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FASTER: REACTION WHEEL STABILIZED PLATFORM TO IMPROVE MICROGRAVITY CONDITIONS FOR EXPERIMENTS IN PARABOLIC FLIGHTS

Abstract

Parabolic flights are widely used for conducting experiments in microgravity and practising for satellite missions or for human space flights. Testing an experiment, a piece of equipment or a spacecraft system in low gravity conditions is often required before it can be included in a space mission.

Most often, parabolic flights are performed on large aircraft such as ESA's Airbus A310 ZERO-G. They offer relatively long periods of low gravity per flight and plenty of space for experiment setup. However, the use of large aircraft also results in higher cost, low repeatability and constraints in location as the flights need to be performed from large airfields. This is one reason for the growing interest in parabolic flights using smaller aircraft, gliders or Unmanned Aerial Vehicles (UAVs). They offer lower initial and operational costs, shorter waiting times and higher flexibility regarding the location where the flight is performed. Depending on the experiment, these advantages will be more important than related challenges of short durations of parabolas and limited space inside the aircraft.

The microgravity conditions provided by large planes, 10^{-2} - 10^{-3} g, are not as good as those achieved at other microgravity platforms such as drop towers, sounding rockets, or the International Space Station (ISS). With smaller aircraft, the quality could be even lower, 10^{-1} - 10^{-2} g, due to their increased sensitivity to perturbations such as oscillations and vibrations. Regardless which of these two platforms will be used, the low-gravity conditions could be improved by reducing the effect of external disturbances and by increasing the stability.

The main objectives of project FASTER (Flying Attitude STabilized ExpeRiment) are to build a stabilizing platform and to prove that it can improve the microgravity conditions for payload experiments

during parabolic flights. The Attitude Control System (ACS) uses three reaction wheels and it is based on the ASTER on REXUS experiment that will be ejected from a sounding rocket during the upcoming 30th ESA Rexus campaign. The platform will be tested in 2021 on the first student arctic parabolic flight campaign organized in Kiruna, Sweden, using a light Cessna aircraft.