UNIVERSAL BALLISTIC LASER GRAVIMETER WITH ELECTROMECHANICAL CATAPULT OF INDUCTION-DYNAMIC TYPE

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When conducting fundamental research in geophysics, geology, astronomy, metrology and other branches of science and technology, it is necessary to know the value of the acceleration of gravity g with an error of less than $(10^{-8}–10^{-9})g$. For high-precision measurements of g, ballistic laser gravimeters are used, in the vacuum chamber of which an optical angular reflector (OAR) moves freely under the action of the Earth's gravitational field. It is an active element of the measuring system of the Michelson laser interferometer. The most widely used ballistic laser gravimeters measure g using asymmetric or symmetric methods. In gravimeters with a symmetric method of measuring g, the OAR is thrown vertically upward by a catapult and then falls downwards, and in gravimeters with an asymmetric method of measuring g, only a vertical fall of the OAR is carried out. In Ukraine, the highest accuracy in determining the absolute value of g is achieved on the DETU02-02-96 ballistic gravimeter, which implements a symmetric measurement method. This gravimeter is the primary standard of the unit of acceleration of gravity and is stored at the National Scientific Center "Institute of Metrology", Kharkov.

To improve the primary standard, a concept of a universal gravimeter is proposed, which simultaneously implements both symmetric and asymmetric methods of measuring g, which eliminates the shortcomings of each method and expands the functionality of the gravimeter. The gravimeter contains a laser-optical system OAR, a vacuum chamber, on the upper wall of which an optical window is located, and on the lower wall on dampers there is a massive force plate. Inside the vacuum chamber there is an electromechanical catapult of the induction-dynamic type, which contains an inductor installed on the plate and an electrically conductive anchor providing vertical movement of the OAR. Since the symmetric method of measuring g causes autoseismic vibrations of the foundation, the excitation of the catapult inductor is carried out either by a series of successive small pulses or by alternating current of high frequency [1, 2]. As a result of modeling electromechanical processes, it was shown that due to the reduction in the amplitudes of the pulses of electrodynamic forces between the inductor and the conductive anchor with a simultaneous increase in the time of their action, the autoseismic component of uncertainty is reduced by 3-5 times compared to excitation by a single short pulse from a polar capacitor.

Literature:

1. Bolyukh V., Vinnichenko O., Neyezhmakov P. et al. Reduction of auto seismic oscillations of the ballistic laser gravimeter on account of the excitation of the induction-dynamic catapult by a pulse packet. *Ukrainian Metrological Journal*, 2020, no. 3, pp. 3-11. DOI: 10.24027/2306-7039.3.2020.216765.

2. Bolyukh V., Vinnichenko A., Omelchenko A. Reduction of the auto seismic component of error of a ballistic laser gravimeter by excitation of an induction-dynamic catapult from an AC voltage source./ *Ukrainian Metrological Journal*, 2021, no. 4, pp. 20-27. DOI:10.24027/2306-7039.4.2021.250401.