

PUL IVS Analysis Center Report 2007

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Abstract

The report briefly presents the PUL IVS Analysis Center activities during 2007 and plans for the coming year. Main topics of investigation in that period were comparison and combination of catalogues of radio source positions, analysis of VLBI EOP series, analysis of radio source position and zenith troposphere delay time series.

1. General Information

The PUL IVS Analysis Center was organized in September 2006 and is located at the Central Astronomical Observatory at Pulkovo of Russian Academy of Sciences (Pulkovo Observatory). The main topics of our activity are:

- Improvement of the International Celestial Reference Frame (ICRF), including investigations of radio source catalogues, constructing combined catalogues, investigation of the ICRF stability, and investigation of radio source position time series.
- Computation and analysis of EOP, station position, baseline length and zenith troposphere delay time series.
- Investigation of Free Core Nutation (FCN).
- Comparison of VLBI results with other space geodesy techniques.

The PUL AC's Web page is available at http://www.gao.spb.ru/english/as/ac_vlbi/.

2. Scientific Staff

PUL team consists of three scientists:

1. Zinovy Malkin (70%) — team coordinator, computation and analysis of EOP, station coordinates and baseline length, development of algorithms and software for data processing and analysis;
2. Julia Sokolova (100%) — global data analysis for deriving radio source catalogues and position time series, comparison and combination of radio source catalogues, time series analysis, development of algorithms and software for CRF studies;
3. Natalia Miller (20%) — investigation of FCN and zenith troposphere delay; application of new mathematical methods to time series analysis.

3. Activities

The activities of the PUL IVS Analysis Center during 2007 included:

- Investigations in the framework of the IERS/IVS Working Group on the Second Realization of the ICRF were continued. Main directions of this activity are comparison and combination of radio source catalogues, computation and investigation of source position time series. The main results obtained in 2007 are the following.

- Two combined radio source catalogues have been constructed and investigated [1]. The first of them provides a stochastic improvement of the current ICRF realization, and the second one allows us to account also for systematic errors in the ICRF. Comparison of the celestial pole offsets obtained from the processing of VLBI observations using ICRF and the combined catalogue has shown improvement of the results. Further improvement is expected after refining the comparison and combination procedures.
- A new method of assessment of the CRF accuracy based on the scatter analysis of the celestial pole offset (CPO) time series is proposed [2]. Several scatter indices based on residual analysis of CPO series with respect to a FCN model and Allan deviation technique and its extensions, which allow the treatment of unequally weighted and multidimensional observations, are investigated. Application of these criteria to several radio source catalogues showed their ability to perform a preliminary assessment of the quality of the CRF realizations.
- Several radio source catalogues and source position time series from a global analysis of VLBI data with the OCCAM 6.2 software were calculated using different modes. Comparison of four lists of reference sources showed significant inconsistencies in source selection. The impact of radio source instability on celestial pole offset estimates was investigated. Analysis showed that variations of radio-source coordinates affect the celestial pole offset estimates (Fig. 1, [6]). These results mainly were obtained during a 6-month visit of Julia Sokolova at the Institute of Geodesy and Geophysics (IGG), Vienna in March–August 2007.
- The first version of a new list of the optical characteristics of geodetic radio sources is compiled. Further development is being performed in cooperation with Geoscience Australia Analysis Center and Pulkovo optical astronomers.

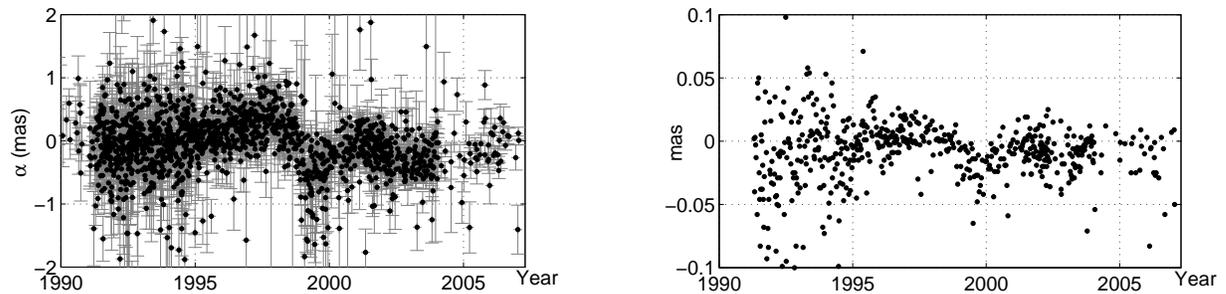


Figure 1. Variations of source 2145+067 positions (left) and differences between two CPO time series (right). For the first CPO series, all the observations were used. For the second CPO series, the observations of 2145+067 were excluded. Source and station positions were fixed in both cases.

- The IVS combined CPO time series was analyzed using several statistical tools, such as spectrum analysis, singular spectrum analysis, or wavelet analysis to investigate both trend and (quasi)periodical components. The results are presented in [4]
- A new VLBI network geometry index, the volume of network, is examined as an indicator of the quality of the EOP obtained from VLBI observations [5]. It has been shown that both EOP precision and accuracy can be described by a power law $\sigma = aV^b$, where V is the volume

of network, in a wide range of network size from domestic to global VLBI networks. The dependence found can be used for comparison of results obtained from different observing programs.

- Several very long and very dense zenith troposphere delay time series provided by the IGG IVS Special Analysis Center as an IVS troposphere product were analyzed by means of the method of Singular Spectrum Analysis (SSA) in both one-dimensional and multi-dimensional modes. The structure of the time series including regular, quasiregular (periodical) and irregular (trend) components was obtained and investigated. Using SSA allowed us to derive nonlinear trends in zenith troposphere delay, and also to research the variation of amplitude and phase of season components with time.
- Regular computation of two refined Free Core Nutation (FCN) time series started in 2006 were continued. They were briefly described in the PUL IVS Analysis Center Report 2006. More detailed description and comparison with other models are given in [3]
- Development of algorithms and software for data processing and analysis was continued.
- PUL archive of VLBI data and products was originated in the end of 2006. At present, all available databases and NGS cards have been stored along with main IVS and IERS products.
- PUL staff members participated in activities of several IVS projects, Working Groups and Committees.

4. Outlook

Plans for the coming year include:

- Continuation of the IVS related studies.
- Development of algorithms and software used for data processing.
- Support of the PUL archive of data and products.

References

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