Author: Z. KNEŽEVIĆ

Serbian Academy of Sciences and Arts (Serbia)

Title: *"Errors of analytical asteroid proper elements"*

Abstract. The asteroid proper elements computed from an analytical secular perturbation theory suffer from two important drawbacks: the availability only for objects with low to moderate eccentricity/inclination, and lack of the estimate of their uncertainty. The former problem may not be very important because asteroids in general have orbits of fairly low eccentricity and inclination, and because other theories have been developed which can handle the high eccentricity/inclination cases.

Regarding the latter problem, accuracy estimates exist for only a very small set of asteroids, representative of the main families. The typical uncertainty of analytical proper elements was found to be on the order of 0.002-0.003 in proper eccentricity, and 0.001-0.002 in proper inclination, while the corresponding instabilities of the proper semi-major axis were typically one or two orders of magnitude smaller. These uncertainties are by a factor of 3 to 4 larger than the corresponding values for the so-called synthetic proper elements, computed by means of a set of purely numerical procedures.

The computation of analytical proper elements has been carried out for more than 25 years as part of the regular maintenance of the catalog available via the AstDyS service. However, if indeed they are of so much poorer accuracy with respect to synthetic proper elements, as indicated on the basis of the above mentioned limited tests, and possibly insufficient for the more and more demanding family classification applications, then their maintenance can safely be discontinued in the future.

For the purpose of determination of the accuracy of analytical proper elements we carried out two different tests, one that exploits the plain comparison of the analytical and synthetic values, with the aim to determine whether they differ more then the corresponding error bars of synthetic elements permit, and the other consisting in repeating the direct determination of instabilities of analytical elements themselves, but on a much larger sample of asteroids.

Here we present some results of the comparison of analytical and synthetic proper elements, obtained for a sample of 10 000 asteroids, but indicative of the method and of the results to be expected for the entire proper elements catalog with about 400 000 entries, as well as some preliminary results of the direct determination of instabilities with the larger asteroid sample.

Joint work with A. Milani.