

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

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JAPAN'S FIRST IN-FLIGHT EXPERIMENTATION OF AUTONOMOUS FLIGHT TERMINATION
SOFTWARE USING A SOUNDING ROCKET.

Abstract

Autonomous Flight Safety System (AFTS) enable fewer range assets to support launch operations, resulting in fewer range constraints and increase launch opportunities. Since 2017, JAXA have developed autonomous flight safety software (AFTSW) to reduce development costs and range assets for commercial launch vehicles and enhance international competitiveness by improving launch capability. We are planning to develop autonomous flight safety software in two phases, first version of software had been completed in 2020. First version introduced two simplified algorithms of flight termination to decrease processing speed and memory capacity. We installed this software on the New Advanced navigation sensor for sounding rocket (NANA-ka) which combined a navigation sensor and a flight safety on-board computer and performed a in-flight experimentation on sounding rocket S-520-33 operated by JAXA. This paper describes the results of in-flight experimentation. Firstly, navigation sensor of NANA-ka mounted on the upper stage of the sounding rocket measures position and velocity of launch vehicle by a hybrid navigation of GNSS and three-axis MEMS accelerometer. Secondly, autonomous flight safety software

of NANA-ka calculates quantity of state and instantaneous impact point (IIP) of launch vehicle based on real-time position and velocity to control flight safety. Finally, these results are sent to the ground to evaluate via telemetry communication of the sounding rocket. In the experimentation, the software just simulated to terminate the flight of the vehicle. We needed to simulate off-nominal conditions when sounding rocket flights normally. Therefore, destruction line (DL) was set to cross over the nominal orbit to determinate the flight intentionally. We succeeded all plans to make determinations of flight. In Japan, this is the first in-flight experimentation of autonomous flight safety software to achieve technical readiness level (TRL) 6. In the coming years, we plan to promote the utilization for JAXA's reusable launch vehicle and commercial launch vehicles.