor, which can be achieved by modifying a conventional camera with a matrix of lenslets, while still using a conventional main lens. The so called micro lens array is mounted at sub-millimetric distance in front of the sensor and allows to record a 4-D light field dataset from which depth and 2-D images can be derived. Previous studies and experiments on in-situ hand lens imaging with plenoptic cameras showed that millimetric to sub-millimetric resolutions in 2-D and in depth are feasible and that the depth of field is largely extended in comparison to an equivalent conventional camera. Hence, a plenoptic camera provides the advantage of using the same hardware as in the case of a conventional camera, while reducing its physical limitations and providing an extended set of data. The scientific output of the mission can be extended and it might also be beneficial for the operation of the lander, e.g. for mapping or hazard avoidance. These advantages come at the costs of a more demanding on-board processing, which is subject of the on-going research. The paper will contain an introduction of plenoptic cameras, experimental results in the context of a small body environment and a discussion in order to allow an evaluation of the performance and usability of plenoptic cameras for future lander missions.