COLLISION OF SPACECRAFT OF VARIOUS SHAPE WITH DEBRIS PARTICLES ASSESSMENT*

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One of the basic results of space debris models application is the calculation of cross-sectional area flux (Q) for particles of different size relative to the given spacecraft (SC). This quantity means the average collision number for a spherical object with unit cross-section per time unit. In many applied tasks there is a necessity of estimating the collision number for bodies of more complex shape (panel, cylinder, cone, etc.). In this paper the technique of taking into account the shape of SC components for calculating the expected collision number per time unit (the flux) is considered. The task is reduced to estimating some effective area (S_{eff}) of SC components, that allows to determine the required flux very simply: $Flux = S_{eff} \cdot Q = C_N \cdot S_{ref} \cdot Q$. Here S_{ref} is the particular easily determined reference area of the SC component (the area of axial cross-section or the panel area); C_N is the dimensionless factor, whose magnitude depends on the SC component orientation and on the statistical distribution of possible directions of a relative particle flux. The values of C_N factor for some SC component of simple shape (panel, cylinder and cone) with different orientation were obtained.

INTRODUCTION

The space debris contamination of the near-earth space (NES) is one of negative consequences of its practical exploration. This activity gave rise to the generation of a set of rather small-sized space objects, whose study became a new trend in classical astronomy. Further NES exploration is impossible without objective analysis of the current state of contamination, along with its sources and evolution laws. The problem of estimating the possibility of collisions with space debris (SD) is relatively new. Now this problem is being intensively developed. Obviously, in the absence of detailed data on the orbital elements of small-sized objects, the study of the hazard of spacecraft collisions with these objects requires a statistical approach.

Our integrated Space Debris Prediction and Analysis model (SDPA) (Refs. 1, 2, 3) is a semi-analytical stochastic technique for mid- and long-term forecasting of manmade SD larger than 1 mm in size. It is designed for constructing the spatial distributions of density and velocity characteristics, as well as for estimating the collision hazard. The aggregate data on SD of various size are considered (without attributing them to

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