NUMERICAL SIMULATIONS OF EFFICIENT SEARCH STRATEGIES FOR NEAR EARTH OBJECTS SURVEYS.

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Introduction. The efficiency of surveys searching Near Earth Objects (NEOs) has been studied in the literature to estimate the time of completion of the Spaceguard goal: find 90% of all Near Earth Asteroids (NEAs) larger than 1 km [2,3]. In these studies, synthetic surveys are developed, capable of producing results in good agreement with the observed NEOs discovery statistics, and this allows to investigate with adequate confidence the future performance of the same surveys. Can a similar approach be used to actually *improve* the search strategies adopted by NEOs surveys? In [5] we presented the preliminary results of our investigation to test the possibility of an improvement of search strategies driven by the passive monitoring of a synthetic NEOs population. The complete results relative to the full numerical simulation of this search strategy will be presented at the ACM meeting, because at the time of writing this abstract most simulation are still running.

Method. A synthetic NEOs population several orders of magnitude larger than the estimated real population [1] is generated, with a distribution in orbital elements that conservatively overlaps the distribution of the estimated real NEOs population. This synthetic population is then subject to the same search by surveys as the population of real NEOs: every synthetic NEO that at a given observing time happens to be in the field-of-view (FOV) of a survey and within the detection limits is removed from the population. The surviving synthetic NEOs, once propagated to the present epoch, become potential NEOs that have never been detected. These steps are represented in Figure 1. By observing in sky regions with a high density of potential NEOs, a survey maximizes its coverage in the space of the orbital elements of the NEOs. This translates into a maximum of the likelihood to detect new real NEOs. This search strategy is *dynamic* and *passive*. *Dynamic* because it is continuously updated to include all the recent observations by all active NEOs surveys, and thus the search patterns generated are a strict function of both recent and past performance off surveys. *Passive* because all NEOs surveys contribute to it without any need to opt-in or exchange dedicated data: all required data is already sent routinely to the Minor Planet Center (MPC) by surveys, and is then made available by the MPC after processing and assimilation.

Results. Our initial results presented in [5] and relative to numerical simulations showed that by following the recipe described above, it is possible to improve the NEOs detection rate over a standard survey covering mostly sky close to the ecliptic plane and opposition. Also, the survey scheme presented here discovered more NEOs with absolute magnitude H smaller than 18, an important improvement with respect to the Spaceguard goal. The recent support of this study by NASA has allowed the acquisition of a dedicated server that is now used to coordinate distributed computing involving hundreds of volunteers from around the world [4]. This approach to the computational complexity of this search strategy is one of the key factors to make this research possible. Again, detailed results will be presented at the ACM meeting.

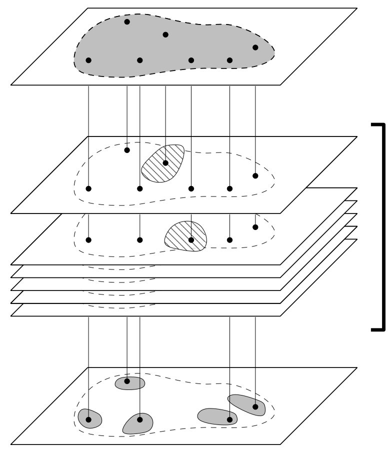

Figure 1: Diagram representing the search strategy. The initial conditions contain real NEOs (black dots) and a dense population of synthetic NEOs (gray area) in the orbital elements space. Survey observations (areas with oblique filling) then remove synthetic NEOs while detecting real ones. Today, all undetected NEOs are located in areas with high densities of potential NEOs.

Discussion. Many are the problems that such a method poses. *Scaling* - In order to adequately sample the space of the orbital elements of the NEOs, a very large number of synthetic NEOs might be necessary. *Generality* - Is there an efficient strategy that every survey should use, or this depends on the physical characteristics of each survey? A very important indirect result of this method is that the synthetic NEOs population tends to converge toward the unbiased real NEOs population.

Conclusions. The important focus switch from NEOs survey modeling to potential enhancement is now possible because supported by technologies and knowledge not available before. After fully modeling this search strategy with numerical simulations, we will proceed with its application to the real world, using all the available past detections of moving objects to prune synthetic NEOs and obtain a restricted set of potential NEOs.

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References. [1] Bottke, W. F. *et al.* (2002), Icarus 156, 399. [2] Jedicke, R. *et al.* (2003), Icarus 161, 17. [3] Moon, H. K. *et al.* (2008), Icarus 193, 53. [4] http://orbit.psi.edu. [5] Tricarico, P. (2007), LPS XXXVIII #2357.