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Title

A feasibility study of a future European Single-Stage-To-Orbit (SSTO) spaceplane

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Abstract

The last two decades have seen the emergence of a new ecosystem of companies and organizations working to build new horizons for space activities and capabilities. The constant decrease of costs and the facilitation of access to space allow to project ourselves in a future where everything is possible. If reusability, recycling and the development of new means of propulsion for space launchers are part of the latest innovations in this field, it is legitimate to ask what the next milestones of these developments are. The past is marked by various projects aiming to replace, not without compromise, the concept of the staged launcher in order to facilitate the reusability and operability of this type of vehicle. Some of these projects have come near to completion, others are still in development and have evolved, sometimes awaiting sufficient technology to allow their completion [1]. One thing is certain, one of these Single Stage To Orbit (SSTO) vehicles will eventually take flight. Do the technological advances in this field allow it? What would be the place of such a vehicle in the future space ecosystem?

This paper synthesizes the development and feasibility system studies of a horizontal take-off and landing SSTO launcher, capable of taking off from the Guiana Space Center (CSG). This medium-sized spaceplane is planned to perform manned flights with 6 crew members or up to 2 tons of payload for low Earth orbit (LEO). We will discuss the results of the design iterations of such an aircraft by considering the variety of sub-studies conducted in order to make informed design choices. Thus, the logic and results of the airframe design of the aircraft, its external structure and aerodynamic performance, but also its internal structure, its layout and the means of accurate weight estimates will be exposed. The aircraft being planned to use airbreathing propulsion technologies and having to execute atmospheric re-entries, the trajectory of a mission, its optimization, the aerothermal constraints and the associated thermal management strategy are taken into consideration. The efficiency of the propulsion means used plays a major role in reaching the low orbit while keeping a payload. From the state of the art and on proposal of innovative concepts, a propulsion system is proposed as well as an optimization of its performances. Manned flights must also meet numerous safety standards and the reusability of the aircraft must be characterized. The analysis of the risks, the reliability and the safety of operation will propose strategies of answers to these criteria.

Finally, the designed spacecraft being proposed for the European market, it is necessary to approach the place that such a device would have and how such a project could be conducted. We will synthesize the study of the current market, the estimate of the costs of design, implementation, associated maintenance and finally the financial sustainability of such a project.

References

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