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

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MAIN ACHIEVEMENTS OF THE SOUNDING ROCKET FLIGHT EXPERIMENT ATEK

Abstract

Reliable access to space with affordable costs can only be achieved using validated design tools for space transport systems. Although numerical methods made big progress in the recent years, they have shortcomings in physical modelling of critical flight parameters and simulation of multidisciplinary interaction. Therefore, using sounding rockets for performing small scale flight experiments is essential to close the design loop. Following previous development work concerning in-flight technology demonstration using sounding rockets, DLR performed in July 2019 the ATEK flight experiment from the launch site Esrange in Kiruna and provided valuable flight data. The second stage and the payload reached an apogee of approx. 240 km. and the second stage continued the descent without any thrust and landed approx. 500 seconds after the take-off at a distance of approx. 67 km from the launch site. The payload was decelerated in the late subsonic flight phase using a parachute to avoid a hard impact on ground and touched down after approx. 800 seconds flight time. The Health Monitoring System allowed the measurement of aerothermal and mechanical loads on the hybrid payload structure, motor adapter, motor case, tail can and fins along the complete flight. Part of the data has been transmitted during flight to ground via telemetry at a low sampling rate of several Hertz. In addition, several impact-resistant data acquisition units could acquire the data at a high sampling rate of several Kilohertz and stored it onboard. The hybrid payload structure and health monitoring data acquisition units have been recovered after the flight and showed complete functionality. Recently developed in-house heat flux sensors measured the total heat flux evolution at selected positions, successfully. This data in combination with several thermocouples, which recorded the structure temperature provide very useful data for validation of aerothermal design tools. The tailcan instrumentation package detected thermo-structural properties of the motor case, nozzle, fins and the tailcan with different types of instrumentation. The motor case temperature was measured with fiber Bragg gratings for the first time. Fin leading edge temperature history measured with several thermocouples at different locations along the complete flight. A new hybrid module made of CFRP and metallic structure has been developed for the ATEK flight experiment. A cork based thermal protection layer was applied for the thermal protection of the module. Post flight data and inspection showed an excellent performance of the CFRP module.