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LAPIS – LAnder Package Impacting a Seismometer – A Proposal for a Semi-Hard Lander Mission to the Moon

C. Lange and the LAPIS Team

Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institute of Space Systems, Bremen, Germany (caroline.lange@dlr.de / +49 421 24420-120)

With an increased interest on the moon within the last years, at least with several missions in orbit or under development (SELENE/Japan, Chang'e/China, Chandrayaan/India and others), there is a strong demand within the German science community to participate in this initiative, building-up a national competence regarding lunar exploration.
For this purpose, a Phase-0 analysis for a small lunar semi-hard landing scenario has been performed at DLR to foster future lunar exploration missions. This study's scope was to work out a more detailed insight into the design drivers and challenges and their impact on mass and cost budgets for such a mission.
LAPIS has been dedicated to the investigation of the seismic activities of the moon, additionally to some other geophysical in-situ measurements at the lunar surface. In fact, the current status of the knowledge and understanding of lunar seismic activities leads to a range of open questions which have not been answered so far by the various Apollo missions in the past and could now possibly be answered by the studied LAPIS mission. Among these are the properties of the lunar core, the origin of deep and shallow moonquakes and the occurrence of micro-meteoroids. Therefore, as proposed first for LAPIS on the LEO mission, a payload of a short period micro-seismometer, based on European and American predevelopments, has been suggested.
A staged mission scenario will be described, using a 2-module spacecraft with a propulsion part and a landing part, the so called LAPIS-PROP and LAPIS-LAND. In this scenario, the LAPIS-PROP module will do the cruise, until the spacecraft reaches an altitude of 100 m above the moon, after which the landing module will separate and continue to the actual semi-hard landing, which is based on deformable structures. Further technical details, e.g. considering the subsystem technologies, have been addressed within the performed study. These especially critical and uniquely challenging issues, such as the structural damping of the landing impact, the communication subsystem and the thermal subsystem have been investigated to some extent and will be described further.
The described study will analyze in a unique way the technology, which is necessary to realize such a rather unconventional mission scenario, which will furthermore to a great extent contribute to the current knowledge on seismic activities on the moon.