Paper ID: 71203
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IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Launch Services, Missions, Operations, and Facilities (2)

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DESIGN AND EXPERIMENTAL TESTING OF A MICROLAUNCHERS EJECT SYSTEM OPERATED FROM NAVAL PLATFORM

Abstract

In recent years, there has been a growing interest from many players worldwide towards alternative launch systems. To date, the solutions experimented the most include air-launch and the launch from marine platform, that allow, in principle, to launch from any desired latitude. Despite introducing higher complexity in the logistic of launch operations, these alternatives are particularly attractive to those Countries or entities which cannot benefit of an adequate ground area for a rocket range and are nowadays considered valuable options for expanding the access to space. In this research, we propose a model to design an eject system for microlaunchers, compatible with the use on a naval platform, developed based on numerical and experimental data. The eject system can accelerate the microlauncher operating in 2 different configurations: (i) using cold gases, namely pressurized air previously generated and stored, or (ii) using hot gases, generated by the combustion of a ballistic charge, ignited when required. The analysis aims at identifying in particular (i) the required flow rate and reservoir pressure of cold gases, and (ii) adequate composition and mass of the ballistic charge, required to eject a launch vehicle of a given mass and cross section within the constraints set by the maximum acceleration during the ejection phase and minimum range/altitude reached from the eject system. The characterization of the system is the result of an extensive experimental campaign conducted on a testbed consisting of an ejection tube with inner diameter of 48 cm and length of 5 m and test masses ranging from 100 to 800 kg. For the cold gas configuration, the system performance was investigated for different values of the reservoir pressure and of the flow rate, ranging respectively from 6 to 14 bar and from 500 to 1070 m3/min. Concerning the hot gas configuration, the performance was evaluated considering different mixtures of black powder for masses ranging from 50 to 500 grams. The testbed includes pressure and temperature sensors, placed at the bottom of the ejection tube, which allow monitoring the time evolution of gases during the ejection

phase, and high frequency accelerometers installed onto the test masses, which are used to reconstruct the dynamics of the masses during the ejection phase and the following ballistic trajectory.