

# SAI-VNF VLBI Analysis Center in 2019–2020

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**Abstract** This report presents an overview of the SAI-VNF VLBI Analysis Center activities. The AC analyzes all IVS sessions for computations of the Earth Orientation Parameters (EOP) and time series of the ICRF source positions and performs research and software development aimed at improving the VLBI technique.

## 1 General Information

The SAI - VNF VLBI Analysis Center is located at the Sternberg State Astronomical Institute (SAI) of Lomonosov Moscow State University in Moscow and at the National Research Institute of Physicotechnical and Radio Engineering Measurements (VNIIFTRI) in Mendeleevo, Russia. The Analysis Center participates in geodetic and astrometric VLBI analysis, software development, and research aimed at improving the VLBI technique, especially for support of the ASC correlator during the Radioastron mission [1].

## 2 Activities during the Past Two Years

AC SAI-VNF performs data processing of all kinds of VLBI observation sessions. For VLBI data analy-

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sis we use the ARIADNA software package developed by V. Zharov [2]. Version 4.11 of this software was used for operative VLBI data processing for Russian EOP operative services at VNIIFTRI [4] in 2019–2020. Now, the new version 5 of the software is under development.

## 3 Staff

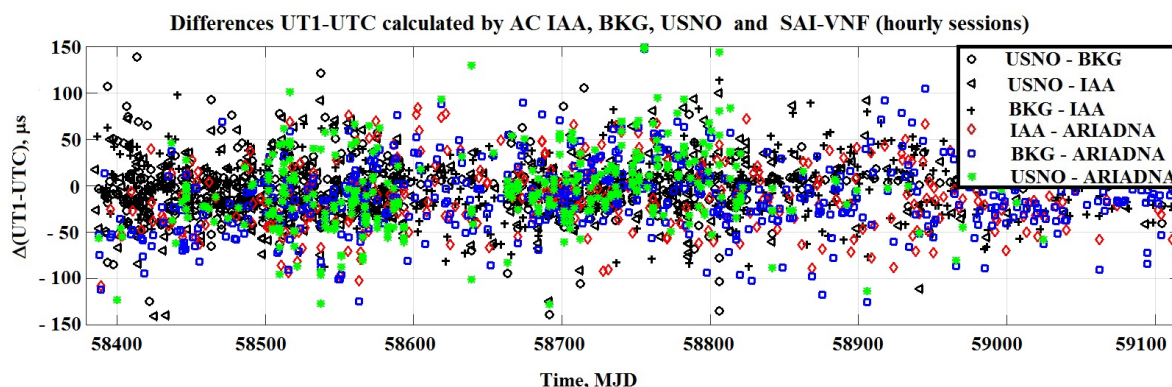
The staff of the joint AC is:

- Vladimir Zharov, Prof.: development of the ARIADNA software, development of the methods of parameter estimation (SAI);
- Sergey Pasynok, scientific researcher: development of control scripts, global solution (VNIIFTRI);
- Natalya Shmeleva, engineer: VLBI data processing (SAI).

## 4 Current Status

### • Software development for VLBI processing

The ARIADNA software is being developed to provide contributions to IVS products. The software is used for calculating all types of IVS products. The EOP series was obtained from observations that were made in 2019–2020. The main features of version 4.11 are: handling input data in the VGOS [3] and NGS formats, performing all reductions in agreement with the IERS Conventions (2010), automatic generation of the SINEX files, and combination of some of the SINEX files to



**Fig. 1** UT1-UTC differences calculated by AC IAA, BKG, USNO, and SAI-VNF for Intensive sessions in 2019–2020. Differences with ARIADNA (AC SAI-VNF) are in color.

stabilize solutions in non-interactive mode, starting from version 4 software allowed to use the CIO based transformation matrix. The method that uses calculations of the equinox-based transformation matrix for precession-nutation was kept to compare new series with old ones. The equinox based matrix  $Q(t)$  transforms from the true equinox and equator of date system to the GCRS composed of the classical nutation matrix, the precession matrix including four rotations, and a separate rotation matrix for the frame biases. Now, the new version 5 of the software is under development.

- **Routine analysis**

During 2019–2020 the routine data processing was performed with the ARIADNA software using the least-squares method with rigid constraints. AC SAI-VNF operationally processed the 24-hour and Intensive VLBI sessions. Forming the data base of the VLBI sessions and processing of all sessions is fully automated. The EOP series *vnf\_vlbi.pvz* was calculated. This series was computed with the catalog VTRF2015 of station positions and velocities.

The SINEX files were generated for all sessions. UT1-UTC differences calculated by AC IAA, BKG, USNO, and SAI-VNF estimated from all Intensive sessions are shown in Figure 1. Differences with ARIADNA (AC SAI-VNF) are in color.

## 5 Future Plans

- Continue investigations of VLBI estimation of EOP, station coordinates, and source coordinates and their variability.
- Improvement of the ARIADNA software for processing of the GNSS troposphere zenith delays.

## References

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