SAI VLBI Analysis Center 2014 Annual Report

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Abstract This report presents an overview of the SAI VLBI Analysis Center activities during 2014 and the plans for 2015. The AC SAI analyzes all IVS sessions for computations of the Earth orientation parameters (EOP) and time series of the ICRF source positions, and it performs research and software development aimed at improving the VLBI technique.

1 General Information

The SAI VLBI Analysis Center is located at Sternberg State Astronomical Institute of Lomonosov Moscow State University in Moscow, 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 Radioastron mission.

2 Component Description

AC SAI performs data processing of all kinds of VLBI observation sessions. For VLBI data analysis we use the ARIADNA software package developed at SAI. Version 4 was finished and tested in 2012. All reductions are performed in agreement with the IERS Conventions (2010).

ARIADNA uses files in NGS format as input data.

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The package ARIADNA (v. 4) is the basis of software named as ORBITA installed on the correlator of the AstroSpace Center at the Lebedev Physical Institute. It is used for the correlation of the ground-space interferometer data during the Radioastron mission. A new modification of the software was developed to perform correlation in “Coherent” mode (see below).

3 Staff

- Vladimir Zharov, Prof.: development of the ARIADNA software, development of the methods of parameter estimation;
- Nikolay Voronkov, scientific researcher: global solution;
- Svetlana Nosova, engineer: VLBI data processing;
- Natalya Shmeleva, engineer: VLBI data processing.

4 Current Status and Activities

- **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. Version 4 was developed in 2012. The main features of this version are performing all reductions in agreement with the IERS Conventions (2010), generation of SINEX files, and the combination of some of the SINEX files to stabilize solutions.
  The used version of this software was corrected in 2013: now it is possible to use the CIO-based trans-

formation matrix. New series of the EOP were obtained from observations that were made in 2013.

The method that uses the calculation of the equinox-based transformation matrix for precession-nutation was kept to compare new series with old ones. The equinox-based matrix $Q(t)$ that transforms from the true equinox and equator of date system to the GCRS is composed of the classical nutation matrix, the precession matrix including four rotations, and a separate rotation matrix for the frame biases. New series of the nutation angles will be used for the preparation of our suggestion to improve the nutation theory.

Some corrections of the model of delay for the ground-space interferometer were made and realized in the ORBITA software, which is used for correlation and routine analysis of the Radioastron observations.

There is a so-called “Coherent” mode for correlation of the ground-space interferometer data during the Radioastron mission. It was developed to support an onboard reference frequency source by synchronizing it from the ground based master H-maser at a tracking station (TS). The phase stable signal of the ground based H-maser frequency is converted to RF, transmitted forward to Radioastron spacecraft and then, after coherent conversion, is transmitted back to the TS. At the TS, both signals (transmitted and received) can be compared to evaluate Doppler residuals and phases, and after that, the timing of the data flow can be corrected. The Coherent mode is the important procedure to keep efficiency of the ground-space interferometer in cases of outage events of the highly stable onboard H-maser. The Coherent mode processing algorithm is realized in the ASC FX correlator.

- **Routine analysis**

  During 2014, routine data processing was performed with the ARIADNA software using the least-squares method with rigid constraints, and non-rigid constraints were used for generation of SINEX files.

  AC SAI operationally processed the 24-hour and Intensive VLBI sessions. Forming the VLBI sessions’ databases and processing of all sessions is fully automated. The EOP series sai2014a.eops and sai2014a.eopi were calculated. These series were computed with the catalog VTRF2008 of station positions and velocities. Experimental series sai2014c.eops was calculated for development of a new nutation theory.