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Title

Exploring large astronomical data archives for the characterization of space debris

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Abstract

With the present work, we aim to gain a deeper understanding of the current state of the orbital debris population. The objective of this project is to develop new and innovative methods for efficiently extracting observations of satellites, debris, and Solar System objects from large astronomical data archives. The data obtained from these archives will provide valuable insights into the size-frequency distribution of debris particles and enable the development of strategies to maintain the usability of Earth's orbit for future satellite missions.

To achieve this objective, we are currently exploring different techniques for detecting the characteristic streaks caused by these objects on images, including a range of cutting-edge machine-learning approaches. The methods developed will not only be useful for detecting space debris but will also be applied to the detection of near-Earth objects, which leave similar features on images.

Once the image-processing pipeline is in place, we plan to process the astronomical data archive from the ESO VLT Survey Telescope, which has collected hundreds of thousands of images over 11 years of observations. After successfully processing the ESO data, we plan to apply our pipeline to archives from other observatories that are publicly available, such as DECam/Blanco and ZTF.

The photometric analysis that we perform on the extracted data will allow us to determine the attitude, size, and composition of the observed objects. This information is critical for the selection of targets for active space debris removal missions, such as ClearSpace-1, a spin-off of the EPFL Space Center (eSpace).

We believe that the results of this project will provide a more comprehensive picture of the evolution and current state of the space debris population. Furthermore, the data and insights obtained from this research will play a critical role in the development of strategies to maintain the usability of Earth's orbit for future satellite missions and facilitate the selection of targets for active space-debris-removal missions.