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EFFECT OF THE SOLAR RADIATION PRESSURE ON THE MOTION OF SATELLITES IN ALMOST CIRCULAR EARTH ORBITS

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This paper considers the effect of the solar radiation pressure on the motion of a satellite in an almostcircular low-Earth orbit. The formulation of the problem is due to the need to determine the effect of solar radiation pressure forces on the motion of light commercial Earth remote sensing (ERS) satellites with large surface areas (solar batteries and antennas). The goal is to determine the main regularities of this effect, construct reasonably simple and accurate estimates of changes in orbital parameters for the orbits under consideration, and clarify their physics (cause-and-effect relations) The novelty of this study also lies in the use of variables specially introduced to describe a motion in almost circular orbits.

The study assumes that the solar radiation pressure force is constant throughout the entire orbit, and it is concerned with dawn-dusk orbits, which are often used for ERS satellites with radar observation systems.

The paper presents simple analytical expressions that describe the main regularities of short-term (several days) changes in orbital parameters. It is shown that the change in the orientation of the orbital plane is determined by the action of the gyroscopic moment. This moment balances the effect of the moment of external forces aimed at changing the orientation and the change in the orientation perpendicular to the direction of the applied moment of the external forces. The main effect of the solar radiation pressure is the excitation of forced oscillations of the orbital radius, whose amplitude linearly increases with time. The maximums of these oscillations (apogee) are at the point where the light pressure forces maximally slow down the motion of the satellite (directed oppositely to the velocity), and the minimums (perigee) are at the point of the maximum motion acceleration.

It is shown that the annual movement of the Sun can qualitatively change the picture of the evolution of orbital parameters. For sun-synchronous dawn-dusk orbits, compact analytical solutions for changes in orbital parameters are constructed, and it is shown that the annual movement of the Sun's declination reverses the direction of evolution of the orbital shape.

The calculations showed a reasonably high accuracy of the analytical solutions at the initial stage. The obtained numerical estimates make it possible to evaluate the effect of the solar pressure on changes in orbital parameters.

Keywords: *solar radiation pressure, Earth remote sensing satellite, main regularities, analytical solutions, change in orbital shape.*

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