SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Small Launchers: Concepts and Operations (7)

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SMALL INNOVATIVE LAUNCHER FOR EUROPE: ACHIEVEMENT OF THE H2020 PROJECT SMILE

Abstract

Today's market for small satellites is expanding, but there is little capacity for affordable, dedicated launches. Launch costs of around 50,000 per kg are required to compete with ride-shares; hence, cost reduction is essential. Fourteen European companies and institutes have joineed forces in a Horizon2020 project called "SMall Innovative Launcher for Europe" (SMILE).

The project aims at designing a launcher for satellites up to 70 kg and a European launch facility in northern Norway. Furthermore, the readiness level of critical technologies on propulsion, avionics, and cost-effective manufacturing is increased.

As the development time of small satellites can be short, launch rate (time-to-launch) is considered a key requirement. An effective and efficient organisation, including supply chain, is needed to maintain the launch cadence and to reduce operational cost, both of which are needed to deliver a commercially viable service. Given the anticipated launch rate and the regulations on space debris, controlled de-orbiting of the upper stage is deemed necessary.

Both liquid and hybrid rocket engines are considered for this small launcher: a high-performance LOX/kerosene engine and a low-cost H2O2/HTPB engine. The reusable liquid engine, for which firing tests are scheduled in 2017, uses a ceramic-based, transpiration cooled combustion chamber and a 3D-printed injector. The existing H2O2/HTPB hybrid engine offers simplicity of the architecture and uses green, storable propellants. Upgrades for this engine are considered, such as composite materials and a light-weight TVC system.

With a choice of two types of engines, different configurations are analysed in a two- or three-stage set-up, with or without boosters, using a multidisciplinary design approach including steps from geometry set-up to trajectory optimisation. Preliminary cost estimations and readiness levels are used as complementary metrics.

A trade-off is performed to select materials and structural elements to withstand the most demanding loading cases. To minimise the mass, a composite sandwich structure is proposed. A suitable automated manufacturing process is then needed for cost-effectiveness. To accommodate both CubeSats and micro-satellites, a flexible payload adapter is designed.

The use of COTS for the avionics is foreseen to reduce cost, with low-cost MEMS gyroscopes are competing with high-performance fibre optic gyroscopes. High-performance multi-processor System-On-chips can combine processing power, real-time control, and high number of interfaces into a single board.

Finally, a new launch site design, including preliminary ground and flight safety analysis, is performed for the launch base in Northern Norway, currently already used for sounding rockets launches.