EPSC Abstracts
Vol. 13, EPSC-DPS2019-1498-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Identification of asteroid streaks in simulated ESA Euclid images using StreakDet software

Mikko Pöntinen (1) and Mikael Granvik (1,2)
(1) Department of Physics, P.O. Box 64, 00014 University of Helsinki, Finland (mikko.pontinen@helsinki.fi)
(2) Division of Space Technology, Luleå University of Technology, Box 848, 98128 Kiruna, Sweden

Abstract

As a sideproduct of its cosmological main mission, ESA Euclid will observe up to 150,000 asteroids. The asteroids will appear as streaks in the images, and automated methods have to be used for finding them.

We tested StreakDet, a software developed to detect space debris, for finding the asteroids in simulated Euclid images. The testing scheme consisted of optimizing the parameters of StreakDet, and developing a separate test and analysis software.

For asteroids brighter than 23 magnitudes, StreakDet finds 99.1% of the objects. The number of false positive detections can be reduced by linking consecutive streaks from all four dithers/exposures.

1. Introduction

Euclid is mainly a cosmological mission, focused on measuring the red shifts of galaxies, in order to shed light on the nature of dark energy. It will observe a large portion of the sky, and therefore, as a side effect, up 150,000 Solar System objects (SSO), mostly asteroids, will appear in the data [1].

As the telescope of Euclid is stabilized relative to the galaxies, the asteroids will move relative to the background sky, and show up as streaks of various lengths in the images. In addition to visual imager data, Euclid will also obtain slitless spectra of the asteroids, producing valuable data, considering the current scarcity of asteroid spectra.

2. StreakDet

The method used in this work to tackle the problem of finding the asteroids is a software called StreakDet, which was developed to detect streaks caused by space debris in astronomical images [2]. We tested StreakDet systematically to diagnose its ability to find asteroids in simulated Euclid images. We did this by optimizing the parameters of StreakDet in a configuration file as well as source code, and by developing a separate test and analysis software to give statistics on the results, and link consecutive streaks from different exposures in order to reduce the number of false positive detections.

3. Results and Conclusions

From the simulated Euclid data, StreakDet finds 99.1% of asteroids brighter than 23 magnitudes, and 96.8% of the individual streaks caused by these asteroids. After magnitude 23 the finding percentage starts to clearly decrease, and reaches zero at magnitude 25 (Figure 1).

StreakDet works better for long streaks, and the detection percentage decreases for streaks shorter than approximately 20 pixels (Figure 2).

The high detection percentage comes with a cost of initially finding a high number of false positives. The number of false positives can be radically reduced by linking consecutive streaks from all four dithers/exposures with the analysis software.

There is room for improvement for finding streaks that are shorter than 20 pixels or fainter than 23 magnitudes.

Acknowledgements

We thank Luca Conversi and Achille Nucita for providing the simulated ESA Euclid images.

References

[1] Benoit, C.: Solar System Science with ESA Euclid, Astronomy and Astrophysics, Vol. 609, pp. A113, 2018.

[2] Virtanen, J. et al.: Streak Detection and Analysis Pipeline for Space-debris Optical Images, Advances in Space Research, Vol. 57, Issue 8, pp. 1607-1623, 2016.

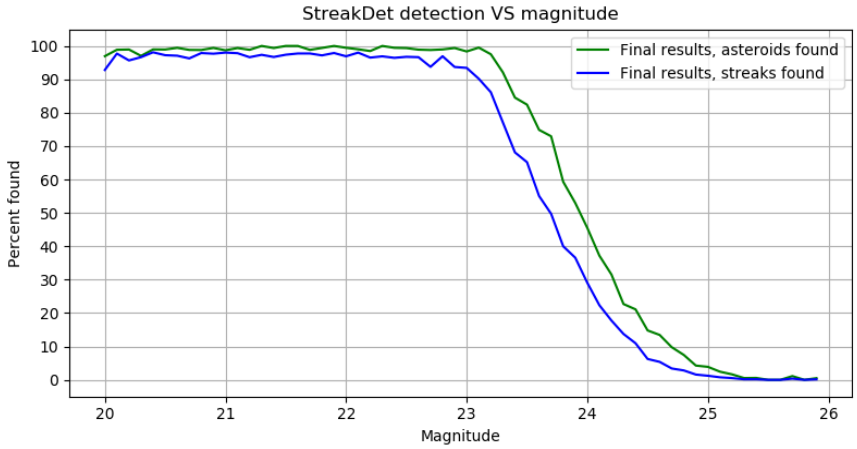

Figure 1: StreakDet detection percentage as a function of magnitude. The blue line shows the detection percentage of separate streaks, while the green line shows the detection percentage of asteroids. In other words, for an asteroid to be found, it needs to be detected in at least one of the four dithers.

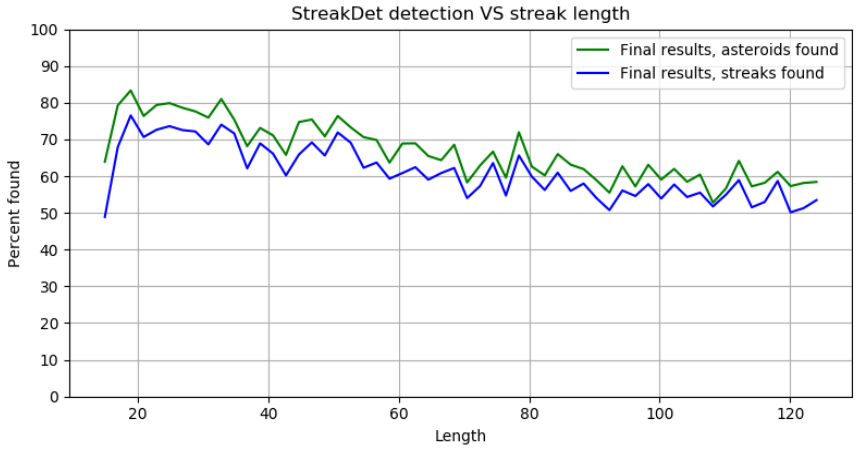

Figure 2: StreakDet detection percentage as a function of streak length. The blue line shows the detection percentage of separate streaks, while the green line shows the detection percentage of asteroids, similarly to Figure 1.