VTVL rocket system engineering

Jérémy Marciacq[1,2] Bernard Foing[1,3]

[1]Swiss Federal Institute of Technology in Lausanne, [2]Gruyère Space Program, [3]ILEWG EuroMoonMars

There is an increasing interest in propulsive landing technologies for planetary landings or in the rocket reuse domain. These kinds of technologies need to be validated in a proper test environment. For this reason, terrestrial vertical takeoff, vertical landing (VTVL) rockets have been developed for several years across many countries. However, no bi-propellant propulsion rocket capable of carrying a payload has yet flown in Europe. Given the opportunity, Gruyère Space Pro-gram (GSP), a swiss aerospace student association, which already has some experience in thrust vector controlled rockets, has started developing such a vehi-cle to be flown late 2023.

Content : The study made in autumn 2021 presents the sizing process, a preliminary design phase concept and the requirements of each sub-system of this VTVL vehicle, Colibri. This rocket relies on a 1200N N2O/Ehanol throttleable rocket engine based on the experience acquired from a 1000N version already developed and tested by the association. Engine gimballing and reaction control system will allow full control of this autonomous vehicle for various flight profiles opportunities. It will be capable to hover for more than 75 seconds while carrying 3kg of payload. The vehicle first tethered flights are expected to happen in the middle of 2023, followed by free flights in the end of the 2023. The development and test program is planned so that the project stays feasible with a small team of less than 10 students.

Finally, this project being managed by students in addition to their studies, its cost estimated to approximately 55'000CHF would be covered thanks to the help of industry partners and donations.
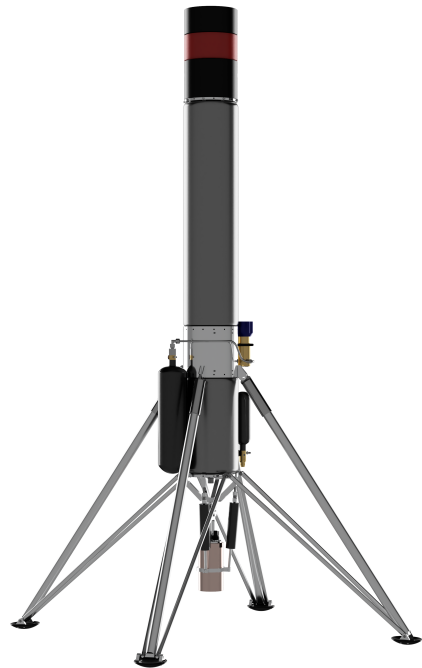

Figure 1: GSP Colibri concept CAD render.

Payload opportunity : This vehicle represents a future high fidelity instrument testing opportunity in Europe. Colibri could for example carry camera systems for terrain analysis, engine plume dust collector or GNC systems for landing simulation.