

ESTIMATION OF THE POSSIBLE ATMOSPHERIC DENSITY FOR DIFFERENT ORBITAL FLIGHT CONDITIONS

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Improving the quality of Earth remote sensing systems is largely due to the development of spacecraft motion control algorithms. A new control problem is to maintain given orbit parameters over a long period of time. To do this, it is proposed to constantly (continuously or discretely) counteract disturbing actions on the spacecraft. The capabilities of modern electrojet engines make it possible to counteract significant aerodynamic actions. This, in its turn, opens up possibilities of reducing the range of working orbits for remote sensing spacecraft to unconventionally low (very low or superlow) orbits of altitude about 300 km. Such superlow orbits for remote sensing spacecraft have a number of advantages.

In low Earth orbits, one of the main disturbing actions is aerodynamic drag. Its estimation is necessary at the preliminary design stage of spacecraft power supply systems when developing requirements for disturbance-counteracting engines. The purpose of this paper is to estimate the possible atmospheric density, which would allow one to quickly conduct pre-design calculations of the aerodynamic drag on the spacecraft for given orbital flight conditions. The density was estimated using the Standard GOST R 25645.166 – 2004, “The Earth’s Upper Atmosphere. Density Model for Ballistic Support of Satellite Flights,” depending on the altitude and a fixed level of solar activity. In doing so, the effect of the following factors on the atmospheric density was considered: the daily effect, the semi-annual effect, and the effect of solar and geomagnetic activity. The coefficients that describe the effect of these factors were estimated at altitudes of 300 to 700 km, and the conditions under which these coefficients and the atmospheric density take extreme (maximum/minimum) were determined. As an example, it was shown that at an altitude of 300 km, the density can theoretically vary by more than two orders of magnitude (from $1.07 \cdot 10^{-12}$ kg/m³ to $1.22 \cdot 10^{-10}$ kg/m³). The results presented in this paper allow one to quickly estimate the possible range of the aerodynamic drag on the spacecraft.

Keywords: *atmospheric density, estimated values, maximum and minimum value.*

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