Section Tools of Modern (Radio) Astronomy

A SYNCHRONIZATION OF SESSIONS OF VLBI-OBSERVATIONS BY MEANS OF THE GLOBAL NAVIGATION SATELLITE SYSTEMS

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Abstract: The article explores the method of preliminary synchronization of VLBI observations with the help of GNSS receiver NVS-GNSS-STA/CH-5831. It also investigates the dependence of the clock difference on the operating mode of the receiver. The results obtained are compared for each of the operating modes. Based on the comparison, the optimum operating mode ensuring a difference in the stroke of the clock not more than 50 ns has been detected.

Keywords: VLBI-observations, GNSS receiver, standard time and frequency.

Improving the accuracy of pre-synchronization of VLBI observations and monitoring the timing of data logging using GNSS receivers operating only with L1 signals is possible. The operation modes of the NVS-GNSS-STA/CH-5831 receiver have been studied for its application in this regard. It has three modes of operation: free mode, averaging mode and "time on hard point" mode. The synchronization error does not exceed 15 ns (one sigma) [1–4].

Temporal stability of a time stamp of the receiver and its dependence on a receiver operation mode has been received and probed. The diagram of the experimental installation is shown in fig. 1.

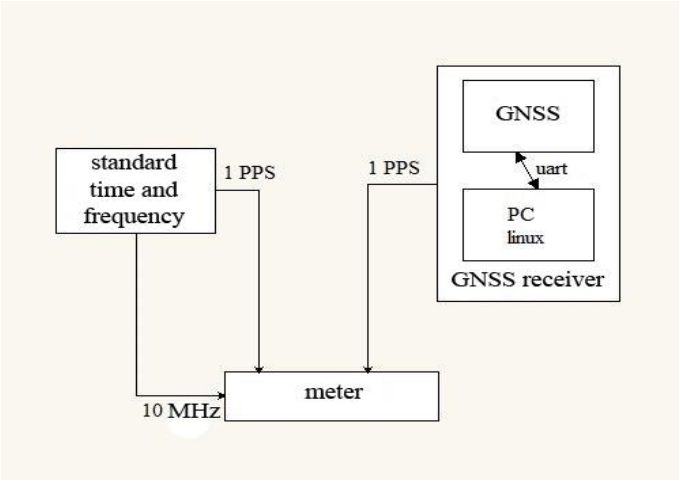

Fig. 1. A block diagram of experimental installation.

The time stamp of the GNSS receiver has a big error and a time delay concerning a time stamp of the standard of frequency and time (fig. 2).

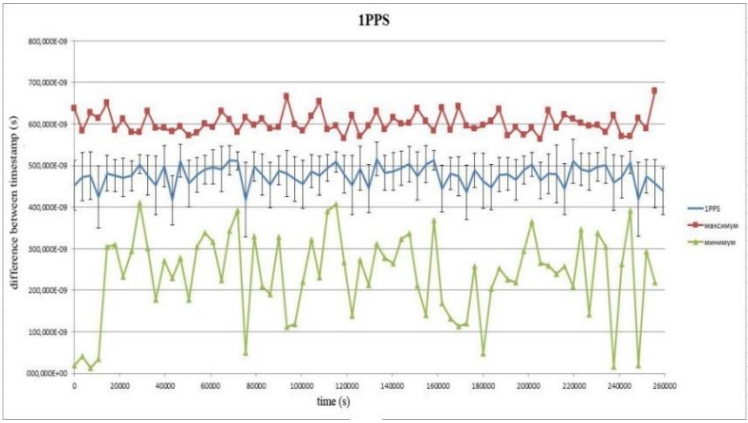

Fig. 2. An average clock difference in free mode.

The graph shows that the magnitude of the difference in the clock for free mode is on average 90 ns.

In the averaging mode of the interval, the errors of the σ label for the averaging time of 20 minutes (Fig. 3) and 1140 minutes (Fig. 4) were calculated in the interval.

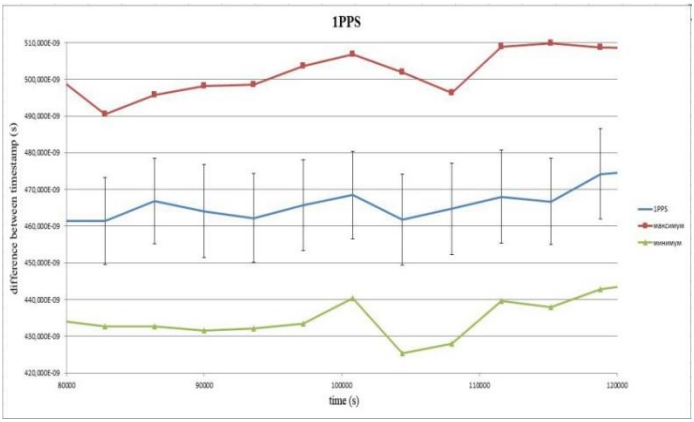

Fig. 3. Averaging the clock difference in the averaging mode in 20 minutes.

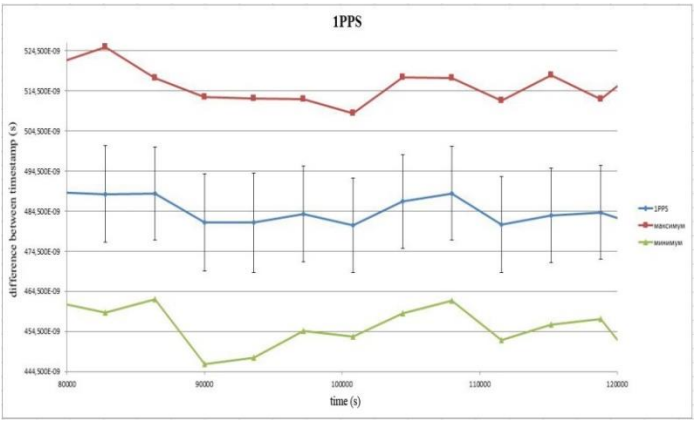

Fig. 4. Averaging the clock difference in the averaging mode in 1140 minutes.

The value of the clock difference for the averaging mode is on average 15 ns. By operation of the receiver in the mode of averaging

of coordinates in 20 minutes and in 1140 minutes the differences of the course of hours identical to each other experimentally were received.

Application of the method of post-processing of the receiver using data information about the correction to the front of the output mark signal relative to the solution of the navigation problem makes it possible to reduce the instability of the receiver time mark to 5–10 ns (Fig. 5).

In contradiction to the free mode, the averaging mode of the coordinates provides an increased accuracy of the timestamp.

The instability and latency of the time stamp of the GNSS receiver relative to the timestamp of the standard frequency and time in the averaging mode of coordinates do not depend on the averaging time of the coordinates. Averaging the coordinates in 20 minutes is enough to obtain accuracy within 50 ns.

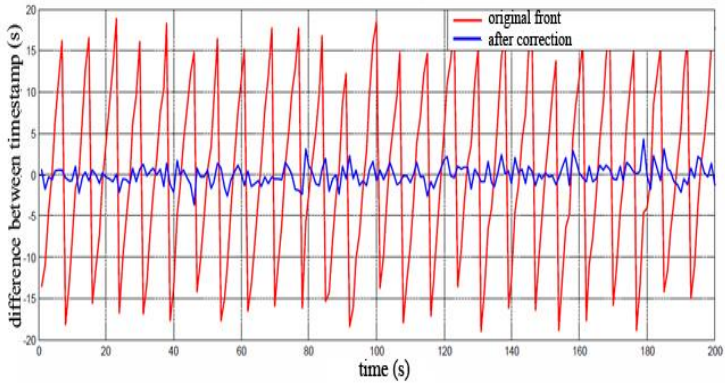

Fig. 5. Shift of 1PPS relative to UTC before and after software correction.

The use of post-processing makes it possible to reduce the instability of the time stamp of the receiver to 5–10 ns, which will improve the accuracy of synchronization of VLBI observations.

GNSS receiver can be used for preliminary synchronization of observational data and control of data acquisition timing.

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A RESEARCH OF DIFFERENT DEFORMATIONS INFLUENCE ON ROT-54/2.6 RADIO TELESCOPE ANTENNA

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Abstract: A telescope is never perfect because of mechanical, gravity, temperature and wind induced deformations of its structure, because of production imperfections and because of accidental small misalignments of the constrictive elements. The resulting degrading effect on the beam pattern is negligible if the corresponding deformation of the reflector and the misalignment of the constructive elements (main reflector, sub reflector, receiver) are small compared to the wavelength of observation, i.e. smaller than λ/16. The degradation becomes noticeable and disturbing if the corresponding deformation is larger than λ/10 [1].

In our work we examined the different deformations influence on field distribution in antenna's aperture for ROT-54/2.6 Radio Optical Telescope. Even taking into considerations that the gravity and wind impacts are minimized