Aerospace Europe Conference 2023
Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX *(to be filled by the organizers)*
Preferred Topics: SUSTSP
Corresponding author: UDRIOT Mathieu
e-mail of corresponding author: mathieu.udriot@epfl.ch
Type: Oral
Status of corresponding author: Regular

Title
Sustainable Space Hub at EPFL: a review of ongoing research projects

Authors
Stephan HELLMICH [1], Mathieu Udriot [2]*, Emmanuelle David [2]*

** Corresponding authors*
[1] EPFL LASTRO, 1015 LAUSANNE, Switzerland, stephan.hellmich@epfl.ch
[2] EPFL Space Center (eSpace), 1015 LAUSANNE, Switzerland, mathieu.udriot@epfl.ch

Abstract
EPFL Space Center (eSpace) is a pioneer in space sustainability. With the Clean Space Initiative, initially proposed to deorbit Swisscube which eventually spin-off from EPFL as the ClearSpace-1 mission to recover the Vega Secondary Payload Adapter (VESPA), the Center can draw on a decade of experience in space sustainability. More recently, in 2019 eSpace initiated a two-year pilot phase of a research initiative on sustainable space logistics (RISSL). This initiative was the starting point of several consortium projects that attracted many stakeholders, resulting in several publications and the development of a space logistics modelling software for mission profile evaluation and optimization [1]. The success of this pilot phase encouraged the Center to continue exploring this new domain. Current research includes life cycle assessment of space transportation vehicles, accounting for space debris risks and the reentry phase, optimisation of space logistics, and mission design. These projects will help understanding and improving the situation in space. It is especially important to assess future impacts of new missions early in the design phase, in order to support space agencies and industry in designing new concepts with lower environmental impacts.

Thanks to these 10+ years of experience, in 2021 EPFL was selected to host the Space Sustainability Rating (SSR), which incentivizes space operators to adopt more responsible mission design and operational behaviour. Its competence and neutrality, two important prerequisites for a successful, fair and widely accepted evaluation system, make eSpace the ideal host institution for the rating. The definition of sustainability in space is constantly evolving. eSpace is therefore continuously improving the formulation of the SSR to address emerging environmental, societal, and economic factors in the assessment.

These efforts are complemented by the EPFL laboratory of astrophysics (LASTRO), which is currently working on detection and characterization of resident objects in Earth's orbit in large astronomical data archives [2]. The information extracted from these archives will allow a better evaluation of the evolution and current state of the small debris population, and support active debris removal that will be necessary to secure the future use of Earth's orbit.

In order to unite EPFL's forces in the domain of sustainability in space, eSpace has recently launched the Sustainable Space Hub (SSH). The goal of the Hub is to coherently manage and foster the growth of these topics. 5 institutes within EPFL are currently involved in research and development projects in the field of space sustainability. The hub is connecting these individual projects in a workflow that rests on three intertwined pillars: measure, understand, and act for space sustainability.

The projects associated with each pillar are essential to find solutions to the problems arising from the rapidly increasing space activities, the risk from space debris, and the generated atmospheric impacts. The Hub will help identify and promote new technologies in space sustainability with new services in orbit and on the ground.

This paper presents the organisation of the new Sustainable Space Hub, and highlights ongoing research and development conducted in this domain. It discusses the three pillars, shows how the development of the individual project benefits from the hub, and gives an outlook on future projects related to space sustainability at EPFL.

References

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