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AN INNOVATIVE SPACE TETHER DEPLOYER WITH RETRIEVAL CAPABILITY: DESIGN AND MICROGRAVITY TEST OF STAR EXPERIMENT

Abstract

The Space Tether Automatic Retrieval Experiment deals with a new concept of space tether deployer with retrieval capability designed, built and tested in microgravity by a team of five engineering students from the University of Padova. The experiment has been developed in the framework of the *Drop Your Thesis!* 2016 educational programme, held by the European Space Agency Education Office. The experiment was first tested in laboratory on a low friction rail and eventually in microgravity conditions at the ZARM Drop Tower facility in Bremen where it was subjected to five launches. In these tests the functioning of the proposed concept was successfully demonstrated. The aim of the project was to adapt the well-established fixed-spool fishing reel technology in order to create an autonomous, simple, and reliable system suitable to be employed in space. The deployer functioning is inspired to passive deployers already developed for past space missions, such as SEDS-I and SEDS-II, integrated with a reeling device to enable the tether retrieval capability. Four main subsystems are identified in the experimental setup: a spring-based launch device to start the deployment phase; a length and length rate measurement

system to measure the amount of deployed tether by means of optical sensors; a dedicated active braking mechanism to control the tether deployment velocity by means of a feedback control on length-vs.-time reference trajectory; and a retrieval system to eventually rewind the tether around the spool and reset the system to the initial state. The importance of developing such a technology is remarkable. At present, both Space Agencies and industries are investigating the use of space tethers for various applications, such as new docking system concepts for On-Orbit Servicing, electrodynamic drag devices, tethered space tug, for which a reliable tether deployer is a key subsystem. So far, such a device does not exist. This paper presents the development of the Space Tether Automatic Retrieval Experiment and discusses the results obtained during the microgravity tests campaign.