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

Author: Mr. Rasmus Bergström
Spain, rasmus.bergstrom@pangeaaerospace.com

Mr. Nicola Palumbo
Spain, nicola.palumbo@pangeaaerospace.com
Mrs. Laura Martí Ramos
Spain, laura.marti@pangeaaerospace.com
Mr. Bart Van Hove
Deimos Space SLU, Spain, bart.van-hove@deimos-space.com
Mr. Giovanni Medici
Deimos Space SLU, Spain, giovanni.medici@deimos-space.com
Dr. Alan Viladegut
von Karman Institute for Fluid Dynamics, Belgium, alan.viladegut@vki.ac.be
Mr. Sébastien Paris
Von Karman Institute, Belgium, paris@vki.ac.be
Mr. Maximilian Soepper
Technical University of Munich, Germany, max.soepper@tum.de
Mr. Pranav Bhardwaj
Technical University of Munich, Germany, pranav.bhardwaj@tum.de
Mr. Dimitrios Rellakis
Heron Engineering, Greece, dimitrios.rellakis@heron-engineering.gr
Mr. Panagiotis Trifa
Heron Engineering, Greece, panagiotis.trifa@heron-engineering.gr
Prof. Athanasios Dafnis
RWTH Aachen, Germany, athanasios.dafnis@sla.rwth-aachen.de
Mr. Marco Kanngießer
RWTH Aachen, Germany, marco.kanngiesser@sla.rwth-aachen.de
Mr. Stefano Piacquadio
RWTH Aachen University, Germany, stefano.piacquadio@sla.rwth-aachen.de

A NOVEL DESIGN APPROACH FOR A REUSABLE VTOL MICRO LAUNCH VEHICLE

Abstract

The rise of small satellite constellations is rapidly changing the satellite industry, but due to the growth of the micro satellite market conventional launch systems have become a bottleneck for this industry. Traditionally, micro-launchers have much higher launch costs per kilogram compared to bigger launchers. However, today the cornerstone of the emerging micro-satellite market is the economic viability of launching smaller payloads into dedicated orbits, at high frequency. The Recovery and Return to Base (RRTB) project, as part of the European Union's H2020 program, aims to develop a novel solution to provide tailored cost-effective access to space for the micro satellite market.

The MESO vehicle is a unique system solution to achieve partial reusability of a micro-launcher. The two-stage vehicle injects the payload into orbit, similar to classical expendable launchers. However, the

separated first stage becomes a re-entry vehicle that performs a series of maneuvers to return safely to the ground. Firstly, the MESO performs a boost-back burn using its methalox fueled aerospike engine, which decelerates the vehicle and points the re-entry trajectory towards a selected landing site. A hypersonic drag device is deployed to decelerate the ballistic re-entry vehicle to supersonic speeds. Having descended through the upper atmosphere, the MESO engages its novel propulsion system for guided landing.

Current technologies for landing a reusable rocket launcher have some well-known drawbacks. While retro-propulsion is powerful it involves major technological challenges. Horizontal landing requires safe and large touchdown areas. Collaborative solutions, such as mid-air helicopter retrieval, increase cost and involve personnel. MESO capitalizes on recent advances in urban air mobility and battery technology. It has two banks of commercial off-the-shelf Electric Ducted Fans (EDFs) mounted on the vehicle. Using electric propulsion the MESO navigates to the landing site, where it performs a controlled hover landing on a small 10x10 m footprint.

The MESO targets a minimum reuse of 10 flights, which implies that many considerations have to be taken into account regarding the design of e.g., the main cryogenic propellant tanks, the vehicle's primary structure, and the thermal protection system to allow for an optimal post-flight refurbishment and inspection. Here, the main technological challenges are reviewed, and a design solution is proposed following a multidisciplinary approach.

The presentation will explore the design philosophy and choices made to develop the MESO reusable launcher. Novel and previously unexplored ideas, including unique system design challenges, will be described and compared with conventional solutions.