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Identification of asteroids and comets: methods and results

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Abstract. Useful and practical methods to identify asteroids and comets, using software developed at Sormano Astronomical Observatory, are presented together with some obtained results.

Key words. Asteroids – Orbit identification – Orbit computation

1. Introduction

With more than 76 million asteroids observations available in the Minor Planet Center database (november 2010), one the most intriguing task is to assign to each of them its object identification and orbit. *"The complete identification process consists of uniquely ascribing all known observations to specific individual minor planets"* wrote Brian Marsden in the mid-eighties, pointing out that *"... relatively little has actually been published on the subject before"* (Marsden 1986).

The problem was assessed and broadened a decade later in a series of papers where new methods and approaches were discussed (Milani 1999; Milani & Valsecchi 1999; Milani et al. 2000, 2001) The philosophy and the aim of a such work transpire in few words reported in the first of those papers: *"... improvements in the algorithms can indeed help the observers to substantially decrease the rate at which asteroids are lost, and to increase the rate at which the lost ones are recovered"*.

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2. Identification of asteroids and comets

In short, identifications are possible in the following four cases:

1. there is a sufficient number of observations for computing two sets of orbital elements, one for each observation arc, together with their covariance matrices;
2. there are observations obtained at the same opposition which did not permit an orbit calculation;
3. orbital elements are accurate enough as to allow a search in the database for single or double night observations;
4. recovery is attempted by means of observing campaigns or using old plates.

The present work takes into account only the first three cases. For the first one we have developed *IDA* (IDentification of Asteroids), a software used to compare and filter all the orbital elements included in the database (Testa 1998).

More specifically it analyzes the orbital elements of newly discovered objects and suggests tentative identifications as starting points

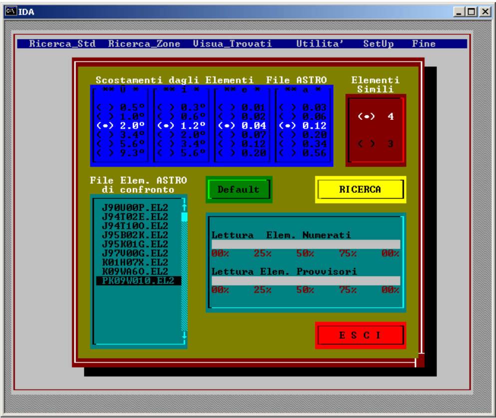


Fig. 1. Screen capture of a run of program *IDA*

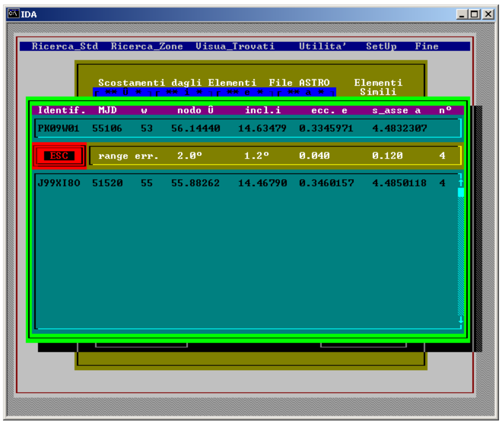


Fig. 2. Screen capture of a run of program *IDA*

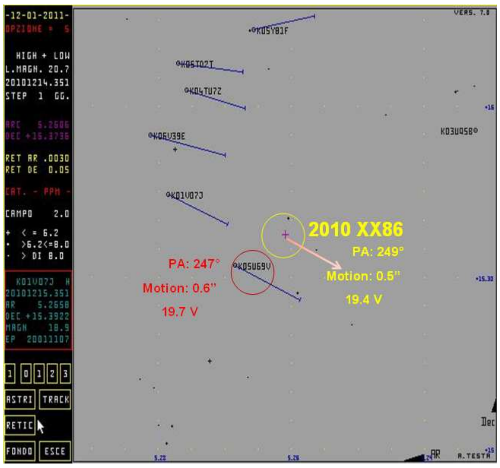
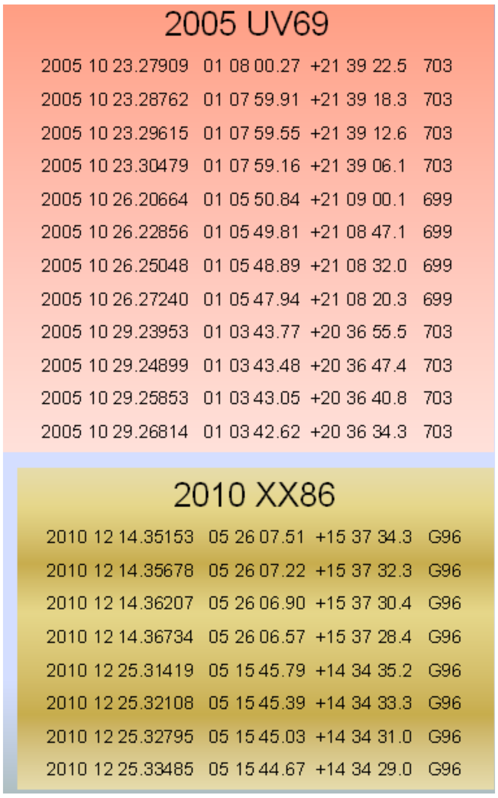


Fig. 3. Screen capture of a run of program *MAPPA2*



2005 UV69

2005 10 23.27909	01 08 00.27	+21 39 22.5	703
2005 10 23.28762	01 07 59.91	+21 39 18.3	703
2005 10 23.29615	01 07 59.55	+21 39 12.6	703
2005 10 23.30479	01 07 59.16	+21 39 06.1	703
2005 10 26.20664	01 05 50.84	+21 09 00.1	699
2005 10 26.22856	01 05 49.81	+21 08 47.1	699
2005 10 26.25048	01 05 48.89	+21 08 32.0	699
2005 10 26.27240	01 05 47.94	+21 08 20.3	699
2005 10 29.23953	01 03 43.77	+20 36 55.5	703
2005 10 29.24899	01 03 43.48	+20 36 47.4	703
2005 10 29.25853	01 03 43.05	+20 36 40.8	703
2005 10 29.26814	01 03 42.62	+20 36 34.3	703

2010 XX86

2010 12 14.35153	05 26 07.51	+15 37 34.3	G96
2010 12 14.35678	05 26 07.22	+15 37 32.3	G96
2010 12 14.36207	05 26 06.90	+15 37 30.4	G96
2010 12 14.36734	05 26 06.57	+15 37 28.4	G96
2010 12 25.31419	05 15 45.79	+14 34 35.2	G96
2010 12 25.32108	05 15 45.39	+14 34 33.3	G96
2010 12 25.32795	05 15 45.03	+14 34 31.0	G96
2010 12 25.33485	05 15 44.67	+14 34 29.0	G96

Fig. 4. Screen capture of a run of program *MAPPA2*

for possible linkages between the corresponding sets of observations. This approach in many cases revealed some difficulties, notably when the duration of the two observational arcs involved is short. An example of a similar particular case was the identification of the comet P/2009 W1 = 1999 XO188 (Minor Planet Electronic Circular 2009-Y21). For the second and third case we used *MAPPA2* (Testa 1997), a sort of dedicated planetary, regularly updated with orbits of asteroids and comets published by the Minor Planet Center. The program allows the plot of all the objects in a selected area of the celestial sphere, highlighting the identification candidates on the basis of parameters such as motion, magnitude and position angle. This system is particularly suitable for objects with a very short observational arc.

A typical example is the asteroid 2005 UV69 = 2010 XX86 (Minor Planet Electronic Circular 2011-A33).

Information about the results obtained are available at the web address `http://www.brera.mi.astro.it/sormano/identification/Identification.html`.

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