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Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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# MICROGRAVITY VALIDATION FOR XENON PROPELLANT DISTRIBUTIONS

**Abstract**

In the current Electric Propulsion era, one of the most relevant propellants is xenon, which is generally stored in supercritical stage. Because of the increase in time of spacecraft lifetime, the amount of propellant stored on-board has been quadrupled in the recent years, and the need of more accurate gauging methods for measuring propellant usage along the missions has become more critical too. Thermal gradients affect the densities distribution of the stored propellants and this turns out to be critical in orbit because of the absence of convection in low-gravity environments.

Recently we have proposed a new gauging method (Soria-Salinas, et al., 2017) that relies on the analysis of measurements from existing and operating technology (in TRL 9), i.e., this method does not imply the development of any new technology. This new method, the improved PVT method, improves by a factor 8 the accuracy of the standard PVT retrievals (Soria-Salinas, et al., 2017). A laboratory experimental validation has shown that, for $CO_2$ at a pressure of about 70 bar, just below the critical pressure, the error of the mass retrieval using this new gauging method is only 0.1% of the initial mass at launch. However, for its complete validation, a microgravity study should be performed in order to quantify the effect of thermal gradients under the absence of convection in a low-g environment. The present work describes:

- the design of a proposed in-flight microgravity validation experiment for a parabolic flight campaign such as those provided by the Airbus A-310 zero-G platform for microgravity research; and
- comparative studies of the expected xenon density distribution of real size tanks under operation in orbit, through computational fluid dynamics (CFD) and heat transfer calculations.