Acceleration inside an aircraft in parabolic flight

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Abstract

This paper aims to present and analyse the acceleration data inside an aircraft during a parabolic flight. The data used were obtained during the flight from the automatic recordings of the aircraft and from a portable data logger with a built-in 3-axis accelerometer connected to a graphic calculator. There is good agreement between the accelerations obtained by the two methods. Based on the altitude data collected during each parabolic manoeuvre performed by the aircraft, it was possible to estimate the gravity of Mars and the Moon, as well as the values of the acceleration of gravity during the moments of microgravity. The analysis presented can also help to improve the understanding of the concepts of inertial forces and the equivalence between gravity and acceleration.

Keywords: parabolic flights, *g*-force, microgravity, experimental activity

Introduction

Parabolic flights are used to conduct scientific experiments and test space equipment technology in microgravity conditions. These type of flights are the only manned research platform capable of inducing weightlessness without leaving the Earth's atmosphere. For example, Plester [1] emphasises the importance of careful aircraft selection for scientific purposes while pointing out the unique and versatile nature of parabolic flights for gravity-related research. The importance and increasing demand for this type of flights is clearly illustrated by the work of Ulltrich *et al*. [2], who present a description of the parabolic flight programme in Switzerland, based on the Airbus A310 ZERO-G, and identifies some of the experimentscarried out aboard the Airbus A310 ZERO-G during the Swiss parabolic flight campaigns. Carr *et al*. [3] highlight the importance of using parabolic flights to simulate the space environment and understanding its limitations. The same authors also highlight the commercial hardware solution for data acquisition, the availability of raw and calibrated data, and the methodology for characterizing *g* levels and corresponding durations achieved for 20 parabolas.

In an educational context, there are a number of programmes where parabolic flights have been used for the study of the effects of microgravity. For example, Pletser et al. [4] present a distinctive approach involving secondary school teachers who facilitated simple experiments to teach students about microgravity. Callens *et al*. [5] and Perez-Poch *et al*. [6] both positively emphasise the use of this type of flight for student experiments purposes, [5] focusing especially on scientific experiments and [6] on biomedical research. Perez-Poch and González [7] present an innovative method for performing parabolic flights with a single-engine aerobatic aircraft, therefore enabling a range of research and educational experiments. Pletser [8] provides an historical perspective on

