IAA VLBI Analysis Center Report 2006

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Abstract

This report presents an overview of IAA VLBI Analysis Center activities during 2006 and the plans for the coming year. The activities of the IAA VLBI Analysis Center developed in two directions: first, routine computations of Earth orientation parameters (EOP), baseline lengths, tropospheric parameters from 24-h sessions and UT1-UTC from IVS Intensive sessions with OCCAM/GROSS software and submission of the results to IVS, and secondly, QUASAR software development with the aim to use one software for generation of our contribution to all kinds of IVS products in 2007.

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. IAA AC contributes to IVS products, such as rapid and long-term series of EOP, station position, tropospheric parameters.

2. Component Description

IAA AC performs routine VLBI data processing using OCCAM/GROSS software. EOPs, EOPi, baseline length, tropospheric parameters are submitted to the IVS on a regular basis. QUASAR software was further developed to conform with IERS Conventions (2003) and to add the possibility to output Daily SINEX files. Global solution was calculated with QUASAR package and was submitted to IVS after Analysis Coordinator approval. IVS NGS-files are generated regularly in automatic mode.

3. Staff

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

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

– Elena Skurikhina, Dr., VLBI data processing, OCCAM/GROSS software development.

– George Krasinsky, Prof., development of new Precession-Nutation Theory based on numerical integration of refined differential equations of the Earth rotation.

– Zinovy Malkin, Dr. (until August), data transmission automatization, EOP-Intensive data processing, OCCAM/GROSS software development, empirical nutation model development.

– Yulia Sokolova, scientific researcher (until March), CRF realization comparison and combination.

4. Current Status and Activities

- **Routine analysis**
  During 2006 the routine data processing was performed with OCCAM/GROSS software

using Kalman Filter. IAA AC provided the operational processing of the "24h" and Intensive VLBI sessions. Submitting the results to the IERS and IVS was performed on a regular basis. Processing of the Intensive sessions is fully automated. The EOP series iaa2005a.eops and iaa2005a.eopi, iaa2005a.bl and troposphere parameters iaa2005a.trl were continued. At the moment, the EOPS series contains 3333 estimates of pole coordinates, UT1, and celestial pole offsets, and the EOPI series contains 5472 estimates of UT1. New long-time series of station coordinates, baseline lengths, and tropospheric parameters (ZTD, gradients) were computed with the station position catalog ITRF2005. Analysis of the results is in progress. New series iaa2007a.eops, iaa2007a.eopi, iaa2007a.bl, iaa2007a.tro and iaa2007a.trl calculated with ITRF2005 station position catalog and new model of station position correction due to oceanic loading will be presented in the near future.

- **Software development for VLBI processing**

  Development of the OCCAM/GROSS software was continued to provide intraday EOP variations.

  QUASAR software [2, 4] was made compatible with the IERS Conventions (2003), and the possibility to output Daily SINEX files was added in 2006. The QUASAR software was developed to provide contributions to IVS products. The software is able to calculate all types of IVS products. After Analysis Coordinator approval, Daily SINEX files will be submitted to IVS on a regular basis and for quarterly solution [3].

- **Global solution**

  In 2006, a global solution [1] using the QUASAR software was obtained and tested for submission to IVS. All available data for 1979–2006 were processed. Stochastic signals were estimated by means of the least-squares collocation technique. The radio source coordinates, station coordinates and velocities were estimated as global parameters. EOP, WZD (linear trend plus stochastic signal), troposphere gradients, station clocks (quadratic trend plus stochastic signal) were estimated as arc parameters for each session.

  3791 24-hours sessions, 4823609 delays have been processed. 2522 global parameters have been estimated: 745 radio-source positions, positions and velocities of 132 VLBI stations (14 with discontinuities).

  Transformation parameters (47 stations were used for calculations) vs. VTRF2005 are listed in Table 1, residuals amount to 6 mm for 1997.0 and 8 mm for 2005.0.

Table 1. Transformation parameters between VTRF2005 and obtained catalogue for two epoch

EPOCH	T1,mm	T2,mm	T3,mm	D, 10^{-9}	R1,mas	R2,mas	R3,mas
2005.0	4.6	-5.3	8.5	-1.9	.027	-.010	.004
1997.0	4.7	-5.3	5.0	-1.6	-.062	-.090	-.005

Fixing the frame was performed by the minimal set of no-net-rotation/translation constraints.

- CRF: no-net-rotation w.r.t. ICRF-Ext.2, using 212 defining sources of ICRF
- TRF: no-net-rotation/translation w.r.t. VTRF2003 using 12 stations of VTRF2003

The mean formal errors of source catalogue were in right ascension 0.15 mas, and in declination 0.12 mas. WRMS differences vs. ICRF.Ext2 was 0.2 mas in right ascension and declination (for statistic on differences used common sources observed more than 3 sessions more 20 times, total 574 sources).

- **Station position estimation**

The station positions of Zelenchukskaya and Badary (Table 2) were calculated in the ITRF2005 reference frame. A-priori values for the velocity components were used from GSP data analysis in both cases. The station position of Zelenchukskaya was calculated from the treatment of 57 IVS 24-hour sessions. These values were used for station Badary coordinate estimation.

Table 2. Station positions and velocities for Zelenchukskaya and Badary, epoch 2000.0, in ITRF2005

Station	Station Position, m			Velocity, mm/year		
	X	Y	Z	V_x	V_y	V_z
Badary	-838200.732 ± 0.006	3865751.582 ± 0.016	4987670.962 ± 0.026	-.0253	0.0002	-.0037
Zelenchukskaya	3451207.819 ± 0.011	3060375.220 ± 0.008	4391914.937 ± 0.014	-.0220	.0156	.0082

The station position of Badary was calculated from processing 8 24-hour observational sessions from August through December 2006 with VLBI network Svetloe-Zelenchukskaya-Badary using the S2 registration system. Correlation was performed on MicroParsec correlator of IAA. Figure 1 shows the time series of station positions for Badary station.

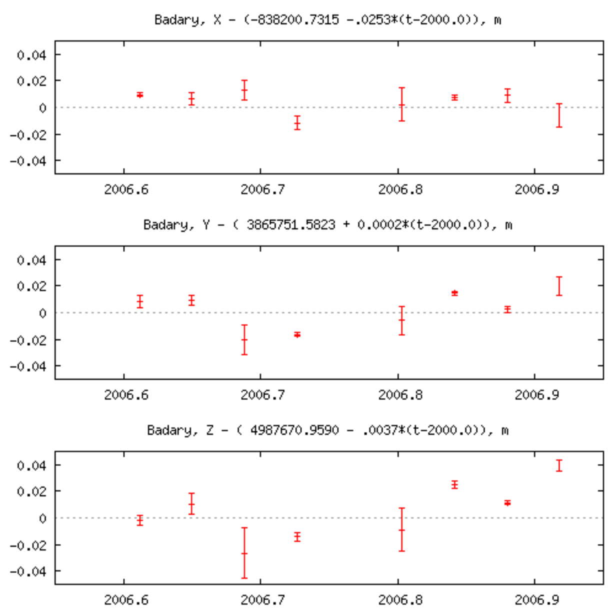

Figure 1. Badary station position time series.

- **Subdaily EOP parameter calculation**
  Earth Rotation Parameters with high resolution were calculated from CONT05 VLBI observing campaign data processing using two different approaches: (1) one 15-day session and (2) global solution for 15 24-hour sessions using Kalman Filter and Least Squares Collocation Methods for Parameter estimation [5, 6].
- **IVS NGS card generation**
  Operational computation of the NGS cards was continued. NGS cards are computed in automated mode. To reduce the delay in delivering NGS cards to the users, IVS data archive is now checked for new files every 6 hours.

  IAA archive of VLBI observations and products was supported. At present, all available X and S databases and NGS cards are stored.

5. Future Plans

- Provide contribution to all types of IVS products (EOP-S, EOP-I, TRF, CRF, Daily Solution Files, Tropospheric Parameters, Time Series of Baseline Lengths) with new QUASAR software.
- Continue regular computation of operational and long-time EOP, station coordinates, and troposphere parameters series with OCCAM software (at least to March 2007).
- Continue investigations of VLBI estimation of EOP, station coordinates, and troposphere parameters, and comparison with satellite techniques.
- Calculation and study of intraday EOP variation.
- Further improvement of algorithms and software for processing the VLBI observations.
- Continue to compute and provide to IVS the NGS cards, every 1-hour for Intensive sessions.

References

[1] Gubanov V. S., Kurdubov S.L. On global solution from VLBI observations. IAA Comm., v. 13, 2005, .434-439. 14.

[2] Gubanov V. S., Kurdubov S.L., Surkis I.F. New Software QUASAR for VLBI oservations data processing. IAA Comm., v. 16, (in Russian, in print).

[3] Kurdubov S. L., Skurikhina E. A. QUASAR software development for using in IAA EOP service. IAA Comm., v. 16, (in Russian, in print).

[4] Kurdubov S. L. Covariation analysis of stochastic parameters of VLBI observations model. IAA Comm., v. 14, 2006, .138-157.

[5] Finkelstein A.M., Ipatov A.V., Smolentsev S.G., Rahimov I.A., Skurikhina E.A., Kurdubov S. L. CONT05: preliminary results. IAA Comm., v. 14, 2006, .3-19.

[6] Finkelstein A.M., Ipatov A.V., Smolentsev S.G., Rahimov I.A., Skurikhina E.A., Kurdubov S. L. CONT05: High-frequency Earth Rotation Parameters from VLBI observations. Proc. XXVI IAU General Assembly, "Highlights of Astronomy", v.14 (in print).