FASTER: A platform to decrease the costs of testing space technology in parabolic flights

Minka Suomela, Arnau Busom Vidal, Juan Gracia García-Lisbona, Rebecka Kjellman, Bruno Comesaña Cuervo, Estelle Crouzet

Luleå University of Technology

Parabolic flights are often used to test technology for space applications before being sent to space. In these types of flights, microgravity conditions of 0.1 to 0.001 g are achieved. The conditions are easily reproducible and the experimenters can easily tweak the experiment between parabolas.

The major problem with parabolic flights is that, in order to achieve adequate microgravity conditions, the flights have to be performed in large aircraft to reduce the perturbations caused by the engines. This makes flight campaigns very expensive and their scheduling inflexible, which in turn causes the testing and iteration process to be difficult and slow.

Parabolic flights can however also be done with smaller aircraft such as gliders or single-engine planes. Flights in these types of planes can be done at a much lower cost, more often, and at almost any location. The major drawback is that the quality of the microgravity achieved is much lower than with large aircraft. The perturbations caused by the engine in the small planes decrease the quality and stability of the microgravity achieved. In addition, the microgravity time is shorter, generally 5 to 10 seconds per parabola compared to the 20 to 30 seconds with large aircraft.

FASTER is a platform that provides attitude stabilisation and control during parabolic flights in small, single engine planes to improve the stability of the microgravity conditions. The experiment is placed inside the cubicle platform and three reaction wheels make sure that the external vibrations and forces do not disturb the experiment measurements during the flight.

We aim to make the flight campaigns in small planes give similar results as those in larger planes at a much lower cost. In addition, the campaigns can be carried out more frequently, scheduled more flexibly, and have less restrictions in location. All these factors will help reducing the cost and the time of prototyping and testing space technology. This will also make the flights accessible to parties that currently cannot afford them. Many student projects, universities and private companies would benefit from tests in microgravity conditions but due to the high cost cannot utilise them at all or can only do a very limited number of tests.

FASTER will do the first flight campaign in 2021, at the Kiruna airport in northern Sweden, to demonstrate how the technology works and to quantify the improvement in microgravity conditions. After that, the aim of the project is to make an adaptable platform that can accommodate many different types of experiments. In the future, the project can also be iterated to adjust it for different microgravity platforms, such as drop towers.

We hope that by developing this platform, we can contribute to the development of space technology and introduce parabolic flights to parties that have not previously had access to them. Kiruna is already the most important space industry location in northern Europe, and more and more space companies are moving there in the upcoming years. This means there will be demand for performing affordable parabolic flight campaigns, and FASTER could be further developed into a startup business to respond to that demand.