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◉ **Near-Earth Object (NEO) Discovery**

Identifying potential NEOs based on their single-tracklet motion

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The motion of an asteroid over its hour long ”tracklet” (a short sequence of observations) is often used to estimate the likelihood of it being interesting [1] – that is, not exhibiting the motion typical of main belt asteroids. This is done by computing a numerical score, $0 - 100$, which must be > 65 for the object to be considered a Near-Earth Object (NEO) candidate.

However, there are limitations to this method, and it has been shown [2] that some NEOs do not meet this minimum score when they are first visible. As well, while objects closer to the Earth are likely to have larger score, they will often exhibit curvature – non-linear motion which also causes their Great Circle Residuals (GCR) to be large. Both of these facts were indeed the case for 2020 SO = P116rK2, an object hidden in plain sight which was thought to be interesting, but was soon realised [3] to be the upper stage Centaur from the 1966 Surveyor 2 spacecraft launch.

While our daily search of linking observations in the recent Isolated Tracklet File (ITF; a rich repository of all orphan tracklets) to discover NEOs is on-going, it requires a minimum of three tracklets observed on different nights. In this current study, we instead focus on increasing the NEO discovery rate by identifying curvature within single tracklets. We have developed new tracklet linking software which does this by fitting acceleration terms with their uncertainties. While we still make use of the recent ITF, we have also begun to process ”chip” images from Pan-STARRS which are more sensitive than the ”diff” images created from an image-differencing algorithm used in the regular pipeline.

Our search for potential candidates does require immediate follow-up effort, but we have expertise from the two major sky surveys as well as the Minor Planet Center. We will present a summary of our search to date, along with a discussion of whether other surveys would benefit from adopting a similar search.

Comments:
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References

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[2] R. Weryk, R. Wainscoat, P. Vereš, NEOs in the Isolated Tracklet File, in: 7th IAA Planetary Defense Conference, p. 32.
[3] Deletion of 2020 SO, Minor Planet Electronic Circulars 2021-D62 (2021).