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

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FEASIBILITY STUDY OF SMALL SATELLITES LAUNCHER VEHICLE LAUNCHED FROM ATMOSPHERIC CARRIER AIRCRAFT

Abstract

The paper deals with the feasibility study of an air-dropped small satellites launcher vehicle. A conceptual design methodology has been defined and then applied to various case-studies, in order to evaluate the main flight, mission and system performances of the unconventional space vehicle (SV) that may be either launched from a supersonic fighter aircraft or from a subsonic cargo aircraft. Space is playing an increasingly important role in the leverage and execution of military, scientific and civil protection missions, which since the last few years have been generating a high request of affordable, continuos, and flexible space access solutions. The SV concept, here presented, is a fast and affordable solution able to access space from any sites of the world in all weather conditions. It is a missile-like solution able to inject in Low Earth Orbits a small payload (mass lower than 200 kilograms), in a few hours, through a low cost mission. The paper begins with a short investigation of the traditional space launch capabilities, which highlights the lack of a dedicated transport solution for the families of Nano and Micro-satellite, for which a high increase in launch demand is expected in the next years. The work proceeds with the analysis of the state of the art of new concepts of unconventional launch solutions. The paper then describes the conceptual design methodology that has been developed and used to accomplish the feasibility study of the SV. This methodology has been translated into a flexible numerical program in Matlab® language, which allows evaluating the main flight and system performances of the SV, after being dropped from its carrier aircraft. The program's code gives the opportunity to set initial flight conditions, the main parameters that describe the SV geometry and its rocket performances. The outputs of the program provide the users with the possibility of evaluating the flight path trajectories and the time history of flight path angles, altitude and Mach number, with an estimation of the trend and magnitude of the aerodynamic and thermal loads acting on the external structure of the spacecraft during its ascent to orbit. Additional output of the program is the preliminary sizing of the SV and particularly of its solid rocket system. The most promising design alternatives, which may be air-dropped either in subsonic or in supersonic flight regimes, are finally described and shown in the paper. Eventually main conclusions are drawn.