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STATISTICAL ANALYSIS OF A WEIGHTING SCHEME FOR ASTEROID OBSERVATION ASTROMETRIC ERRORS TAKING INTO CONSIDERATION THE CLASSIFICATION OF THE OBSERVED ASTEROIDS

Abstract

Observations of asteroids and other near-Earth objects are of great importance for planetary defence activities, the purpose of which is to determine their position in space and the probabilities of Earth impacts, as well as developing strategies to mitigate this risk. In this framework, having precise observations is important to describe accurately the orbits of near-Earth asteroids. However, given a general absence of a-priori uncertainty information, the single observations are given proper weights that reflect the accuracy expected by the observers who perform the observations. The weights are calculated for each observer on the base of statistical analysis of systematic and random errors and providing them with an accurate definition is of fundamental importance if the magnitude of the error of a single observation is to be correctly estimated.

In this paper an innovative weighting scheme for asteroid orbit determination is proposed, as a modification of Vereš et al. (2017), where a statistical analysis of systematic observation errors of the major asteroid surveys is presented. The weighting scheme hereby presented proposes to carry on the statistical analysis of systematic observation error with the inclusion of dynamical considerations on the observed asteroids, particularly focussing on its classification as a Near Earth Asteroid (NEA) or a Main Belter. It is indeed known that measurement uncertainties depend on factors such as faintness or rate of motion and it is thus reasonable to think that these uncertainties could be influenced, more in general, by the type of observed asteroid.

Proper statistical analysis on the astrometric residuals will be performed on these two different clusters with the aim of assigning more precise weights to observers based on the observed object.

Results showing a consistent lowering of orbit residuals, confirm the relevance of the introduction of this further criteria to improve the error model.

[Peter Vereš, Davide Farnocchia, Steven R. Chesley, Alan B. Chamberlin 2017. Statistical analysis of astrometric errors for the most productive asteroid surveys. Icarus 296, 139-149.]