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Identification of asteroids and comets: update on methods and results

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Abstract. Starting from previous experiences in this field, we present an updated version of the software developed at Sormano Astronomical Observatory as a useful and practical method to identify asteroids and comets. In addition we report some information about the database.

Key words. Asteroids: orbit determination – Comets: orbit determination – Orbit identification

1. Introduction

The identification of the orbits of asteroids and comets is a field where it is still possible to try and improve existing methods for finding asteroids and comets which have been lost due to insufficient observation coverage, or to create new, more efficient algorithms for the same purpose (Marsden 1986; Milani 1999; Milani & Valsecchi 1999; Milani et al. 2000, 2001). We are facing this problem since several years, and we have partially solved it with the implementation of software tools which were presented at the X Meeting of Planetology (Manca et al. 2011). On that occasion we were presenting a particularly effective method for managing and updating our internal database of orbital elements and observations of asteroids and comets, based on the observations published monthly by the Minor Planet Center.

These first positive results have provided the stimulus that has allowed us to make some improvements, especially in the most delicate part of the software, represented by search and selection algorithms. The programs performing these tasks are essentially two: *IdaW* for the comparison of orbital elements against an orbital catalog (or a section thereof, selected by the user, see Fig. 1), and *Mappa2W* for displaying trajectories of known objects in order to perform identifications based on their motions and position angles (see Fig. 2 and 3).

For a better understanding of the validity of the methods and tools used, we report as example the cases of asteroids *2010 TV150* (see Fig. 4) and *2010 MM32*. These objects were discovered and observed by satellite *WISE* (Wide-Field Infrared Survey Explorer), launched by NASA in order to observe and carry out a a survey in the infrared region. *WISE* satellite observed thousands of asteroids and comets, but for many of these objects the observational arc has been too short for finding a positive identification, also because sometimes the estimate of the absolute magnitude H obtained by observing in the infrared is completely wrong. For this reason it has not been possible to identify with absolute certainty these two objects using the program *IdaW* for the comparison of the orbital elements. Moreover in the case

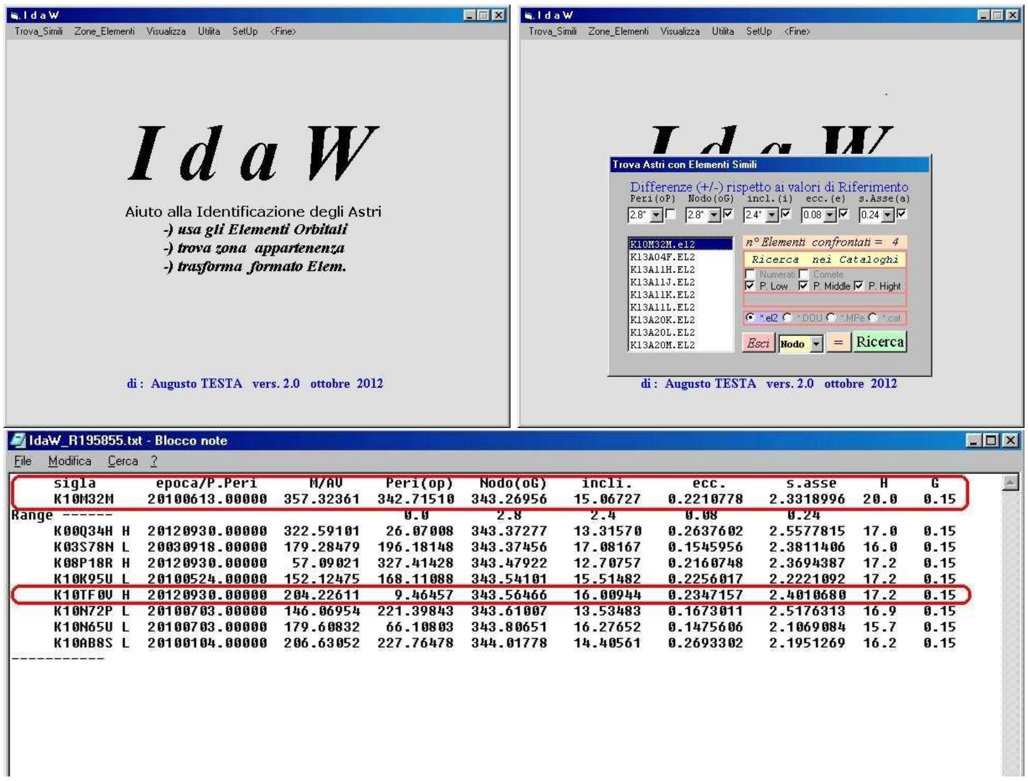


Fig. 1. Example of usage of program *IdaW*.

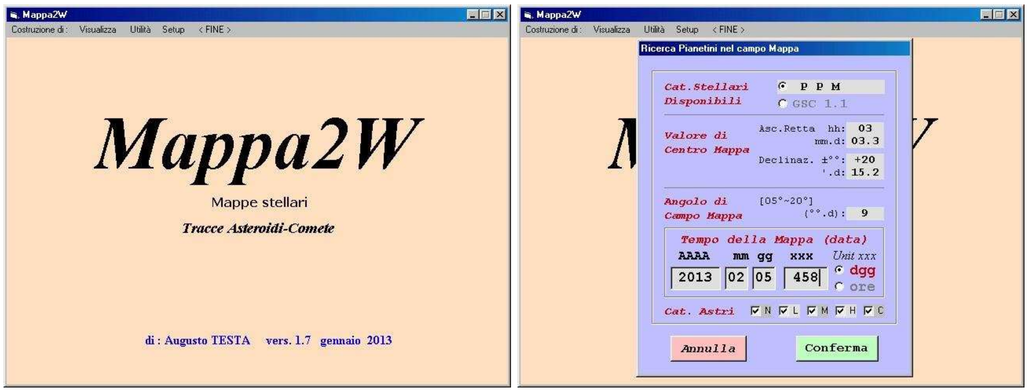


Fig. 2. Example of usage of program *Mappa2W* (input).

of *2010 MM32* (discovered by *WISE* on June 20, 2010) the short period of observation (two days) has not allowed to calculate an orbit sufficiently precise to be “linked” to other objects in the database; the identification problem has been worsened by the fact that the value of the absolute magnitude has been overestimated. In this case only a subsequent analysis, performed with program *Mappa2W*, has allowed us to find in the catalog a candidate

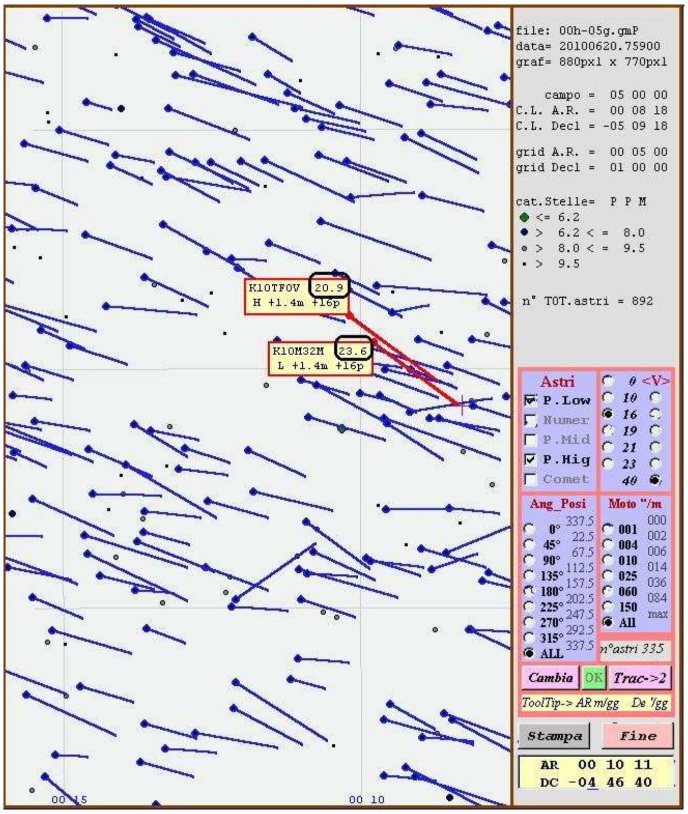
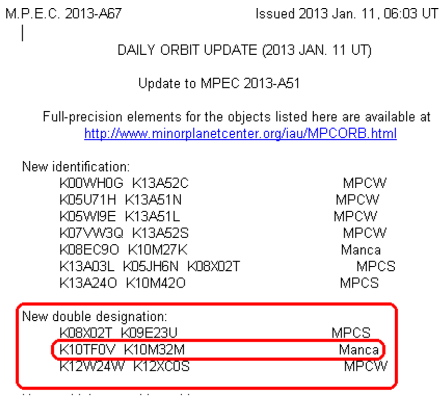


Fig. 3. Example of usage of program *Mappa2W* (output).

for the identification of the "short arc" of *2010 MM32*. In other words the software *Mappa2W*, adequately improved through the use of search filters, pointed out the similarity of the two asteroids under consideration on the basis of the plot of their motions and position angles.

In situations such as those presented in this report, it is necessary to perform the comparison starting from the object having less accurate orbital elements, or even lacking completely orbital elements, and for which only observations are available. Using program *Mappa2W* we could identify many objects discovered by *WISE* satellite (and having and observation arc of only one day) with orbits of asteroids already observed in the past, even when no identifications had been found by the automated systems in use at the Minor Planet Center.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DAILY ORBIT UPDATE (2013 JAN. 11 UT)

Update to MPEC 2013-A51

Full-precision elements for the objects listed here are available at
http://www.minorplanetcenter.org/iau/MPCORB.html

New identification:

K00WH0G K13A52C	MPCW
K05U71H K13A51N	MPCW
K05WI9E K13A51L	MPCW
K07VW3Q K13A52S	MPCW
K08EC9O K10M27K	Manca
K13A03L K05JH6N K08X02T	MPCS
K13A24O K10M42O	MPCS

New double designation:

K08X02T K09E23U	MPCS
K10TF0V K10M32M	Manca
K12W24W K12XC0S	MPCW

Fig. 4. MPC communication of the identification of *2010 TV150*.

The results obtained so far are available in the dedicated web page:

http://www.brera.mi.astro.it/sormano/identification/Identification.html and divided according to their original groups:

Comets	1
PHAs	4
NEAs	4
MBAs	140
Mars crossers	1
Pallas	1
Hungarias	5
Trojans	5

The database in use, updated to December 12, 2012, is composed of:

83,300,874	observations of numbered asteroids
8,883,036	observations of asteroids with provisional disignation
663,592	observations of comets
asteroids	
455,934	orbital elements of asteroids with provisional disignation
3,534	orbital elements of comets

This database is updated monthly on the basis of data published by the Minor Planet Center, together with the catalog of observations of single-night objects lacking orbital elements. The rate of growth in the number of observations and orbital elements, due also to an increase of discoveries and rediscoveries made by the large scale surveys, stresses the need for an improvement of the methods presented here. In addition there is a clear discrepancy in the number of observations available for the computation of the orbit of each object between numbered asteroids and asteroid with provisional designation (see Fig. 5, 6 and 7); this highlights the need for a continuous and accurate follow-up.

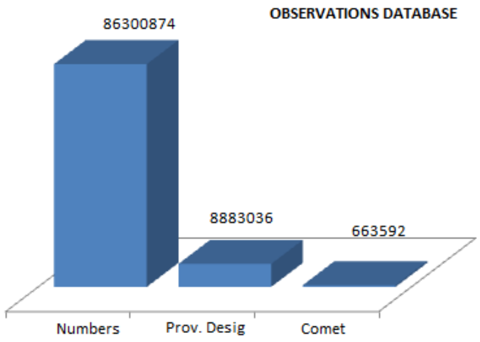

Fig. 5. Total number of astrometric observations in the database, divided between numbered asteroids, objects with provisional designation and comets.

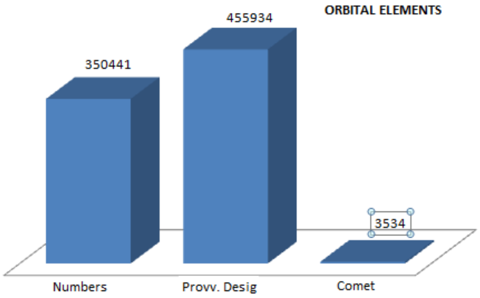

Fig. 6. Total number of orbits in the database, divided between numbered asteroids, objects with provisional designation and comets.

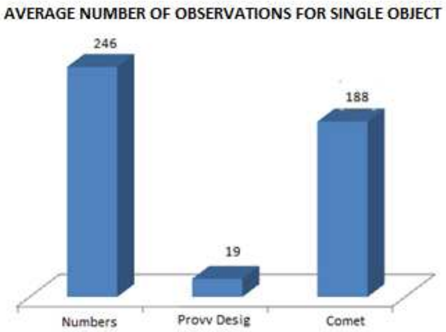

Fig. 7. Average number of observations per object, divided between numbered asteroids, objects with provisional designation and comets.

References

Manca, F., Sicoli, P., & Testa, A. 2012, Mem. SAIt Suppl., 20, 22
Milani, A. 1999, Icarus, 137, 269
Milani, A., & Valsecchi, G.B. 1999, Icarus, 140, 408
Milani, A., Sansaturio, M.E., & Chesley, S.R.

2001, Icarus, 151, 150
Milani, A., et al. 2000, Icarus, 144, 39
Marsden, B.G. 1986, in Asteroids Comets Meteors II, Lagerkvist C.-I. et al. (eds.), (Uppsala University, Uppsala), 3