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

Author: Mr. Christian Schmierer
German Aerospace Center (DLR), Germany, christian.schmierer@dlr.de

Dr. Mario Kobald
German Aerospace Center (DLR), Germany, mario.kobald@dlr.de
Mr. Konstantin Tomilin
German Aerospace Center (DLR), Germany, konstantin.tomilin@dlr.de
Mr. Ulrich Fischer
German Aerospace Center (DLR), Germany, ulrich.fischer@dlr.de
Prof. Stefan Schlechtriem
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, stefan.schlechtriem@dlr.de

LOW COST SMALL-SATELLITE ACCESS TO SPACE USING HYBRID ROCKET PROPULSION

Abstract

Increased demand for smallsat launch capabilities drives on the search for low-cost launch vehicles. Hybrid rocket technology has been pushed forward in the recent years and is now ready to meet the demand of this low-cost rocket development. With intrinsic safety and reliability the development and production cost of hybrid rocket engines can be a small fraction of bi-liquid propulsion systems. At the German Aerospace Center DLR a hybrid rocket engine is developed in cooperation with the German start-up company HyImpulse Aerospace GmbH in order to advance launcher technology in Germany. A concept for a mini-launcher has been designed by HyImpulse Aerospace and the development of a 75 kN (SL) hybrid rocket engine is on-going with a test campaign foreseen in 2019. This engine will be the largest hybrid rocket engine ever tested in Europe. It takes advantage of the long development and research history of paraffin-based hybrid rockets at the DLR Lampoldshausen. Since 2010 paraffin-based fuels have been analyzed and improved. Additives have been found to greatly improve the mechanical properties of the paraffin solid fuel. At the same time the regression rate has been modulated to adapt the fuel for use in launcher applications. The concept of the HyImpulse mini-launcher includes eleven engines of this type, which will result in large scale serial production for the foreseen launch rate of twelve launches per year. This further reduces production costs of the hybrid rocket engine. The advantage of paraffin-based fuel lies in the simple geometry of the grain caused by the high regression rate. A cylindrical fuel grain will be at a much lower manufacturing cost compared to classical wagon wheel fuel grains with HTPB. Hybrid launchers are often planned with pressure fed propulsion systems, but in order to increase the payload of the launcher this is replaced with a gas generator and turbo pump driven propulsion system for this launcher concept.