

Some results of research on the LatLaunch project for the launching system of pico- and nanosatellites into low Earth orbit

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Abstract:

The Riga Technical University (Latvia) is developing a project for a system for launching pico- and nanosatellites (PNS) into low Earth orbit (LEO) using an aerial platform called LatLaunch. An A319 type transport aircraft was chosen as the air platform and a three-stage carrier of PNS was specified as a carrier, the aerodynamic and specific characteristics of which are the characteristics of one of the modern supersonic interceptor fighters. Systems for using a winged launch vehicle to launch PNS into LEO have been developed since the middle of the 20th century. In the USA, within the framework of the RASCAL project, some aircraft were studied as the first stage of such a launch system (F-106, F-4, F-14, F-15). Similar projects were developed in the USSR (RF) and other countries. The F-15 was identified as the most suitable aircraft for this purpose, but the conclusion was made in favour of the development of a specialized carrier, the prototype of which was the F-22 fighter. The F100 engine of the F-15 aircraft was chosen as the prototype of the engine for the power plant that needed to be modified in accordance with the mass injection pre-compressor cooling (MIPCC) concept. Within the framework of the RASCAL project, the concept of the MPV (MIPCC-powered Vehicle) launch system was developed. Having analysed such options, the authors also chose one of the modern supersonic fighter-interceptors as the first stage of the carrier of PNS. Within the framework of the LatLaunch project, the possibility of using a supersonic fighter-interceptor and methods of its modification was studied to obtain the necessary characteristics of the PNS launch system to achieve the specified altitude and flight speed of the first stage of LatLaunch in conjunction with the second stage, prior to its detachment, and an assessment of the necessary characteristics of the second stage LatLaunch for its implementation of the output of the third stage LatLaunch at a given height at a given speed. To solve this problem, the authors analysed the available technical characteristics of similar existing and prospective aircraft models and chose the MiG-25 interceptor fighter as an aerodynamic prototype based on the technical characteristics (flight altitude record, flight speed record, and the availability of information on some characteristics of aircraft aerodynamics). A mathematical model of the aerodynamic parameters of the first stage of LatLaunch was developed based on the aerodynamic characteristics of this aircraft. As the power plant of the first stage of a launch, it is planned to use an engine of the AL-55 type. Overdriving and modifying the engine can significantly increase its features.

The report presents the methods used by the authors to determine the flight parameters of the first and second stages of LatLaunch, an assessment of the necessary characteristics for the implementation of the launch of the third stage of LatLaunch to a given altitude at a given speed, and an assessment of the results obtained, taking into account the problems of the aerodynamics of the carrier and the problems of increasing the power of engines for flight on high speeds and altitudes.