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FLEXIBLE ELECTROMAGNETIC LEASH DOCKING SYSTEM (FELDS) EXPERIMENT FROM DESIGN TO MICROGRAVITY TESTING

Abstract

Flexible Electromagnetic Leash Docking system (FELDs) is a technology demonstrator, designed and realized by graduate students, whose main objective is to test an electromagnetic soft docking technology that guarantees a mechanical connection between two spacecraft through the use of a flexible cable. Soft docking is performed by launching a ferromagnetic probe towards the target vehicle, which attracts it with a static magnetic field. Since the connection between the probe and the launching spacecraft is flexible, the system is self-adjusting, with no need for precise positioning and attitude control; this represents a significant advantage over the existing mechanical docking systems, which may have strict alignment requirements and hence significant fuel consumption during proximity maneuvers. The FELDs experiment consists of a prototype of the proposed docking system, which comprises two main subsystems, the launcher (GUN) and the receiving interface (SEC), housing an electromagnet, plus sensing instruments to evaluate the probe trajectory, the electromagnetic guiding effect and the loads transmitted to the

target during docking. The experiment was tested in microgravity at the ZARM Drop Tower in Bremen in the framework of ESA Drop Your Thesis! program. Five drops were performed, with different system parameters to measure the probe dynamics evaluating the effects of magnetic field and tether friction on the GUN, to verify the effectiveness of the proposed docking solution. The first three drops were performed with perfect alignment between GUN and SEC, and the docking attempts were successful. The last two drops were performed with a significant misalignment; in these cases, the probe did not reach the target due to snags in the tether release system. This paper describes the FELDs experiment design and development and presents the results from the microgravity test campaign.