

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

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DESIGN MODIFICATIONS FOR PERFORMANCE ENHANCEMENT OF A SUBORBITAL ROCKET
ILR-33 AMBER 2K**Abstract**

This paper presents an overview of the development of the upgraded version of the ILR-33 AMBER sounding rocket designed and manufactured at the Lukasiewicz Research Network - Institute of Aviation in Warsaw, Poland (L-IoA). The successful, maiden flight of the first version of the ILR-33 AMBER took place on 22.10.2017, however since then, L-IoA was putting continuous effort to improve and develop critical technologies of the rocket. The rocket was tested in-flight two more times in 2019. New version of the ILR-33 AMBER 2K focuses on performance enhancement: changes aim at increasing maximum payload weight and extending time that the rocket spends in microgravity conditions. These should allow users to perform wider range of scientific experiments. Following paper concerns description of the main rocket upgrades which include: solid rocket motors and flight control system. The optimisation process, based on simulations and technical analysis, was executed in order to find the most effective way to increase the performance. However few different concepts were investigated, utilization of larger solid rocket boosters turned out to be the most advantageous one. Trajectory analyses in variation of solid rocket motor performance and dimensions were carried out. The simulations also took into account the flight control system. Main baseline scenarios of the flight trajectory were examined and they appeared to be very promising in terms of maximum apogee and overall performance. As a result, the upgraded rocket can offer extended system capabilities which make the ILR-33 AMBER 2K a very attractive launch vehicle in terms of commercial usage and academic research. The next step is to test the new propulsion unit and flight control module to verify the system's integrity and examine its performance. Flight tests, in order to increase maturity of the whole rocket, are planned to take place in 2020 and 2021. As a conclusion, it appears that the proposed modification can significantly improve general performance of the rocket which should effect in maximising payload weight and extended time at the microgravity. The new version will be capable of reaching 100 km with 10 kg payload. With the upgrades, ILR-33 AMBER 2K can become an affordable and easily accessible platform, for both commercial and academic research.

Due to its unusual configuration, that makes use of parallel solid-rocket-boosters-based stage, it can also be used as excellent platform for in-flight verification of new launch vehicle technologies and concepts.