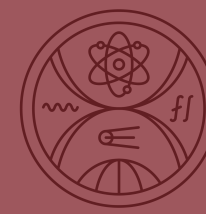


Advanced algorithms for segmentation of space debris astronomical images



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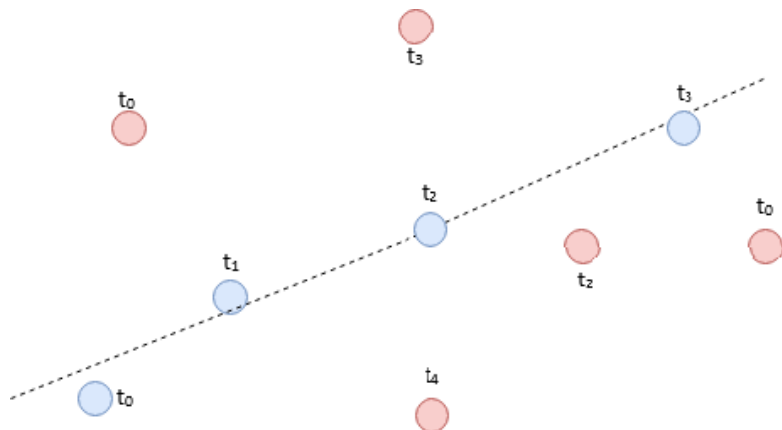
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Motivation

In recent decades, the population of space debris has risen rapidly. In the future, if we do not find a solution to this problem, Earth's orbit might become unusable for satellites. Regarding this issue, space agencies around the world are developing systems to monitor and collect space debris. We created system processing of series of images of artificial objects orbiting Earth [Silha et al., 2019]. In recent years, machine learning is the best performing method for various problems. It can also be used in prediction of positions of moving objects.

Tracklet

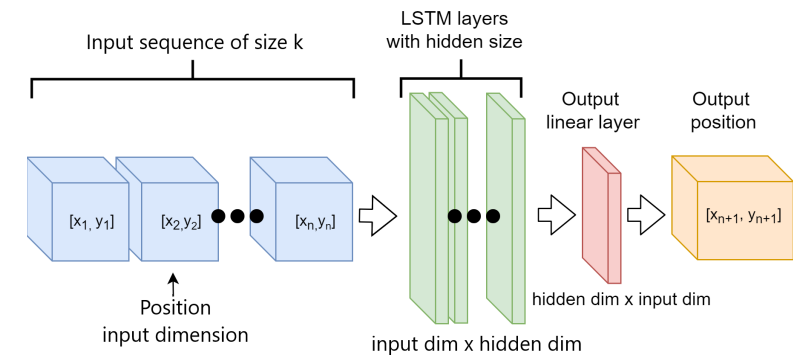
A tracklet is a data structure containing positions of an moving object in time. We can refer to tracklet as trajectory of the object. Main goal of the thesis is a system for finding moving objects and creating tracklets.



The Solution

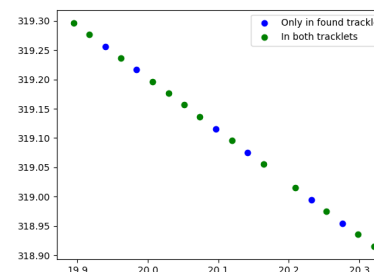
An input to the system is a sequence of lists. Each list contains positions of the moving object in corresponding image. Tracklets are then created as pairs of positions from first two lists in sequence. Recurrent neural network is used to predict next position of moving object given positions from tracklet. If there is a real object in the next list whose position is near the predicted position, then the real object's position is added to the tracklet. Updated tracklets are then feed to system until the whole input sequence is processed.

For neural network training purposes, artificial data were generated.



Results:

The new system was tested against current system and testing data containing 26 processed image series from AGO70 telescope. Each series contains positions of one of the 5 real life satellites. The new system was able to create tracklets for all test series and all tracklets contained only positions of satellites.



Tracklets created by the new system in most cases contained more positions of moving object which can help to precisely identify their orbit. Green points represents positions of an object contained in tracklet created by the new system and also in tracklet created by current system. Green points are positions present only in the tracklet created by the new system.