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Prediction of impactors: method based on an Exhaustive Search of Orbital Planes

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ABSTRACT

We consider a problem of determining small bodies' orbit in a case when the data-arc span of observations is short. In this case the orbit of a new celestial body is uncertain. It is important to know, even with few observations, whether or not there is the possibility of an impact with the Earth in the near future. When such asteroids are discovered, the confidence region resulting from preliminary orbit determination is large and we should be able to select the orbits which lead to collisions with the Earth.

We propose to select the possible collisional orbits together with the determination of preliminary orbits. The orbits are determined by the following way. The exhaustive search for heliocentric orbital planes of a small body is used. For each plane we obtain the geocentric distances of a small body at times of observations. The orbital elements are determined by the method using two heliocentric positions (generally positions for the first and the last observations) and times. The obtained sets of elements are used to calculate the rms between the observed and calculated positions and to obtain the values of the Earth MOID. Then we choose the planes the rms and MOID of which are less enough.

The method was verified on the examples of asteroids 2008 TC3, 2014 AA and Chelyabinsk meteorite assuming that these bodies were discovered a few months before the collision with the Earth.

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