

15th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations (IP)

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EXPERIMENTAL ESTIMATION OF THE KINEMATICS OF A SPACE DEBRIS MOCK-UP VIA
FAULT-TOLERANT METHODS**Abstract**

Capturing and de-orbiting space debris for removal purpose is a maneuver that requires the assessment of the target kinematics and inertial properties. Typically, the equipment of the chaser spacecraft comprises a set of vision sensors for tracking the natural features of the target. A plenty of methods, which are often based on Kalman filtering, are available for the estimation of the target's dynamic state from feature positions; however, to guarantee the filter convergence, it is assumed that the tracking of a few specific features is never interrupted. Guaranteeing this last assumption is tough due to the relative tumbling between the satellites and the harsh lighting conditions of the environment.

For this reason, the same authors of this paper developed in the recent past a set of fault-tolerant methods for estimating the whole kinematic state of the targets. The main aspect of novelty consisted of substituting into the state the attitude with finite rotations to eliminate the direct dependence between the state and the tracked features. Moreover, compressive sampling techniques were considered to recover potential missing samples within the measurements.

However, the above methods have lacked until now of a final validation through an experimental campaign. In this paper, the two approaches for localizing the center of mass and estimating the angular rate of space debris are resumed, while the results of laboratory tests are also illustrated.

The exploited laboratory is equipped with a monocular IR camera, a stereo-rig system, and the mock-up of the upper stage H10 of the Ariane 4. The last element is mounted on a two degrees-of-freedom mechanism that allows the mock-up rotation. The test results of the developed methods are shown separately for the two cases for which the measurements come from the stereo cameras and the microbolometer respectively