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ICESHUTTLE TEREDO: AN ICE-PENETRATING ROBOTIC SYSTEM TO TRANSPORT AN EXPLORATION AUV INTO THE OCEAN OF JUPITER'S MOON EUROPA

Abstract

The proposed paper introduces the concept of an ice-penetrating robot, or cryobot, which is capable of delivering an underwater robot through an ice body into the ocean beneath. Furthermore, the cryobot is designed to interact with the exploration robot for launch, recovery, navigation and docking.
Due to its huge body of water supposedly existing beneath its icy crust, the Jovian ice moon Europa is one of the most interesting spots to search for possible extraterrestrial life in our solar system. To explore the depth of the ocean of such an ice moon, an underwater robot needs to be delivered by an additional robotic system through the ice to the water ocean. Within the project Europa-Explorer (EurEx), a mission concept to explore the ocean of Europa was developed, as well as fully functional test prototypes for experiments in a terrestrial environment. These two systems are an autonomous underwater vehicle (AUV) and an ice-penetrating robot as the delivery system for the AUV.
Besides the exploration AUV, the delivery system is an essential key element to the whole mission. The main tasks of such a system are to melt through the ice, overcome possible obstacles, transport a scientific payload (in this case an AUV) and deploy the payload safely into the water body to explore. In the given mission scenario the vehicle will also function as a base station providing additional essential features like further navigation sensors for the AUV, as well as a docking interface to facilitate external communication (mission control) and energy supply for the AUV. Because of its unique ability to transport a payload like an exploration AUV through the ice to an ocean beneath, this cryobot is described as an IceShuttle.
In terrestrial applications as well as in the context of exploring an icy moon's ocean, thus far underwater robots and cryobots have been developed independently from each other. In contrast, the basic requirement within the project Europa-Explorer was to design these two systems in combination as a heterogeneous robot team to take into account the complete mission scenario and use the ice-penetrating robot as the actual transporter for the exploration AUV. This created strong dependencies and design restrictions for both systems, but addresses an essential key requirement of a mission to Europa's ocean.
Within the paper the final design of the IceShuttle, as well as first experiments concerning the interaction with the AUV will be presented.