

A Cheaper Method of Space Traffic Management: Tracking Satellites with a DSLR



References

Background Image: Own observation
Data used throughout from space-track.org (US Space Force)

*Background:
The International Space Station passing
overhead during a couple of minutes*

Introduction

Using a digital camera on the roof of the observatory, images are captured of the sky nightly to catch satellites which pass overhead. Using these images, software was developed to use catalogues of artificial objects which orbit the Earth to determine which satellites can be seen in each image. This has proven that it is possible to identify and track Earth's artificial satellites without using large and expensive radar arrays.

Methods

The *skyfield* Python package was used to calculate the positions of all known satellites using catalogues maintained by the US Space Force at the time interval of any given photo and calculate a so-called 'likelihood' for each one by comparing geometries of the observed and predicted trails by their lengths, angles and separation.

An example image in Figure 1 shows the path traced by an object in the sky as observed by the camera. Figure 2 then overlays where the predicted location of the all known satellites are in this image (green dashed line). This "SL-14 R/B" rocket body has a 'likelihood' value of 86.5%, indicating a very good match which is confirmed by a visual comparison of the observed trail and the overlaid predicted position at the same time. Such successful identifications are saved and slowly allow a collection of observations to be built up.

Results Overall, the project was a success and satellites are able to be identified approximately 85% of the time which could help track space debris in a cheaper manner than is currently used in a world where space is becoming increasingly more polluted. This could be achieved by placing multiple cameras across the globe to catch more satellites and enable the calculation of more accurate orbits which could aid in space traffic management efforts.

Surprisingly, the majority of the objects seen in the night sky are expended rocket bodies as opposed to active satellites, with the earliest rocket body still in orbit being from the 1950's.

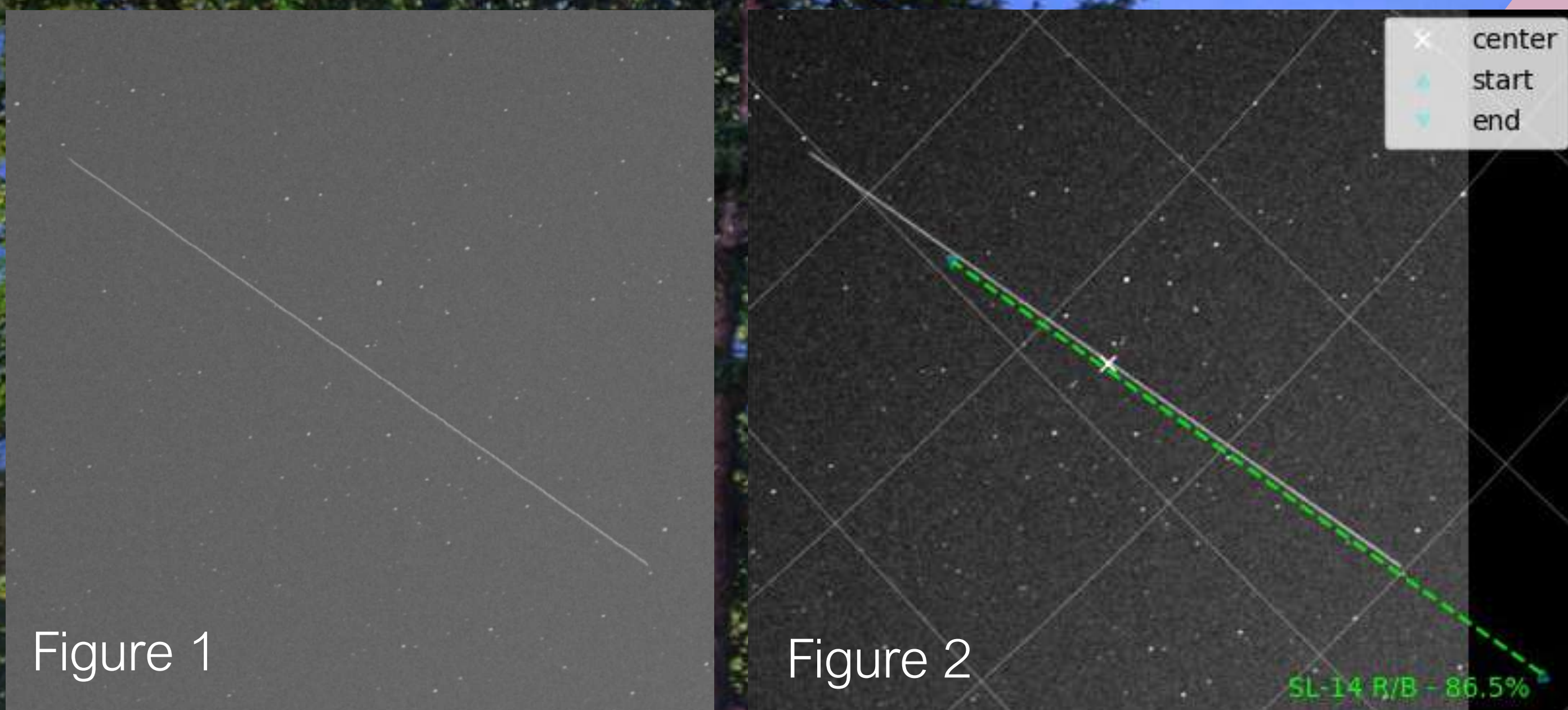


Figure 1

Figure 2