

LEO technogeneous contaminants evolution modeling taking into account satellite's collisions

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The goal of the paper is to develop the techniques for mathematical modeling of long term orbital debris evolution within the frames of continua approach. Under the approach the evolution equations contain a number of source terms responsible for the variations of quantities of different fractions of orbital debris population due to fragmentations and collisions. The efforts were concentrated on determining the source terms for the evolution equations, developing the numerical-analytical technique for integration the evolution equations making it possible to obtain results within a reasonable time interval using modern PCs.

The suggested method for orbital debris evolution modeling has the following peculiarities:

- making use of a statistical approach describing the current debris environment in the form of distribution functions for the main elements of debris orbits;

- applying the averaged description for the sources of space debris production;

- taking into account collisions of debris fragments of different sizes (including non-catalogued ones) that could lead not only to debris self-production but also to a self-cleaning of the Low Earth Orbits;

- developing semi-analytical numerical methods for integration of the governing system of evolution equations in partial derivatives.

Examples of long-term forecasts of the space debris environment are discussed. The role of collisions of debris fragments of different sizes in the overall processes of space contamination and self-cleaning of the low orbits is evaluated.

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