Just-in-time Collision Avoidance (JCA) using a cloud of particles

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ABSTRACT

Collisions among large cataloged objects statistically happen every 5 years.

When an operational satellite, maneuverable, is implied in such a potential collision, its trajectory can be modified in what is called a Collision Avoidance Maneuver.

But when both objects are debris, dead, non-maneuverable, avoiding a collision is obviously more complex.

Several potential solutions are nevertheless under study and progress reports have been published; for instance, the use of lasers, either on ground or in orbit, can potentially nudge one debris with a magnitude large enough to prevent the collision.

Other solutions have also been presented, considering the insertion of an artificial atmosphere in front of one of the two debris with the goal to induce a drag, hence a modification of its orbital parameters, enabling after several orbits to induce a margin between the two objects preventing the collision.

We have been working since several years on the optimization of such a system, considering three topics leading to a proof of feasibility.

- The first topic consists in evaluating the quantity of gas and particles necessary to achieve an efficient deviation, and the corresponding optimization of the braking cloud,

- The second is linked to the mission itself, identifying the requirements for the vector carrying the cloud generation mechanism at the requested altitude, including the required precision and the number of launch bases

- The third topic is the cloud generation mechanism itself; it was found that the most efficient braking cloud should consist in very small solid particles with very low velocity. A brainstorming effort led to the identification of several promising solutions, and a definite proof of feasibility

The proposed paper will deal with the trade-offs associated to the three aspects of the question, and proposes a potential solution, hoping to raise interest and lead to an international effort to develop such a collision avoidance solution.