IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (IP)

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THE CHALLENGES OF DESIGNING A STUDENT SOUNDING ROCKET FOR A 100 KM APOGEE

Abstract

Among all the projects developed in the Rocketry Division of the Students' Space Association at Warsaw University of Technology (SSA WUT) the Grot boosted-dart rocket is one of the most challenging. Currently, a team of about 30 members of the SSA is working on this rocket, whose goal is to achieve the apogee of 100 km. They encounter not only design, but also organizational issues, which arise during work on the rocket. In April 2019 the Association gained nationwide recognition by setting the Polish amateur rocket flight altitude record of 18.5 km. The new desired apogee is over 5 times bigger than the one already reached 3 years ago. This is one of the reasons for the necessity of applying new technological solutions.

The final iteration of the rocket is assumed to be a three-stage boosted dart with additional two strap-on boosters. In the project, it is desired to utilize as much technology already existing in the SSA as possible. This includes system solutions such as rocket motors, recovery systems and on-board computers.

Although rocket motors previously used in the Division will serve as the main boosters, their adaptation for future multi-stage vehicle will require additional mechanical design improvements. Moreover, all motors should pass several tests, such as proof pressure test or static fire test, to ensure the ability to withstand the conditions present inside the combustion chambers.

Additionally, several challenges arise connected to flight simulations and estimation of the rocket's flight performance. Prediction of the aerodynamic characteristics of non-classical geometry engages using CFD numerical simulations. Performing high accuracy simulations requires extensive computational time along with the resources to do so.

Another challenge of designing such a mission is the recovery system. To provide safe touchdown of all rocket's components, they require low descent speed. However, low speed might lead to high downrange distance, which might result in the rocket landing out of the safe zone. This is especially crucial considering significant wind speeds at higher altitudes. To overcome this problem, the rocket needs to use staged parachutes, which, at the same time, increases the risk of the mission failure.

Another problem is the launch site, which is very probable to be located by the water. Such circumstances greatly increase the complexity of the launches, not only imposing the need for the rocket to be waterproof and buoyant, but also complicating search activities during on-water recovery.