Soutenance de thèse

Laurent BEAUREGARD soutiendra sa thèse de doctorat préparée au sein de l'ICA et de l'équipe d'accueil doctoral ISAE-ONERA CSDV et intitulée «*Approche systématique de la conception d'un véhicule d'ascension opérant entre la surface de la Lune et une station spatiale en orbite cis-lunaire*»

Le 12 juillet 2021 à 14h00,
Soutenance en visio-conférence

devant le jury composé de

M. Joseph MORLIER	Professeur ISAE-SUPAERO	Directeur de thèse
Mme Stephanie LIZY-DESTREZ	Professeure Associé ISAE-SUPAERO	Codirectrice de thèse
M. Josep Joaquim MASDEMONT SOLER	Professeur Universitat Politècnica de Catalunya	Rapporteur
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Summary: As part of future solar system exploration missions, the international space agency community plans to deploy an inhabited space station, called Deep Space Gateway (DSG), to support operations on the lunar surface or to more distant destinations. (like Mars, Asteroids ...). In this context, and in addition to the concept of the Lunar Village (Moon Village) of ESA (European Space Agency), a first mission, called HERACLES (Human-Enabled Robotic Architecture and Capability for Lunar Exploration and Science), is currently underway with its design consistent with the International Space Exploration Coordination Group (ISEGC) roadmap. This mission aims to demonstrate the use of relevant technologies for human space exploration of other celestial bodies using precursor robotic systems. The first mission would be composed of: a lunar descent vehicle (LDE), a lunar ascension vehicle (LAE), a surface mobility element (SME) and a sample container for rockets and volatiles (ISSPE). It therefore a new need appears: the reuse of the lunar ascension vehicle module. The evaluation of this reuse (primarily to improve scientific and economic performance) could also provide guidance for multi-purpose populated exploration missions. The technologies selected could also be tested using demonstrators, which would make it possible to prepare Mars' future robotic and human exploration missions. This question of the reuse of the ascent vehicle involves the design of a reusable propulsion system that can withstand several take-offs and landing and can be refueled. The complexity of these new vehicles also gives rise to a large combinatorial of possible configurations for which no basic architecture has been proposed. In particular, a major challenge to be overcome by such a project is to integrate, from the preliminary design phase, the uncertainty of the evolution of the requirements due to the lack of experience and knowledge of the lunar and cis-lunar environment. This research aims to support the development of a decision support tool for the design of an ascension vehicle operating between the lunar surface and a space station orbiting one of the Lagrange points of the Earth-Moon system. The initial objective would be to propose a methodological approach that would allow a vast exploration of the design space, taking into account not only the quantitative issues through the optimization of the performances (trajectory, propulsion, ...) but also for qualitative criteria (covering aspects costs, risks, planning, ...). These criteria are likely to evolve could introduce fuzziness and uncertainty. Solutions against fuzzy objectives and in the uncertainty of changing requirements. This is why, in this thesis project, it is proposed to develop an interdisciplinary tool in support of the proposed method and covering all the criteria in order to allow the evaluation of the scenarios and to compare the concepts.

Keywords: Conception, Reusability, Trajectory, Multidisciplinary optimization, Architecture, Earth-Moon System