IAA Correlator Center Report

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Abstract The IAA Correlator Center activities in 2023 and 2024 are described in this report. All observations of the Russian national geodetic VLBI programs were transferred to the IAA in e-VLBI mode and processed using RASFX and DiFX correlators.

1 General Information

The Correlator Center is located in St. Petersburg, Russia and maintained by the Institute of Applied Astronomy. The main goal of the Correlator Center is the processing of the geodetic, astrometric, and astrophysical observations made with the Russian National Quasar VLBI network [1]. The Svetloe, Badary, and Zelenchukskaya observatories are connected to the Correlator Center by a 2 Gbps link. At present, RASFX and DiFX correlators are hosted and operated by the Correlator Center.

In 2014, the Russian Academy of Sciences FX (RASFX) six-station, near-real time GPU-based VGOS correlator was developed. The correlator software was installed on an HPC cluster with 85.34 Tflops performance, which contains 40 servers, each equipped with two Intel CPUs and two Nvidia GPUs, and can process up to a 96 Gbps input data rate [2].

Since 2015, multiple versions of the DiFX software correlator have been installed and run on the HPC cluster.

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2 Activities During the Past Two Years

Three VGOS-compatible 13.2-m telescopes RT-13 located in Badary, Svetloe, and Zelenchukskaya were used to carry out observations on a regular basis. Five one-hour S/X observation sessions and one S/X/Ka observation session were processed by a RASFX correlator every day. S/X observations were made using two 51 MHz bandwidth frequency channels (IFs), one IF in each band; S/X/Ka observations were made using four 512 MHz IFs, single in S and X band with two IFs in Ka band. The total recording rates were 4 Gbps and 8 Gbps for S/X and S/X/Ka observations, respectively. Also, we have carried out 24-hour experiments in S/X frequency mode every month. The data transfer rate limits the processing frequency of 24-hour experiments.

Three 32-meter telescopes RT-32 located in Badary, Svetloe, and Zelenchukskaya were also used to carry out observations on a regular basis. One-hour S/X band observation sessions with 8 MHz IFs, ten in X band and six in S band, were processed every day.

In 2023 and 2024, we have done a series of experiments aimed at GLONASS satellite observations with our RT-32 antennas in L1 band. Data processing was performed using the RASFX correlator. During post-processing, we obtained high precision time delays and delay rates.

The experiments with new small 4-meter radio telescope RT-4 located in Svetloe were made. Several VLBI sessions with seven radio telescopes—three RT-13, three RT-32, and RT-4 in S/X, with one 512 MHz IF in each band—were processed by the DiFX correlator.

Finally, the Correlator Center also continued work on testing the receiving and recording equipment. We have done a few observations in order to calculate signal delay propagation stability and the influence of the equipment delay instability on the Universal Time Determination [3].

3 Staff

The list of the staff members of the IAA RAS Correlator Center in 2023 and 2024 is given below.

- Igor Surkis — Lead researcher, software developer;
- Voitsekh Ken — GPU software developer, data processing;
- Alexey Melnikov — DiFX processing, scheduler;
- Alexander Kumeyko — Software developer;
- Vladimir Mishin — Software developer, data processing;
- Nadezhda Mishina — Software developer, data processing;
- Yana Kurdubova — Software developer, data processing;
- Violetta Shantyr — Software developer;
- Vladimir Zimovsky — Data processing lead;
- Mikhail Zorin — Software developer, PhD student;
- Ivan Arnaut — Software developer, PhD student;
- Ekaterina Medvedeva — Data processing;
- Andrey Mikhailov — Field system support;
- Ilya Bezrukov — e-VLBI data transfer lead;
- Alexander Salnikov — e-VLBI data transfer.

4 Future Plans

In the upcoming years, we will focus on the following tasks:

- Processing of the geodetic observations;
- Testing compatibility and stability of radio telescope equipment;
- Research on satellite signal processing methods;
- Automation of the data processing.

References

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2. Surkis I., Zimovsky V., Ken V., Kurdubova Ya., Mishin V., Mishina N., Shantyr V. A Radio Interferometric Correlator Based on Graphics-Processing Units. ISSN 0020-4412, Instruments and Experimental Techniques, 2018, Vol. 61, No. 6, pp. 772–779.
3. Vekshin Yu., Ken V., Kurdubov S. Optimal Signal Averaging Time in VLBI Sessions. International VLBI Service for Geodesy and Astrometry 2022 General Meeting Proceedings, NASA/CP-20220018789, pp. 144–147, 2023.