

Background asteroid orbit distribution around asteroid pairs

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Asteroid pairs are identified by the similarity of their heliocentric orbits. The method of Pravec and Vokrouhlický (2009; PV09), recently applied in the 5-D space of mean orbital elements, computes the probability that a given candidate asteroid pair is a random orbital coincidence of two genetically unrelated asteroids. If the probability of random coincidence is low, the two asteroids are a statistically significant detection of asteroid pair. The method assumes a locally uniform distribution of background asteroid orbits around the tested pair. We looked into this assumption and studied actual distributions of background asteroid orbits for a sample of 36 pairs. Our motivation was that with an improved description of the distribution of background asteroid orbits, we may extend the method to asteroid pair candidates with a non-uniform distribution of background asteroid orbits.

We tested a presence of gradient in the distribution of orbits around each studied pair. We assumed zero density gradient in the orbital elements Ω and ϖ and we studied the local orbital distribution in the elements a, e, i . We found that in about half of the 36 cases, the local background asteroid orbit density does not significantly differ from uniform. In the other half cases, we obtained significant gradients. We found that the deviations from the uniform background asteroid orbit density had following reasons: a presence of nearby asteroid family, an effect of a nearby mean-motion resonance, or the pair was located close to the ecliptic plane. Families significantly affecting the local background asteroid orbit density were identified and we corrected the calculation of the probability of random coincidence for the non-uniform background asteroid density. Our results will allow us to extend the PV09 method to regions in the space of mean orbital elements where it could not be applied so far (e.g., in outskirts of asteroid families).