

SPACE EXPLORATION SYMPOSIUM (A3)  
Solar System Exploration (5)

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ENCELADUS EXPLORER (ENEX): A LANDER MISSION TO PROBE SUBGLACIAL WATER  
POCKETS ON SATURN'S MOON ENCELADUS FOR LIFE**Abstract**

The project "Enceladus Explorer" (EnEx) aims to design a mission to the Saturnian icy moon Enceladus, as well as to develop an operable drilling technique to penetrate the icy surface of the moon using the "IceMole", a novel maneuverable subsurface ice melting probe for clean sampling and in-situ analysis of ice and subglacial liquids. The presumed ocean of liquid water under Enceladus' thick ice crust would make a prime target in the search for extraterrestrial life and would be more easily accessible near one of the recently discovered plumes of water vapor on the moon's south pole. The general mission concept therefore, is to land EnEx at a safe distance from an active plume. The IceMole would then be deployed, melting its way through the ice crust to a water-bearing crevasse at a depth of 100 – 200 m for an in situ examination for the presence of microorganisms. The project is sponsored by the German Aerospace Center (DLR) and is carried out by a research consortium of seven German universities. In this context our institute is responsible for the overall mission and system design of the EnEx spacecraft. Various mission architecture and operational concepts that satisfy the mission requirements have been developed and traded-off. These include an orbiter that will eventually land, separate Enceladus orbiter and lander, Saturn orbiter with Enceladus lander etc. Trade-offs were also performed between options for various lander subsystems such as Guidance Navigation and Control and landing sensors. For the transit to Enceladus we have both designed a primary Nuclear Electric Propulsion (NEP) trajectory, and implemented a backup chemical propulsion trajectory. We have additionally developed a novel method to maintain stable polar science orbits around Enceladus using low thrust propulsion. We have used a simple kinetic controller to model and optimize the landing trajectory. A highly autonomous system operation and advanced fault detection, isolation and recovery (FDIR) methods will be required, especially during landing. A number of autonomy and FDIR methods have therefore been investigated and the most promising have been selected for further study. Potential mission risks, show stoppers and key failure modes have also been identified. In the above we have considered environmental parameters such as radiation, particulates ejected from the plumes, terrain and ice morphology at Enceladus.