RESEARCH ON PARAMETERS OF TIME SCALES FORMED BY RECEIVERS OF SIGNALS OF THE SATELLITE RADIONAVIGATIONAL SYSTEM GPS

S. V. Trambovetskiy, J. A. Koval, V. V. Bavykina, and A. A. Tkachuk
Kharkov State Technical University of Radio Electronics (KTURE), Ukraine

Abstract

The basis of all methods for synchronizing requires information on the time scale. Benchmark analysis of methods for synchronizing shows that the best accuracy requires:

- *a carried quantum watch;*
- *satellite radionavigational systems (SRNS) - GPS and GLONASS;*
- *an artificial communication satellite;*
- *a radiometeoric method of synchronizing (RMS).*

Use of the signals from GPS and GLONASS is one of the most exact ways of determination of coordinates and global synchronization. The most acceptable for deciding a problem of synchronizing are two ways comparable in accuracy - SRNS and RMS, which mutually complement each other.

From the review of the present of the GLONASS system (from 24 satellites there are only eight in working condition) and limited capability of producing receivers, it is possible to make a conclusion – for the consumer, there is a greater interest in GPS.

From the enormous production of GPS receivers, we examined these receivers: Trimble ACE II, Ashtech G8, Trimble 4000SSi Series, and Trimble Acutime 2000. Measurements were conducted based on the State standard of time and frequency of Ukraine. We made two cycles of measurements.

In the first cycle, we researched inaccuracy in synchronizing on comparatively short time intervals – 1,000 measurements for each receiver with a 3-second interval. In the second cycle, measurements were produced over a whole week. For each of the receivers, with the break at 1 day 240 averaged measurements were accumulated for each of the receivers.

The first cycle of measurements have shown that, for short time intervals, the main contribution to inaccuracy in forming time scales was the frequency instability of the internal quartz generators. The STD was 16.6-55.4 ns. When using an external master signal with the frequency of 10 MHz, instead of the built-in quartz generator, the STD was 0.55 ns. The systematic error of time scales, from the GPS receivers, was from 531.7 ns (for Acutime 2000) to 1406.9 ns (for ACE II).

The second cycle of measurements confirmed the presence of systematic error that prevents calibration of each GPS receiver. On the basis of the conducted studies, it is shown that the combination of the two methods of synchronization (SRNS and RMS) achieves the best results.