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DEVELOPMENT OF SMALL WINGED ROCKETS FOR SUBORBITAL TECHNOLOGY DEMONSTRATION BY UNIVERSITIES IN COLLABORATION WITH GOVERNMENT AND INDUSTRIES

Abstract

Kyushu Institute of Technology (Kyutech) has been studying unmanned suborbital winged rocket and its research issues concerning aerodynamics, NGC (Navigation, Guidance and Control), cryogenic composite tanks etc., for realizing future fully reusable space transportation system since 2005. In 2008, Kyutech first developed a small winged rocket called WIRES (WInged REusable Sounding rocket) 011, which has the total length of 1m and initial mass of 8kg, and conducted its flight tests up to the altitude of 0.5km for 5 times in order to verify the attitude control performance of ascent phase. In 2010, Kyutech developed a conventional rocket called WIRES012 to demonstrate a new flight termination and complete recovery system with 2-stage parachute and airbags for the safety operation. WIRES012 has the total length of 1.7m and initial mass of 34kg. The flight tests were completed in 2011 to reach the altitude of 0.8km and demonstrate the mechanical design of the flight termination and recovery system successfully. Since 2012, Kyutech started to develop WIRES014 to verify the technologies of onboard real-time guidance system and attitude control system in collaboration with JAXA (Japan Aerospace Exploration Agency). WIRES014 is a larger winged rocket with total length of 1.7m and initial mass of 49kg, which is capable to reach the altitude of 1.7km propelled by a propulsion system of CAMUI (Cascaded Multistage Impinging-jet) hybrid rocket provided by Hokkaido University and Uematsu Electric Co., Ltd. Its first flight test was conducted in June 2013, but failed due to the malfunction of ADS (Air Data System). Kyutech is now underway of manufacturing next WIRES014-2 by improving the technical problems that have been discovered by the post-flight analysis. Kyutech has already started the detail design of relative large winged rocket WIRES015 as a pre-demonstrator of suborbital vehicle, the purpose of which is to perform high maneuverability using the onboard real-time guidance, advanced attitude control system by aerodynamic control surfaces and RCS (Reaction Control System) using Nitrogen Gas. WIRES015 will have the total length of 4m and the weight of 500kg, which is capable to reach the altitude more than 6km. This paper introduces the total development plan of winged rockets up to the suborbital technology demonstration flight by universities in collaboration with government and industries, as well as the past and current flight test results. The nearest goal of suborbital flight for technology demonstration will be 2017.