

SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Technologies (5)

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IP-BASED POSE ESTIMATION FOR SPACE DEBRIS REMOVAL: IMPLEMENTATION AND RESULTS

Abstract

In the context of autonomous rendezvous and space debris removal (non-cooperative targets), the estimation of the relative pose between the target and chaser becomes a critical task. Based on an image or sequence of images, advanced image processing and tracking algorithms can provide accurate capability to obtain full 6DOF relative pose information during the proximity operations.

Our proposed image processing technique takes advantage of the knowledge of the model to be studied by matching and continuously tracking a 3D model of the target with respect to the chaser camera. This model is made up of lines, which provides a good invariance to pose and illumination changes, as well as robustness to noise or blurring. The goal is to find the best alignment between edges of the 3D model, once projected in the image, and the edges extracted from the image. Additionally, by incorporating other visual features to the model, such as textures or surface appearance, a more robust estimation can be obtained by also matching those with other visual features in the image.

Furthermore, based on the assumption that the camera pose and the camera displacement between successive frames can be considered random variables, statistical filtering has been integrated to improve the results of the tracking stage.

The algorithms have been already tested within real images coming from the PRISMA mission, where its two satellites, MANGO and TANGO, are a clear analogy between the target and chaser in a rendezvous or debris removal scenario. The obtained results have been used as the basis for the definition of the IP architecture for the COBRA-IRIDES experiment.

COBRA-IRIDES experiment has been proposed as an extension of the IRIDES experiment currently on going between the MANGO spacecraft and the CNES spacecraft. The goal of the experiment will be to induce a torque on Picard spacecraft by means of plume impingement from MANGO. Image processing will be the basis for the definition of the trajectories, pre experiment status and experiment efficiency.

This paper will present the results obtained during the IP algorithms testing with real PRISMA images as well as the IP development for the COBRA-IRIDES experiment and the current status of the experiment itself.