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STATISTICAL CALCULATION OF THE FORCE LOAD EXERTED BY THE COMBUSTION PRODUCTS OF LOW-THRUST ENGINES ON THE SPACECRAFT SURFACE

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This paper is concerned with an aerodynamic calculation of supersonic gas jet flows and the determination of the force exerted by them of t on obstacles in the flow. The goal of the paper is the application of the test particle method, which is a variant of the Monte Carlo method, to the numerical simulation of control engine jets and the determination of their effect on spacecraft elements and surrounding environment.

Using the test particle method, for typical operating conditions a study was conducted on the effect of spacecraft control engines on the operation of a Cubsat spacecraft in the form of a right hexagonal prism with control engines along the upper and lower belts of its perimeter with axes parallel to the solar panels and inclined at an angle of 30° to their surface.

For the specific gas mass flux, the normal pressure, and the tangential stress, their maximum values and the distribution over the solar panel surface were determined. The calculated results obtained for each component of the efflux products followed by their superposition were compared with those obtained for the total efflux density of the gas mixture and the averaged characteristics of the combustion products determined in proportion to their mass fraction. To check the introduced geometry of engine arrangement and orientation with respect to the solar panels, distribution fields were constructed for the distribution of the gas mass flux algorithm over the solar panel surface and the dimensionless density logarithm over computation region cross-sections.

This study shows that the test particle method may be used in the solution of numerous fundamental and applied problems in gas jet dynamics. This use of the test particle method in the aerodynamic calculation of spacecraft control engine gas jets is the first in Ukraine,

Keywords: jet flow, control engine, spacecraft, statistical simulation, numerical calculation, test particle method, gas-dynamic parameters, force load.

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