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Author: Prof. Mykola Dron
O. Honchar Dnipropetrovsk National University, Ukraine, nord@mail.dsu.dp.ua

Dr. Andrii Dreus
O. Honchar Dnipropetrovsk National University, Ukraine, dreus.andrii@gmail.com
Mr. Alexandr Golubek
Yuzhnoye State Design Office, Ukraine, a.golubek@mail.ru
Prof. Yevgen Abramovsky
O. Honchar Dnipropetrovsk National University, Ukraine, obuch.era@mail.ru

INVESTIGATION OF AERODYNAMICS HEATING OF SPACE DEBRIS OBJECT DESCENDING IN EARTH ATMOSPHERE

Abstract

Today space debris is serious problem to near-Earth space activities. The officially cataloged space debris amounts more than 17,000 objects. To take away the debris from Low Earth Orbits, the active and combined debris removal technologies should be considered as a high priority approach. At the Oles Honcar Dnipro National University (Dnipro city, Ukraine) the group of researchers studies the methods and solutions for space debris removal from Low Earth Orbits. This project is supported by the Ministry Science and Education of Ukraine. The presented work deals with investigation of aerodynamics heating of space debris object at reentry to Earth atmosphere aimed of its control possibilities. To minimize the risks of potential ground impact of such objects, the assessment of its burn-up in atmosphere should be considered. The purpose of presented work is to develop the method of calculation thermophysical parameters at in the processes reentry of space objects to Earth atmosphere. The method is mathematical modeling of ballistics and non-stationary heat transfer about the body moving in the atmosphere is used. The engineering approach to calculation of aerodynamic heating is proposed. The qualitative and quantitative analysis of aerodynamic heating of space debris elements, which are made of various materials is conducted. The re-entry angle into the atmosphere is a parameter that can provide efficient control the thermal state of the moving object. The steeper is the re-entry angle, the higher are g-force and heat flux. The effect of the object trajectory (re-entry angle) on aerodynamic heating of surface is estimated. The cumulative effect of these factors creates prerequisites for the effective destruction of the object. It is shown that mechanisms of object destruction in Earth atmosphere needs further studies. The increase of space debris re-entry angle results in the significant increase in the both ram effect and g-force, which, combined with an increase in temperature and respective degradation of mechanical properties of materials, and create the prerequisites for the object destruction or burning up.