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Author: Mr. Julien Peyrard
GMV Aerospace & Defence SAU, Spain

Ms. Mariella Graziano
GMV Aerospace & Defence SAU, Spain
Mr. Luigi Strippoli
GMV Aerospace & Defence SAU, Spain
Dr. Olson John
Sierra Space, United States
Ms. Kathy Benzin
Sierra Space, United States

ADR GNC CONCEPT FOR THE DREAM CHASER: THE ENVISAT DE-ORBITING CASE

Abstract

AA feasibility study has been conducted to assess the possibility of using DreamChaser for an Active Debris Removal (ADR) mission. To assess the mission feasibility, ESA's ENVISAT spacecraft was taken as a reference target. ENVISAT's large size and geometrical and mechanical configuration makes this mission particularly complex. Further contributing to this complexity is the lack of data about the current rotational state of ENVISAT. DreamChaser is a unique spacecraft for pursuing an ADR mission. While its primary mission is not ADR, DreamChaser provides a platform with significant on-orbit capability with multiple launcher options. Due to this maneuvering potential, DreamChaser may be able to target multiple objects, depending on the de-orbit method. Its modular outfitting approach enables mission tailoring with minimal redesign required. The use of the robotic arm is preferred as it is more suitable to be reused on successive ADR missions. Finally, by performing an ADR mission with DreamChaser, the development costs for an ADR mission can be spread over multiple missions, targeting a variety of LEO assets. The reusability consideration has the potential to reduce mission costs for all. This paper shows a GNC concept for the rendezvous, capture, and deorbit of ENVISAT using DreamChaser. The assessment is built upon previous analysis conducted during the DreamChaser for European Utilization (DC4EU) program, which culminated in a mission concept for an ENVISAT ADR mission. As with the DC4EU program, this study confirmed the feasibility of using DreamChaser to deorbit ENVISAT. For the assessment reviewed in this paper, DreamChaser is launched by Ariane-V to a 445km orbit. DreamChaser increases its orbital altitude to match ENVISAT's orbit around 760km. Dream Chaser then performs a RVD with the satellite, and inspects its attitude. With sufficient knowledge of attitude and relative position, Dream Chaser continues its approach along the most favorable rotation axis of ENVISAT, until the robotic arm can be deployed to capture ENVISAT. After detumbling, ENVISAT is set on a direct reentry trajectory and DreamChaser separates to return safely to Earth. The mission duration, approximatively one week, the propulsive capabilities, and the impulse budget estimation are shown to be within the capabilities of DreamChaser. The RVD phase has also been simulated with many realistic elements, such as sensors and actuators models, orbit and attitude perturbations, GNC in the loop, and the preliminary results have confirmed the feasibility of the planned mission scenario. Removing ENVISAT with DreamChaser is preliminary shown to be feasible.