

NEO Characterization

Impact probability estimation with Partial Banana Mapping: search for virtual impactors.

Vavilov Dmitrii E.^(1,2)

⁽¹⁾ IMCCE, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Université Lille, 77 Av. Denfert Rochereau, 75014 Paris, dmitrii.vavilov@obspm.fr

⁽²⁾ Institute of Applied Astronomy of Russian Academy of Sciences, 10 Kutuzova emb., St. Petersburg

Keywords: Near-Earth objects, impact probability, numerical methods

ABSTRACT

In this work we improved the Partial Banana Mapping (PBM) [1] method (a robust linear method for impact probability computation). In the method we assume a Gaussian distribution of errors of equinoctial orbital elements to be fulfilled on the interval from the asteroid's detection to the time of a possible collision. Thus it allows us to take into account the fact that the distribution of possible positions of the asteroid is a thin curvilinear area, stretched mostly along the nominal asteroid's orbit. The method consists of two stages. On the first stage we propagate the orbit of the asteroid with variational equations till the time of a possible collision (it is very close to the time when the distance between the Earth and asteroid's orbit is minimal). Then on the main line of the curved uncertainty area we find the virtual asteroid that is closest to the Earth. On the second stage we compute the impact probability for the found virtual asteroid by a target plane method. The applicability of this approach has already been shown. However, gravitational perturbations from massive bodies, like major planets, can change the positions of virtual asteroids and distort the impact probability values.

In this work we find the coordinates and velocities of that chosen virtual asteroid but at the epoch of observations. Then we propagate the orbit of this virtual asteroid and compute the probability once again. This approach takes into account all the gravitational perturbations and significantly extends the applicability of the method even in the cases of moderate gravitational perturbations. To deal with strong gravitational perturbations we have to use more time consuming methods like LOV or Monte-Carlo.

[1] Vavilov D.E. (2020) *The partial banana mapping: a robust linear method for impact probability estimation*. MNRAS, V. 492, p. 4546–4552.

Comments:

Preferably poster