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

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BLUE BOOMERANG: A DESIGN FOR A LOW-COST SMALL SATELLITE LAUNCHER

Abstract

This paper presents a design for a low-cost launch vehicle concept for delivering small satellites to Earth orbit. The purpose of this study is to consider the core design issues that impact the development, production and operation of a practical small launcher that reflects minimum cost and engineering complexity. Key areas of cost reduction are explored in the design, which include; operational concept, reusability, vehicle and engine reliability, hardware development and production, propulsion system options and technology level.

Various strategies for vehicle reusability are discussed, which is a primary factor for cost reductions in any Space launch system and many additional design drivers that have an impact on cost reduction are identified and incorporated in the concept design presented.

A system level design model for a multi-stage launcher was created based on the selected configuration and hardware constraints, which is used to estimate the overall stage masses and performance data. The vehicle design data was used in a trajectory model to verify the target mission and assess the requirements for first-stage recovery. The nominal design mission used in this study is for a 200kg payload to a 567km circular orbit with a 97.7 degree inclination (Sun-synchronous).

The resulting launcher configuration, named Blue Boomerang, is a vertically launched 3-stage rocket based on conventional technology and features a reusable winged fly-back first-stage; incorporating a small jet engine and undercarriage for horizontal recovery. The vehicle's first and second stage uses a common existing LOX/Kerosene rocket engine which is adapted for sea-level and high altitude operation and a small upper stage is used for orbit circularisation. The size of the reusable first-stage and alternative options for the propulsion system are examined for comparison of performance and resulting impact on launch costs.

A summary of the launcher design is provided including the key economic considerations for the overall development, production and operational life; which show there are

significant cost savings compared with an equivalent expendable launcher design and highlights the critical design drivers that have an influence on reducing the recurring operational costs.