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Automatic Detection of MEO Satellite Streaks from Single Long Exposure Astronomic Images

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Abstract

Nowadays, there is an increased interest in achieving an accurate surveillance of the sky, since the number of objects in Earth's orbit (active satellites and debris) is continuously increasing. The satellites constantly need to be supervised in order to notice their deviations from their trajectories and update their coordinates. This paper presents a new method for satellite detection in 2D astronomic images acquired with a cheap, easy to set up optical surveillance system. The proposed method use the Radon Transform in order to identify satellite strikes in images followed by a set of decision rules to decide whether the streak is a satellite or not. The method was tested on multiple sequences of astronomic images, and was found to have a very high detection rate, along with a very low false positive rate.



Image acquisition

The optical system consists of two optical sensors placed at a distance of 37 km from each other.

Each sensor contains:

- Newtonian 150mm, f/5 telescopes (D=150mm, F=750mm),
- DSLR Canon EOS 50D (2352 x 1568 pixels) camera,

(9.4 μm x 9.4 μm) pixel size.Equatorial tracking mount,

- type Celestron CG5.
- GPS based trigger for acquisition synchronization.

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Results

Tests were performed on a dataset of 294 images (image size = 2357×1568 pixels). The followed objects in these sequences are four MEO satellites: two GLONASS (733, 738) and two GPS (PRN10, PRN08). Comparative tests were performed against the method proposed in (Oniga, 2011):



Satellite	(Oniga, 2011)	Proposed method
733	100%	100%
738	100%	100%
PRN10	69%	100%
PRN08	59%	100%