

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

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A MISSION ARCHITECTURE OF A ROBOTIC SPACEFLIGHT TO ENCELADUS FOR ENABLING
EXPLORATION OF ITS SURFACE AND SUBGLACIAL OCEAN.

Abstract

Saturn's sixth moon Enceladus is one of the most promising destinations in the Solar System to search for possible presence of extraterrestrial life. The basis of such assumptions is the confirmed presence of a large accumulation of water in the area of Enceladus South Pole under a layer of the 3 to 5 km thick ice. In the same region, many cryovolcanic sources have been observed, studying of which can provide understanding about development of life on Earth and searching for life on other planets in the Solar System.

This paper presents a conceptual mission architecture to explore Saturn's moon Enceladus with a possibility of conducting surface and subglacial ocean studies. The project was conducted by the international team of students and researchers during the "Space Development: Theory and Practice" online program in summer 2022.

Scientific goals and objectives of the proposed mission defined technical requirements and the framework of the project. The project includes developing an automatic interplanetary station for studying the surface of Enceladus and equipment required for a contact study on and under the surface, such as a landing platform, rover, melting device and submersible robotic systems.

One of the key tasks of the mission development is a landing site selection. Since the terrain of Enceladus is unknown, the choice of the exact location must be made at the time of landing, if the lander can observe the surface. The landing system proposed in this work is a special composition of a platform landing equipment assembly, which includes a set of collapsible surfaces, fixed landing supports, control and braking systems with low-thrust engines designed within the framework of the project. A proposed in this study subglacial underwater robotic vehicle designed for obtaining the most accurate and detailed information about the composition of the Enceladus ocean water and a possibility of life there. A melting device powered by a radioisotope energy source melts the ice crust allowing the subglacial robotic vehicle to immerse into the ocean. Using contour heat pipes enables heat transfer to the ice and controls the melting process without conversion into electricity. The proposed mission concept can provide a more complete picture of Enceladus as a celestial body, give a detailed description of its surface, characteristics of the subglacial ocean, and potentially answer the question of the existence of life in the subglacial ocean of Enceladus.