
On the analysis of the orientation of deformable spacecraft

© L.V. Severova, S.P. Severov

Bauman Moscow State Technical University, Moscow, 105005, Russia

The problem under consideration is formulated as follows. There is a spacecraft (SC) with external elastic elements of solar panel type. The main design parameters of the spacecraft and dynamic characteristics (shape, frequency and damping) are assumed to be theoretically determined and experimentally confirmed by flight or ground simulation tests. SC has a system of sensors that determine its orientation to the specified object in the sky, as well as an active complex of executive bodies — the engines. The craft must keep the specified orientation in the definitely small area of variations. At the preliminary design stage it is required to synthesize a nonlinear system of orientation of the deformed craft. The study is aimed at using the flywheel rotor as the executive body and the method of poly-phase plane for algorithmization of orientation management processes. In accordance with the method of bi-plane, the paper looks at the portable motion of the vehicle on a single sheet and the relative motion of solar cells on the second sheet of the phase bi-plane. The results could be used to detect the closed limit cycles of self-oscillation, and to assess the accuracy of the craft orientation.

Keywords: spacecraft, solar panels, the system of orientation, the phase plane.

REFERENCES

- [1] Raushenbakh B.V., Tokar' E.N. *Upravlenie orientatsiyey kosmicheskikh apparatov* [Orientation control of spacecraft]. Moscow, Nauka Publ., 1974.
 - [2] Popov V.I., Severova L.V. *Dinamika makhovichnoi sistemy upravleniya dvizheniem kosmicheskogo letatel'nogo apparata otnositel'no tsentra mass s uchetom uprugikh elementov* [Dynamics of flywheel motion control system of the spacecraft relative to the center of mass taking into account elastic elements]. Moscow, Nauka Publ., 1979, pp. 83–90.
 - [3] Rutkovskiy V.Yu., Sukhanov V.M. *Upravlenie v prostranstve, tom 1* [Space control, vol. 1]. Moscow, Nauka Publ., 1973, pp. 37–43.
 - [4] Pavlov Yu.N., Severova L.V. *Ob ispol'zovanii mnogolistnykh fazovykh poverkhnostei v dinamike kosmicheskogo apparata* [On the use of multi-sheeted phase surfaces in the dynamics of spacecraft]. *Tr. XIV Chteniy K.E. Tsiolkovskogo. Sektsiya «Mekhanika kosmicheskogo poleta»* [Proc. XIV, K.E. Tsiolkovsky Read. Section “The mechanics of space flight”]. Moscow, Inst. Hist. Sci. Tech. Acad. Sci. USSR, 1980, pp. 101–108.
 - [5] Severova L.V. *K opredeleniyu dinamicheskikh kharakteristik razvertyvayemykh kosmicheskikh konstruksiy* [On the dynamic characteristics of deployable space structures]. *Tr. XIV Chteniy K.E. Tsiolkovskogo. Sektsiya «Mekhanika kosmicheskogo poleta»* [Proc. XIV, K.E. Tsiolkovsky Read. Section “The mechanics of space flight”]. Moscow, Inst. Hist. Sci. Tech. Acad. Sci. USSR, 1981, pp. 21–28.
 - [6] Andronov A.A., Vitt A.A., Khaikin S.E. *Teoriya kolebaniy* [Theory of oscillations]. Moscow, Fizmatgiz Publ., 1959.
-

Severova L.V. graduated from Bauman Moscow Higher Technical School in 1965. Ph.D., assoc. professor of the Theoretical Mechanics Department at Bauman Moscow State Technical University.

Severov S.P. (b. 1937), Dr. Sci. (Eng.), Professor of the Underwater Robots and Machines Department at Bauman Moscow State Technical University. Author of 68 scientific papers and 54 inventions in the field of dynamics of machines, instruments and apparatus of rocket-space and underwater robotics, as well as in the theory and techniques of creative engineering in higher professional education. e-mail: sseverov@mail.ru