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The Pan-STARRS Moving Objects Processing System: Six Years of Improvements through Reality Checks

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During the last six years, the Pan-STARRS Moving Objects Processing System (MOPS) has been stable, and evolved slowly: It gets its inputs from the same Pan-STARRS subsystems and submits its outputs to the Minor Planet Center (MPC). Our objective in this paper is to present a few concrete cases demonstrating how we adapted theoretical models within a functional system.

After briefly describing the MOPS stages, we will show how by introducing two new metrics we are able to filter out 80% of the false alarms in terms of candidate tracklets. The first metric is based on the deviation of astrometric measurements relative to the best fitting great circle. The second one, essentially based on the photometry and the morphology of detections of a same tracklet, takes into account the features of the tracklet to validate its reality.

We will then show how common software engineering techniques have helped to speed up processing, allowing MOPS to submit all results within two hours from sunrise. Design patterns like decorators, facades, and flyweights are now commonly used in the MOPS implementation which has now been almost completely rewritten from Perl into Java. We will also describe how looking for ground-truth in sample data helps our effort in validating our system in terms of continuous integration.

Finally, we will show statistics about our performance. Even if near to 100,000 detections can be submitted on a good night, the MOPS should do better, especially in terms of faint objects. We will give a few ideas about how we think the MOPS could be improved.

[☆]This document is a collaborative effort. The authors names are in alphabetical order.

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