MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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INFLUENCE OF WIND GUSTS ON MICRO-GRAVITY QUALITY IN PARABOLIC FLIGHTS WITH SINGLE-ENGINE AEROBATIC AIRCRAFTS

Abstract

This study aims to catalog and analyze the influence of the atmospheric conditions in μg (microgravity) flights, in particular describing the wind influence on parabolic flights in single-engine aerobatic planes such as the CAP10B operated in the UPC BarcelonaTech platform.

It has already been proved that μg parabolic flights with single-engine aerobatic aircrafts are technically feasible and provide a reduction in costs for every campaign, and a faster access to platform.. These flights may eventually provide values close to 9 seconds of μg in standard atmosphere conditions, that is, ideally, no wind (Pérez-Poch, A., González, D., IAC 2008). However, the real value of μg obtained may depend on atmospheric conditions, as the smaller the aircraft the more dependent it is on g-jitter perturbations.

Therefore, it is important to analyze its impact in order to improve the quality of the reduced gravity obtained. In this research, a method is developed to evaluate the wind influence in a particular aircraft. The method allows us to evaluate the influence of the wind gusts on the μg quality obtained with the aircraft CAP10B, and propose recommendations for the crew operating the aircraft. A combination of two different physical phenomena simulation systems are used: a Computational Fluid Dinamics (CFD) "Solidworks Flow Simulation" and a Multibody Dynamics Simulation, (MDS) "Solidworks Motion".

Starting from a 3D part of a specific aircraft surface, CFD is used to simulate and classify forces exerted by winds on the aircraft, with different incidence angles.

This procedure enables us to evaluate the incidence of a range of winds on the μ g quality, as well as to evaluate potential corrective actions performed by the pilot. Results from the simulator are discussed and compared with test flight results performed at the UPC BarcelonaTech platform, operated at Sabadell Airport (Barcelona, Spain). This research may have a significant impact on the micro-gravity quality achieved withsingle-engine aerobatic parabolic flights , and can also provide meaningful information for other aircrafts with a wider wingspan.

In conclusion, the new specific simulation tools that have been developed have proven to be an important tool for optimizing the performance of parabolic flights that are more sensitive to wind gusts. This technique can also be applied in conventional flights to evaluate the design of future aircrafts, for example by measuring the impact of wind gusts on passengers and other charges.