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

Author: Mr. Leonardo Ricci
Politecnico di Torino, Italy

Mr. Federico Giraldo
Politecnico di Torino, Italy
Mr. Gianmarco Floro
Politecnico di Torino, Italy
Mr. Antonin Lecomte
ISAE-Supaero University of Toulouse, France
Mr. Vincent Bourinet
ISAE-Supaero University of Toulouse, France
Mr. Matteo Nobili
Politecnico di Torino, Italy
Mr. Baptiste Rubino-Moyner
Politecnico di Torino, France
Mr. Mario Rizzi
Politecnico di Torino, Italy

PRELIMINARY DESIGN OF SAMPEI: SUBSURFACE ACCESS AND MOBILITY PROBE FOR EUROPA INVESTIGATION

Abstract

Europa is one of the most promising celestial body in the Solar system for life research. Despite the hostile environment, the Jupiter moon has many characteristics for enhancing this possibility. The most important milestones of this hypothesis come from three missions: the NASA's Voyager 2, the Galileo orbiter, and the Hubble Space Telescope. They discovered evidences of an ice crust with ridges and cracks that hides a huge ocean beneath, which vents plumes of water vapor. The future of this moon exploration will be even brighter thanks to the ESA's Jupiter Icy Moons Explorer (JUICE), and the NASA's Europa Clipper and Lander. The European mission, set for launch in 2023, will conduct a comparative study of Ganymede, Callisto and Europa, and a complete characterization of Jupiter with an emphasis on the tidal effects and their electrodynamic interactions through different flybys. The American Clipper mission, set for launch in 2024, is more focused on Europa, and it will investigate the conditions suitable for life. This expedition will be complemented with the Lander which will directly work on the surface.

This paper aims to design a subsurface robot capable of overcoming all the challenges that it will encounter during its exploration phases. The design of the system will require important trade-offs. Indeed, this paper highlights the preliminary characteristics the robot will need to survive and work in the Europa hostile environment: i. mobility required to descent through the Europa ice crust; ii. communication strategy needed to exchange data with the lander; iii. energy source and thermal control, which necessitates optimized systems to keep the subsurface element alive while allowing the descent; iv. radiation shielding necessary to preserve all the electrical equipment; v. planetary protection strategies to prevent environmental contamination.

In this context, the subsurface element shall be properly tool equipped for environmental exploration, including science instruments and descending mechanism. The system will be able to gather data and

to analyze samples, looking towards the main existence ingredients. This study has been carried out within the frame of the International Specializing Master in SpacE Exploration and Development Systems (SEEDS) XIV, by a team of graduate students coming from Politecnico di Torino (Italy), ISAE-Supaero (France), and the University of Leicester (UK), with the support and interest of ASI, CNES and ESA and the collaboration of prominent industrial companies such as Thales Alenia Space Italy and ALTEC.