SAI VLBI Analysis Center Report 2011

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Abstract

This report presents an overview of the SAI VLBI Analysis Center activities during 2011 and the plans for 2012. The AC SAI analyzes all IVS sessions for computations of the Earth orientation parameters (EOP), time series of source positions at the scope of new realizations of the ICRF, and 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.

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. All reductions are performed in agreement with the IERS Conventions (2003). A new version of the package is being developed that will use the IERS Conventions (2010).

ARIADNA uses files in NGS format as input data.

The latest version named as ORBITA is used on the correlator of the AstroSpace Center in support of the Radioastron mission.

3. Staff

- Vladimir Zharov, Prof.: development of the ARIADNA software, development of the methods of parameter estimation.

- Aleksander Akosta, post-graduate student: development of the ORBITA software, analysis of the Radioastron data

- Dmitry Duev, post-graduate student: VLBI data processing, troposphere modeling

- Nikolay Voronkov, scientific researcher: global solution

- Svetlana Nosova, 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.

  The latest version of the software called ORBITA is used for solving many tasks during the Radioastron mission: calculation of delay and delay rate for the ground-space interferometer,

orbit determination of the space telescope by numerical integration of the differential equations of motion and use of Doppler tracking, laser ranging and VLBI observations for improvement of the Radioastron orbit on the basis of the Kalman filter. The report about the first successful detection of the interference fringes – a correlated signal on ground-to-space baselines can be found online (http://www.asc.rssi.ru/radioastron/news/newsl/en/newsl_10_en.pdf).

The successful detection of interference fringes demonstrates the overall adequacy of the technique used in the ORBITA software.

- **Routine analysis**

  During 2011 the routine data processing was performed with the ARIADNA software using the least-squares method with rigid constraints. A new approach with non-rigid constraints will be developed for the generation of SINEX files too.

  AC SAI operationally processed the 24-hour and Intensive VLBI sessions. The formation of databases for the VLBI sessions and processing of all sessions is fully automated. The EOP series sai2011a.eops and sai2011a.eopi were calculated. These series were computed with the catalog VTRF2008 of station positions and velocities.

- **Global solution**

  N. Voronkov developed software to obtain a global solution. The radio source coordinates and velocities and the station coordinates and velocities were estimated as global parameters. EOP, troposphere wet zenith delay (approximated as a polynomial function), troposphere gradients, and station clocks (approximated as a polynomial function) were estimated as arc parameters for each session. An experimental catalog of the radio source positions and velocities was obtained.

- **Troposphere modeling**

  At the stations with the meteorological data missing we used surface data files (temporal coverage: four-times daily, spatial coverage: 2.5 degrees latitude x 2.5 degrees longitude global grid) from NCEP/NCAR Reanalyses(http://www.cdc.noaa.gov/data/gridded/data.ncep.reanalysis.surface.html) for calculating air temperature, pressure, and relative humidity. For that purpose a program was written, which interpolates these data to the given coordinates of the station at the time of the observations.

  A test version of the software was developed to use the troposphere zenith delay from the GNSS service in the VLBI analysis.

5. Future Plans

- Continue investigations of VLBI estimation of EOP, station coordinates, and troposphere parameters, and comparison with satellite techniques.

- Development and testing of the version of ARIADNA in which all reductions are performed according to the IERS Conventions (2010).

- Improvement of the ARIADNA software for processing of the GNSS troposphere zenith delays.