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Small Launchers: Concepts and Operations (Part I) (7)

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

Abstract

Today's market for small satellites is expanding, but there is little capacity for affordable, dedicated launches. Fourteen European companies and institutes have joined forces in a Horizon2020 project called "SMall Innovative Launcher for Europe" (SMILE), which aims at designing a launcher for satellites up to 70 kg, at increasing the maturity level of critical technologies on propulsion, avionics, as well as cost-effective manufacturing, and at designing the ground segment on Andøya, Norway.

Two small launchers are designed: one based on hybrid engines from NAMMO and one with liquid engines from DLR. Nammo is looking specifically at low-cost production. INCAS performs CFD analyses to study the effect of the exhaust plume interaction of the four engines in the first stage.

To demonstrate the development of these critical technologies, several prototypes are developed:

- a reusable 7 kN unitary liquid engine made of C/C-SiC running on LOX/Jet A-1;
- a carbon-composite structure of the upper stage;
- a flexible payload deployment mechanism for micro-satellites;
- an avionics box to be launched as payload on a student rocket;
- a hardware-in-the-loop test bench for launcher control.

For the liquid engine, several test campaigns are performed by DLR at the test site of PLD Space to verify the injector printed by 3D Systems, the igniter, and the combustion chamber in both metal (calibration unit) and ceramics (flight unit).

The structure of the upper stage is designed by Airborne, Heron Engineering, and NLR using representable load cases during flight. The fairing is excluded from the prototype. An automated manufacturing process is used to produce the carbon composite sandwich structure including thrust frame and payload adapter. The latter contains a flexible separation system for micro-satellites (M3S), developed by ISIS.

NLR develops a 6DOF simulator in Matlab/Simulink to analyse the launch vehicle behaviour during flight. This simulator is ported to the simulation framework EuroSim using the Simulink Coder and the conversion tool MOSAIC. Together with Terma, a hardware-in-the-loop test bench is set up in which the

control algorithms are executed on a target on-board computer interfacing with the simulator to retrieve sensor information and to send actuator commands.

Andøya Space Centre is responsible for the design concept of the ground segment: mission requirements analysis, derivation of the specifications, identification of design drivers, constraints and main assumptions, and design options trade-offs. The design is concluded with the facilities siting, their description, and the concept of operations.