

## In-orbit fragmentation characterization and parent bodies identification by means of orbital distances

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### ABSTRACT

Once a potential fragmentation event has been detected by the Space Surveillance Network of sensors, it is necessary to confirm and characterize it.

Typically, the network is observing a number of fragments crossing their field of view and a fundamental step for the analysts is the identification of the parent body (or bodies) of the observed fragments.

We propose a new approach to correlate fragments with known orbits to parent objects, using the definition of a suitable orbital similarity function, like it is usually done in the case of asteroid families and meteor streams identification. The method can be used both if short time has passed from the instant of breakup and if a long time has already elapsed.

Among the known orbital distances (D-criteria) defined in the literature, we have chosen some of them as suitable metrics to be used for the case of space debris orbiting around the Earth. Moreover, we also consider the Minimal Orbital Intersection Distance (MOID) between two orbits (that is the absolute minimum of the Euclidean distance between a point on the first orbit and a point on the second one) as a further valuable possibility.

The developed method will be applied to known past fragmentation events, using TLE data of real fragments, and to some specific cases of simulated fragmentations (both explosions and collisions). The performance of the different D-criteria will be evaluated and the benefits and issues related to each one will be discussed.

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