Paper ID: 79864
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IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

Author: Prof. Koichi Yonemoto
Tokyo University of Science, Japan, yonemoto@rs.tus.ac.jp

RECENT STATUS OF EXPERIMENTAL SUBSCALE WINGED ROCKET WIRES#015 AND IT'S FULL EXPANDER CYCLE LOX/LNG ENGINE COMBUSTION TEST

Abstract

Space Systems Laboratory at Tokyo University of Science and Tokyo University of Science's start-up SPACE WALKER Inc. have been developing an experimental subscale winged rocket called WIRES015 (WInged REusable Sounding rocket)[1] in cooperation with Japan Aerospace Exploration Agency (JAXA) and German Aerospace Center (DLR). It has the dimensions of 4.6m and initial mass of 1,000kg to conduct the comprehensive flight demonstration of the technologies for realizing suborbital spaceplane[2] such as LOX/LNG (Liquid OXygen/Liquefied Natural Gas) engine, autonomous NGC (Navigation, Guidance and Control) system and fully composite LOX/LNG propellant tanks. The LOX/LNG engine has a full expander cycle system with a common pump to feed LOX and LNG propellant to the combustor, which achieves high Isp (specific impulse) performance. The features of NGC are the real time guidance by Dyn-DGA (Dynamic Distributed Genetic Algorithm) and the attitude control law by DI (Dynamic Inversion) theory that guarantees stability onboard. One of the most important demonstration technologies is the world's first composite liquid oxygen tank using LOX compatible pCFRPC (pitch Carbon Fiber Reinforced Poly Carbonate), which is currently being a joint research and development with DLR. WIRES015 is currently in the process of fabrication. The helicopter drop test using dummy vehicle for validating the recovery system will be conducted in December 2023, and the helicopter sling test of WIRES015 for validating the NGC will be performed in May 2024. The hardware-in-the-simulation test are scheduled for mid-2025. The LOX/LNG engine test has been conducted in March 2023. The CFT (Captive Firing Test) will be scheduled in January 2025. The first flight test of WIRES015 will be conducted in December 2025 followed by the three additional flight tests.

[1] Yonemoto, K. and Fujikawa, T., "Development Status and Flight Demonstration Plan of Experimental Winged Rocket WIRES015 at Tokyo University of Science", IAC-22-D2,5,2, x69845, the 73rd International Astronautical Congress (IAC), Paris, France, 18-22 September 2022. [2] Fujikawa, T., and Yonemoto, K., "Application of Multidisciplinary Design Optimization to the Development of an Unmanned Suborbital Spaceplane by Industry-Government-Academia Collaboration", IAC–22,D2,7,9,x71209, the 73rd International Astronautical Congress (IAC), Paris, France, 18-22 September 2022.