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

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PACMAN EXPERIMENT: ON-GROUND TEST RESULTS AS BASELINE FOR PARABOLIC FLIGHT DEMONSTRATION

Abstract

In the field of spacecraft autonomous rendezvous and docking, no solution is currently available for small satellites and only few orbital demonstrations have been performed. Researches are therefore focusing on developing different solutions for proximity operations, addressing relevant issues such as fuel consumption and close range navigation constraints on satellites mass budget and complexity. At today, relative magnetic navigation appears to be a promising solution as the chaser and target attitude and position can be controlled by means of relative magnetic interactions.

In this framework, PACMAN Experiment is a technology demonstrator designed to exploit the advantages of magnetic interactions for relative position and attitude control during rendezvous and proximity operations. The experiment is supported by the University of Padova and is selected to fly during the 68th ESA Parabolic Flight Campaign, planned for Fall 2017, within the ESA Education *Fly Your Thesis!* 2017 Programme. The main goal of the project is to develop and validate in low-gravity conditions an integrated system for proximity navigation and soft docking based on magnetic interactions, suitable for small-scale spacecraft. This will be accomplished by launching a miniature spacecraft mock-up towards a free-floating target that generates a static magnetic field; a set of actively-controlled magnetic coils on-board the spacecraft mock-up, assisted by dedicated localization sensors, will be used to control its attitude and position relative to the target. Results from the experiment will allow to study the behaviour of a miniature spacecraft subjected to controlled magnetic interactions and to validate the theoretical/numerical models that describe such interactions.

In this work a complete and detailed description of PACMAN experiment and its operations is presented, as well as the outcomes obtained from integration and operational tests on ground. The experiment will be tested on a 2D low-friction table and the preliminary results regarding the system dynamics will be analysed. The comparison with the expected final outcomes will be done after the parabolic flight demonstration.