IAA VLBI Analysis Center Report 2011

Elena Skurikhina, Sergey Kurdubov, Vadim Gubanov

Abstract

This report presents an overview of IAA VLBI Analysis Center activities during 2011 and the plans for the coming year.

1. General Information

The IAA IVS Analysis Center (IAA AC) is located at the Institute of Applied Astronomy of the Russian Academy of Sciences in St. Petersburg, Russia. The IAA AC contributes to IVS products, such as daily SINEX files, TRF, CRF, rapid and long-term series of EOP, baseline lengths, and tropospheric parameters. EOP, UT1, and station positions were estimated from domestic observation programs Ru-E and Ru-U. The IAA AC generates NGS files.

2. Component Description

The IAA AC performs data processing of all kinds of VLBI observation sessions. For VLBI data analysis we use the QUASAR and the OCCAM/GROSS software packages. All reductions are performed in agreement with IERS Conventions (2010). Both packages use NGS files as input data.

The IAA AC submits to the IVS Data Center all kinds of products: daily SINEX files for EOP and EOP-rates and station position estimates, TRF, CRF, baseline length, and tropospheric parameters.

The QUASAR and the OCCAM/GROSS software packages are supported and developed.

IVS NGS files are generated in automatic mode on a regular basis.

3. Staff

– Vadim Gubanov, Prof.: development of the QUASAR software and development of the methods of stochastic parameter estimation.

– Sergey Kurdubov, Dr.: scientific researcher: development of the QUASAR software, global solution, and DSNX file calculation.

– Elena Skurikhina, Dr.: team coordinator, VLBI data processing, and OCCAM/GROSS software development.

4. Current Status and Activities

- **Software Development for VLBI Processing**

  The QUASAR software is capable of calculating all types of IVS products. A new release of the QUASAR software was developed in 2011 by S. Kurdubov with the ability to estimate a generous amount of new parameters (tidal waves, for example).

- **Routine Analysis**

During 2011 the IAA AC continued to submit daily SINEX files for the IVS-R1 and IVS-R4 sessions as rapid solution (iaa2010a.snx) and SINEX files based on all 24-hour experiments for the quarterly solution.

A new global solution was calculated.

The routine data processing was performed with the OCCAM/GROSS software using a Kalman Filter. The IAA AC operationally processed the "24h" and Intensive VLBI sessions and submitted the results to the IERS and IVS on a regular basis. Processing of the Intensive sessions is fully automated. The EOP series iaa2007a.eops and iaa2005a.eopi, baseline lengths iaa2007a.bl, and troposphere parameters iaa2007a.trl were continued. Long-time series of station coordinates, baseline lengths, and tropospheric parameters (ZTD, gradients) were computed with the station position catalog ITRF2005.

- **EOP Parameter Calculation from Domestic QUASAR Network Observations**

  Regular determinations of Earth orientation parameters with the QUASAR VLBI Network Svetloe-Zelenchukskaya-Badary and single baseline 1-hour observations for UT1 with e-VLBI transfer were performed weekly. Correlation is performed at the IAA correlator ARC. For 2011 the mean RMS EOP deviations from the IERS 08 C04 series in the Ru-E program were 1.0 mas for Pole position, 35 μs for UT1-UTC, and 0.37 mas for Celestial Pole position for 38 Ru-E sessions. The RMS deviation of the Universal Time values from the IERS C04 series for 58 sessions of the Ru-U program was 53 μs. We used station positions from the QUASAR global solution in our calculations.

- **Tidal Deformation of the Earth from VLBI Data Analysis**

  In a study by V. S. Gubanov and S. L. Kurdubov, statistically significant corrections to the parameters of the lunar-solar tides as the complex Love/Shida numbers were obtained from the analysis of VLBI observations carried out in 1985 – 2010 by international geodetic programs on global networks. The new nominal (independent of frequency) values of these parameters (in 10^{-4}) are the following:

  - for total tide $h^{(0)} = (6113 \pm 3) - (33 \pm 2)i, \quad l^{(0)} = (843 \pm 1) - (5 \pm 2)i,$
  - for diurnal tides $h^{(0)} = (6106 \pm 3) - (10 \pm 6)i, \quad l^{(0)} = (843 \pm 1) - (8 \pm 1)i,$
  - for semi-diurnal tides $h^{(0)} = (6106 \pm 3) - (24 \pm 3)i, \quad l^{(0)} = (843 \pm 1) + (3 \pm 1)i.$

  The frequency-dependent effects of resonances in the diurnal tides could not be evaluated because of the existence of close frequencies in their harmonic expansion. In the future, for this purpose it is proposed to involve positional data GPS-measurements. But for 50 VLBI stations we have discovered a new effect of the asymmetry of the horizontal tidal displacement in the direction of tectonic movements of these stations.

- **TSUKUBA station position**

  TSUKUB32 station positions and velocities were estimated. After the Tohoku Earthquake we estimated the station position and velocity using a linear approach for two time steps; results are presented in Table 1.

Table 1. Station positions and velocities for TSUKUB32, epoch 2000.0, in ITRF2005.

Time span	Station Position, m			Velocity, mm/year		
(MJD)	X	Y	Z	V_x	V_y	V_z
until 55631	-3957408.757	3310229.3920	3737494.782	-0.0022	0.0049	-.0053
	± 0.001	± 0.001	± 0.002	± 0.0002	± 0.0001	± 0.0002
55632	-3957405.798	3310231.506	3737495.661	-0.2987	-0.2332	-0.0861
to 55767	± 0.327	± 0.292	± 0.397	± 0.0287	± 0.0256	± 0.0348
55768	-3957408.0631	33310229.231	3737494.3503	-0.1020	-0.0363	0.0266
to present	± 0.117	± 0.101	± 0.121	± 0.0099	± 0.0085	± 0.0102

5. Future Plans

- We plan to continue to submit all types of IVS product contributions.
- Continue investigations of VLBI estimation of EOP, station coordinates, and troposphere parameters, and comparison with satellite techniques.
- Further improve algorithms and software for processing VLBI observations.

References

[1] A. Finkelstein, E. Skurikhina, I. Surkis, A. Ipatov, I. Rahimov, S. Smolentsev, "QUASAR National Programs of EOP Determinations", Measuring the future, Proceedings of the Fifth IVS General Meeting, ed. A. Finkelstein, D. Behrend, St-Petersburg, "Nauka", 2008, p. 319–323.

[2] A. Finkelstein, A. Salnikov, A. Ipatov, S. Smolentsev, I. Surkis, I. Gayazov, I. Rahimov, A. Dyakov, R. Sergeev, E. Skurikhina, S. Kurdubov, EOP determination from observations of Russian VLBI-network QUASAR, in Proceedings of the 20th Meeting of the European VLBI Group for Geodesy and Astronomy, Ed. by W. Alef, S. Bernhart, A. Nothnagel, 2011, IGG, Germany, p. 49–51.