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Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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LONG DURATION HYPERSONIC FLIGHT EXPERIMENT ATHEAT

Abstract

The new long duration hypersonic flight experiment ATHEAt with multiple payloads will be carried out with a two-stages sounding rocket configuration and will reach higher Mach numbers than the previous flight experiment STORT [1]. This improvement is directly linked to two powerful motors. The first stage motor Red Kite is a new development in Germany and was flight qualified in November 2023 during a single stage flight from Andøya Space in Norway [2]. The second stage of ATHEAt uses the Black Brant Mark IV motor. This motor combination allows to fly 195 kg payload mass at Mach numbers above 9.0 for a duration for more than 140 seconds. The forebody of the scientific payload consists of a massive CMC nose followed by four CMC segments, which are manufactured with different techniques. The third module has a transition from circular shape to facetted flat surfaces. The module ahead of body flaps has completly flat surfaces to allow proper inflow conditions for flap experiments. Two active cooling experiments are foreseen on two opposed flat facettes direction. A pneumatically driven actuator system will increase the initial 5 deflection of all four flaps to 20 during the hypersonic flight phase. The conical module between the payload and second stage engine will be used for a structural health monitoring (SHM) experiment. In addition to 370 intrusive sensors (pressure, heat flux, temperature, strain) additional nonintrusive techniques will be used for the measurement of displacement and deformation of hot structures. Two IR cameras and four pyrometers will measure the surface temperature distribution of the flap rear surfaces. The flight qualified predictor based on the 3 DoF trajectory simulation will determine the ignition time of the second stage motor by means of data coming from the GPSS and new generation IMU, which was also flight qualified during STORT flight as passive payload. 1. A. Gülhan, D. Hargarten, M. Zurkaulen, F. Klingenberg, F. Siebe, S. Willems, G. di Martino, T. Reimer; Selected Results of the Hypersonic Flight Experiment STORT, Acta Astronautica, Volume 211, October 2023, Pages 333-343. 2. Scheuerpflug, Röhr et. al., The RED KITE Sounding Rocket Motor – Qualification Milestones and Application Spectrum, 3rd HiSST, 14.-19. April 2024, Busan.