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AUTOMATIC IMAGE ANALYSIS FOR SPACE DEBRIS MEASUREMENT

Abstract

The space debris represent a danger for operative satellites and human missions. A large amount of debris is located in Low Earth Orbit and in Geostationary Orbit. The worldwide surveillance networks, mainly NORAD and RosKosmos, started monitoring debris since a long a time and testify the continuous growing tendency in the number of objects.

Since a few years Aerospace Systems Laboratory of University of Rome started optical space debris observation campaigns by dedicated observatories. The observation activity includes not only planning and taking images of selected portions of the sky, but also analysis of raw picture data to extract the relevant astrometry and/or light-curve information. During the optical campaigns a large amount of images is typically taken and one of the most time consuming activities in optical space objects observation is the data analysis, requiring dedicated and specialized man power. This is the reason why the development of automatic images processing algorithms and procedures to identify the presence of debris, to identify its nature and perform the astrometry computations would highly desirable.

The paper deals with the development of automatic procedures and algorithms to detect objects with relative motion with respect to stars in both sidereal tracking mode or terrestrial fixed one. In particular, the developed software is able to recognize the debris inside the picture, solve the star field within the picture and use both these information to achieve the angular measurements of the debris. Relevant efforts have been put in the software development, such that human interaction is not required.

The astrometry computations algorithm works without predefined information about the image. In particular the knowledge of the pointing angles are not required, even if starting from a condition close to the actual one improved the convergence speed, and the picture can be solved starting from a "lost in space" condition. The main algorithm drivers and the tradeoffs in the software implementation are depicted and preliminary results and software performance in actual observation campaigns are discussed in the paper.