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

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A DETAILED DESIGN OF A EA/LOX LIQUID ROCKET FOR A SUB-ORBITAL FLIGHT

Abstract

The authors have developed low-cost small liquid rocket system with well-known technologies and easily available parts. A development project is originated with association of like-minded comrades named "NATSU NO ROCKET DAN" (means summertime rocketeers). Professions of original members cover a lot of fields such as entrepreneur, novelists, illustrator, manga artist, aerospace journalist, photographer and engineers on various fields, etc. A purpose of the project is "Easy Access to the Space." A near-term goal of the project is to handle launch system for Micro/Nano-satellites into orbit. We are to realize the launch system with "the world smallest liquid rocket". The reason why we choose the EA/LOX liquid propelling system is to reduce development cost and risk. A concept design of the orbital launcher has three stages liquid rocket engine, minimum components for carrying Micro/Nano-satellites into orbit. As a result of developing low-cost launch system, we watch for a chance of early transfer from experimental to a commercial launch. We have already done a commercial launch for a promotion in 2013. As a preliminary step of orbital and next commercial launch, we plan to conduct sub-orbital flight test within a year. The rocket has 20 kg payload capacity, a 9 kN thrust EA/LOX engine, a He pressure feeding system for the propellant, a TVC system for a pitch and a yaw angle, a gas jet system for a roll angle control, a reentry system for a recovery of an avionics and payloads. A LOX supplying valve is driven by a servomotor and others are driven pneumatically. Each control systems use feedback from outputs of an IMU and gyro sensors. We have done many kinds of tests of the system such as a static firing test of a small scale engine, a supersonic flight test, a tethered flight test for gimbal control system, and so on. In 2015 summer, a few hundred meter altitude flight test for a thrust vector control system with a gimballing mechanism and a roll angle control system with a gas jet. Static firing tests for sub-orbital launcher will conducted simultaneously. In the conference, results of some tests and a detailed design of sub-orbital launcher will be reported.