The Solar System Notification Alert Processing System (SNAPS)

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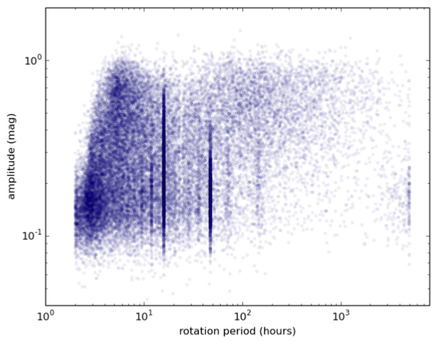
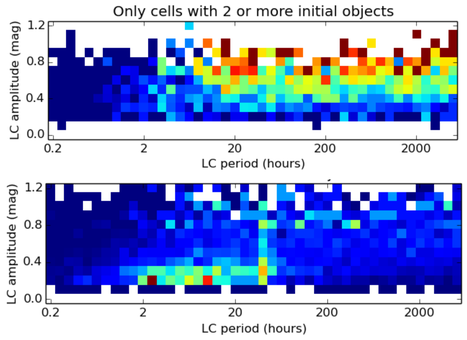
We present here a set of updates for the Solar System Notification Alert Processing System (SNAPS). SNAPS is a solar system broker that ingests alert data from all-sky surveys. At present, we ingest data from the Zwicky Transient Facility (ZTF) public survey, and we will ingest data from the forthcoming Legacy Survey of Space and Time (LSST) when it comes online. SNAPS is an official LSST downstream broker. SNAPShot1 (5.5M observations, 32K asteroids) was published in Trilling et al. (2023); our second data release SNAPShot2 (10M observations, 100K asteroids) will be published later this year.

Period and amplitude for 31,693 asteroids



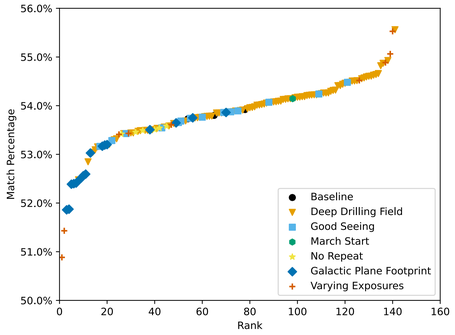
SNAPS amplitude as a function of SNAPS period. Given this kind of sparse data set, very long periods with low amplitudes would be difficult to detect, and there is a relative lack of objects in this part of the figure. The lack of objects with short periods and high amplitudes is real: objects in this area would require significant strength (see bottom left). The lack of objects in this area of parameter space indicates that indeed most asteroids have little or no strength. This figure is from Trilling et al. (2023).

Toward a debiased distribution of period and amplitude



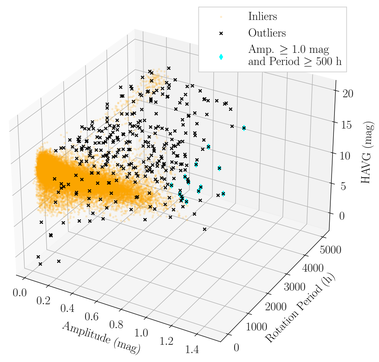
Preliminary results toward producing a debiased distribution of periods and amplitudes for main belt asteroids. *Top:* The efficiency of detecting synthetic objects with the given period and amplitude, from 0 (cold colors) to 1 (hot colors). *Bottom:* Detections in each grid cell compared to the synthetic population. Hot colors indicate false positive solutions (e.g., the alias solutions at 48 hours). Cold colors indicate missed solutions. *Both:* Combining these two results, with a much larger synthetic population, with our SNAPS periods and amplitudes (figure to the left) will allow us to derive a debiased distribution of main belt periods and amplitudes. (Trilling et al., in prep.)

Exploring different LSST cadences



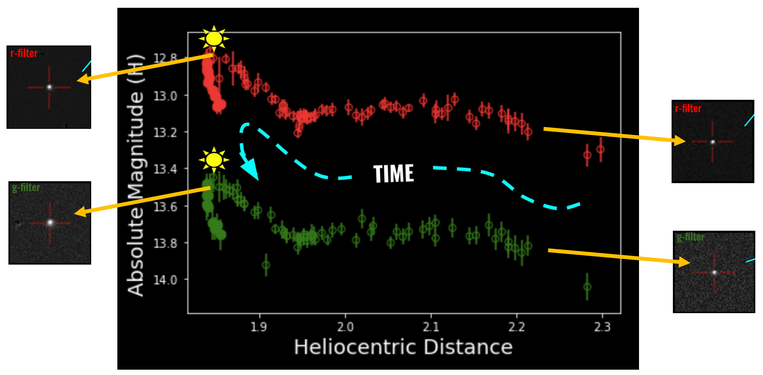
Match fraction (derived period solution compared to injected period solution) for asteroids in 150 different potential LSST cadences. In general, the Deep Drilling cadences provide the best cadence for deriving asteroid periods, as do cadences with longer exposure times. Short exposure times and cadences with non-repeated fields have the worst match rate. (From Kramer et al., submitted)

Population outliers (Rare Gems)



Outliers detected algorithmically in the light curve amplitude, rotation period, and H (absolute magnitude) feature space. Inliers are plotted as translucent orange circles and outliers (1% of all objects) are shown as black “x” markers. We highlight objects with lightcurve amplitude >1 mag and rotation period of >500 h using cyan diamond markers. There are only 14 objects with these properties and algorithm detects all of these as outliers denoted by the 14 diamond markers imposed behind the ``x" markers. (From Gowanlock et al., submitted)

Individual outliers (Rare Gems)



We detect individual outliers – objects whose properties change from one observation to the next – such as this asteroid, which exhibits activity near the Sun (increase in absolute magnitude at smallest heliocentric distance), where the postage stamps clearly show an extended source. This figure is from Clark et al. (in prep.). The talk by by M. Chernyavskaya presents other examples of outliers.

Current and upcoming work:

- Gowanlock et al. (submitted) present our approaches to population outliers (Figure in lower left)
- Clark et al. (in preparation) present our detection of individual outlier (active) asteroids
- Chernavskaya et al. (in preparation) present the distribution of strengths in SNAPS targets
- SNAPShot2 will contain at least 10M measurements of 100K asteroids with >50 observations (in preparation)

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