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Near-Earth Asteroids Data mining on Astronomical Databases: EuroNEAR experience

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Abstract: In the framework of EuroNEAR network several databases around the world were datamined. The main scientific objective was the astrometry of Near-Earth Asteroids (NEAs) for both precovery and secure orbits of these objects. The article presents few aspects of data-mining and the developed procedures for accomplishing these objectives.

Introduction

EuroNEAR is a network composed by both astronomers and amateurs, dedicated to study Near Earth Asteroids (NEAs) and Potentially Hazardous Asteroids (PHAs) using existing telescopes available. Between its activities we cite here the data mining of photographic and CCD image archives, observations of infrastructure (telescopes) in use through free competition for observing time, observations using dedicated instruments of amateurs members of network, EuroNEAR militates and supports actions for dedicated,1-2m diameter facilities.

EuroNEAR's data mining activities were started in 2007 (Vaduvescu et al, 2009), by the exploitation of photographical plates database of Bucharest Observatory, in Romania. Neither Main Belt Asteroids(MBA) nor NEAs were datamined previously to this database, except for the photographical plates devoted to astrometry of MBAs, This archive of Bucharest was acquired using the Prin Mertz double refractor (F = 6m, D = 0.38m) and contains about 13,000 photographical plates imaging mostly Solar System objects (asteroids, comets, planetary satellites), during the past nine decades (Vass, 1994).

Datamining of inside EuroNEAR is a very good, successful experience of scientific activity involving both astronomers and amateurs. The organization of datamining activity together with some results obtained during several projects developed for several databases are presented.

1. Infrastructure and tools

Datamining activities are developed in a flexible schedule and based on volunteers. Once the project is defined - which database(s) and scientific objective(s) – milestones are defined in a reasonable way, depending on % of working time of participants. The main tool for preparing the schedule is the EuroNEAR webpage (http://euronear.imcce.fr) devoted to datamining and the email member list of project. The webpage (Figure 1), organized in wiki environment, contains widgets to programs developed for querrying the database for possible occurrences of NEAs which might be present on the images.

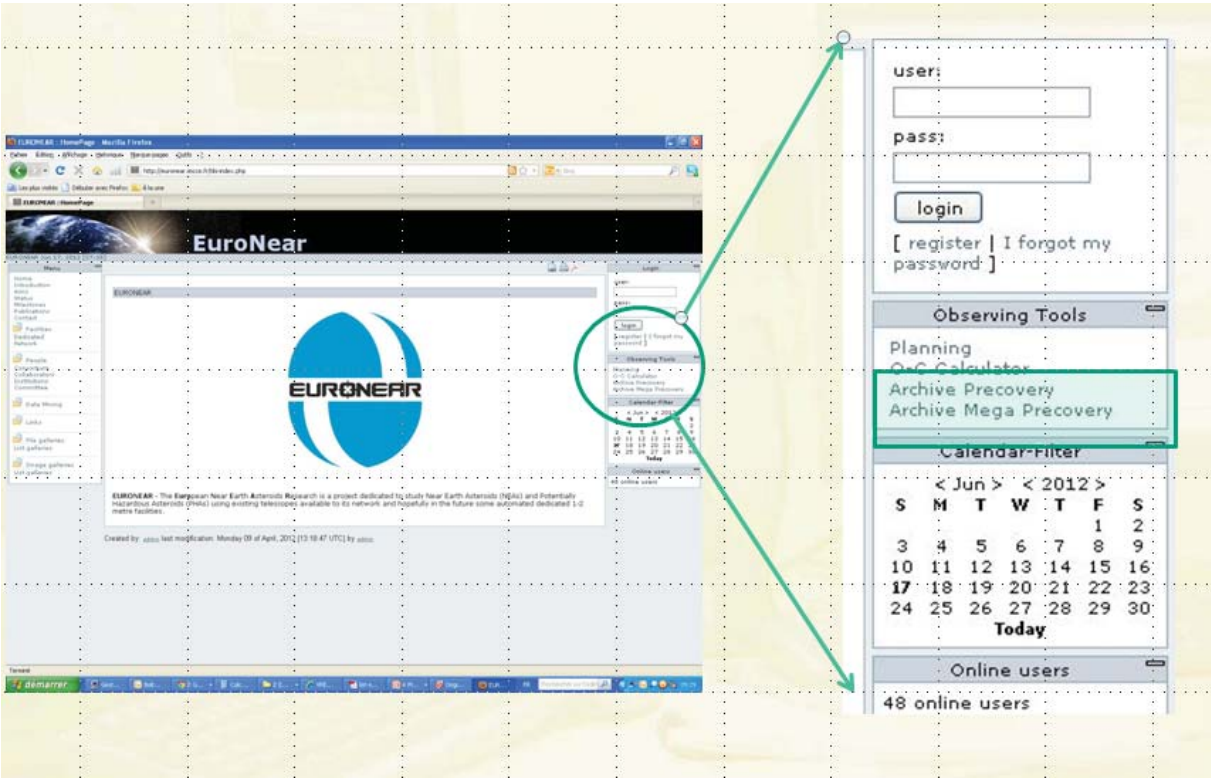

Figure 1. EuroNEAR frontpage and the zoom on datamining tools

There are currently used two programs for querrying databases: Precovery and MegaPrecovery respectively. The most recent is the MegaPrecovery tool (Vaduvescu et al, 2012). Figure 2 presents the workflow of MegaPrecovery and the detailed description of the software could be find in Vaduvescu et al, 2012.

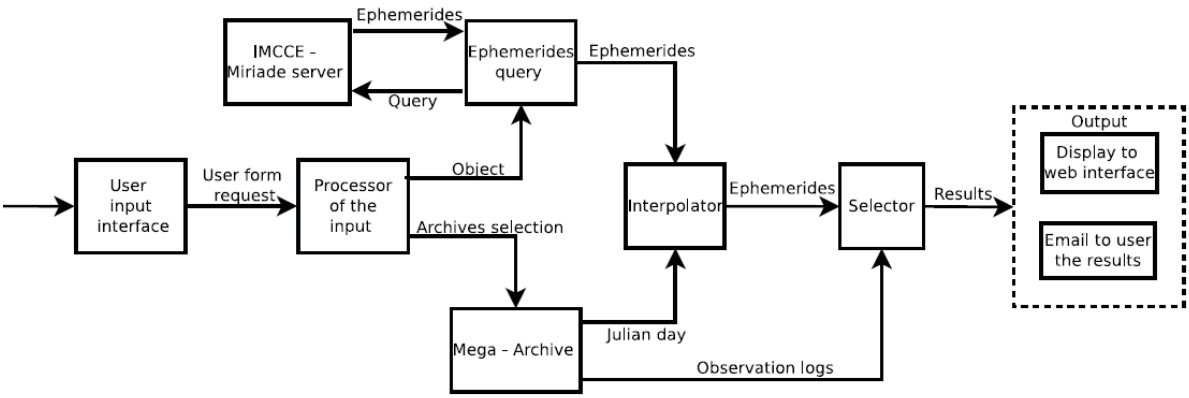

Figure 2. Workflow chart of MegaPrecovery tool

2. Results on Bucharest archive and CFHT LS

The photographical plates of Bucharest Observatory were investigated in 2006-2007 using Precovery tool for NEAs detection. Precovery, as well as MegaPrecovery, search for possible areas on the database, taking into account precompiled ephemerides service SkyBoT (http://vo.imcce.fr/webservices/skybot/). Every plate covers 2°x2°. Precovery checks the possibility of finding NEAs which could be occasionally in the field. More than 2,700 of NEAs possible occurrences of precovery and more than 180 NEAs occurrences of recovery were obtained without any filter. These relatively important numbers diminishes dramatically when a threshold in magnitude was applied. Thus, for a limiting photographic magnitude of 15, the possible occurrences of precoveries diminish below 90 while the recoveries diminish to 11 occurrences. The visual inspection of the plates gave negative results for all occurrences. This could be explained by the threshold in magnitude, too optimistic for objects having an important apparent movement.

In the frame of CFHT-LS archive EuroNEAR team investigated more than 25,000 MegaCam fields using Precovery tool. Positive occurrences for 508 fields, containing 143 NEAs were measured and the astrometry was reported to Minor Planet Center (Vaduvescu et al, 2011). The NEAs threshold in magnitude was around V~22, reasonable for the 3.6m Canada-France-Hawaii Telescope. The astrometry allows the extension of orbital arcs from few months up to 6 years.

Conclusions

Datamining of old archives might provide good information and relatively important input for the computation of long period ephemerides. EuroNEAR network experienced datamining on several important archives in order to investigate NEAs and to obtain new astrometry of these objects using high precision stellar catalogues. This experience is very successful: it opens new insights in astrometry of solar system objects.

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