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Author: Dr. Aline Zimmer
Jet Propulsion Laboratory, United States, aline.k.zimmer@jpl.nasa.gov

LANDING ON EUROPA: KEY CHALLENGES AND ARCHITECTURE CONCEPT

Abstract

NASA has extended the scope of the potential exploration of Europa beyond the planned Europa Clipper mission and initiated a Pre-Phase A mission concept study of a potential Europa Lander. With a massive liquid water ocean beneath its icy crust, Europa is one of the Solar System's prime candidates for hosting life. Consequently, there is a strong desire in the scientific community to perform in-situ Europa science through a landed mission. Jupiter's hostile radiation environment and the lack of information about the moon's terrain at the scale of a lander spacecraft would require significant technology development to overcome the inherent landing challenges. This paper provides a brief overview of the Europa Lander mission concept and describes the significant challenges associated with landing on Europa, the technologies required to overcome those challenges, and a strategy for Deorbit, Descent, and Landing (DDL). In the current baseline, DDL would begin with the separation of the lander, descent stage, and deorbit vehicle from the carrier stage. Due to Europa's tenuous atmosphere, a propulsive deorbit maneuver would be required to slow the spacecraft down from orbital velocity. After burnout and jettison of the deorbit stage, the descent stage and lander would use a camera and lidar altimeter to compute its position and velocity relative to an onboard map provided by Europa Clipper reconnaissance. Based on this updated map-relative state, the spacecraft would calculate and follow a powered approach profile to a few hundred meters above the targeted landing region. Now in vertical descent, the spacecraft would scan the surface terrain with the lidar and in real time construct a digital elevation model, generate a safety map, and select a safe landing location. In the last stage of landing, the lander would be lowered on tethers from the descent stage in a sky crane configuration before final touchdown, after which the descent stage would fly away and crash-land at a safe distance from the lander. Due to the long light-time between Europa and Earth and the fast sequence of events during DDL, landing would be completely autonomous. The information to be presented about the Europa Lander is predecisional and is provided for planning and discussion purposes only.