IAF EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations - IAF EARTH OBSERVATION SYMPOSIUM (IP)

Author: Dr. Sergiy Matviyenko
JSC "RPC "KURS", Ukraine

AUTONOMOUS THREE-AXIS RELATIVISTIC GRAVITATIONAL GRADIENTOGRAVIMETER FOR THE "GRAVISAT" SPACECRAFT.

Abstract

At present, dozens of missions to measure the parameters of the Earth's gravitational field have already been successfully implemented, of which the GOCE and GRACE missions are the most successful. However, only the GOCE spacecraft uses a specialized instrument - a three-axis satellite gravity gradiometer. All other missions use the ballistic method, which is to measure changes in the parameters of the orbit of the spacecraft under the influence of gravity. The main disadvantage of the GOCE mission satellite gravity three-axis gradiometer is its non-autonomy. For the successful operation of the device, it is necessary to ensure an ideal circular orbit of the spacecraft, which is ensured by using a high-precision navigation receiver and a propulsion system that compensates all types of orbital disturbances, including gravitational ones, in real time. This significantly complicates the work of the spacecraft and, accordingly, increases its cost and reduces the period of active existence. The authors have developed and patented in Ukraine an autonomous gravitational gradientogravimeter, which can simultaneously measure the absolute value of the free fall acceleration, its relative change and the gradient along three axes. The principle of its operation is based on the use of the relativistic "red shift" effect, which is why we called the device relativistic. Since the operation of the device does not require the use of external information and orbit correction, it is autonomous. Especially for this device, a specialized spacecraft "Gravisat" with a gravitational orientation system was developed and patented. The most important element of a gradiometer is the frequency standard. At present, optical frequency standards have already been created, which have dimensions commensurate with a match head and stability at the level of 10-18. When using such a frequency standard on board the "Gravisat" spacecraft, we will obtain a resolution on Earth no worse than 1-3 km with an error in measuring the value of the gravitational acceleration no worse than 1 Gal. At present, by order of the State Space Agency of Ukraine, the first sample of a relativistic gravimeter was created in 2017 and is successfully operated. Its unique characteristics allow it to be used not only in near and far space, but also on Earth on any mobile base, including on ships. It should be noted that the problem of creating a mobile marine gravimeter with a measurement error no worse than 10 Gal is one of the most urgent problems.