PUL IVS Analysis Center Report 2006

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Abstract

This report briefly presents the PUL IVS Analysis Center activities during 2006 and plans for the coming year. The main topics of investigations in 2006 were improvement of celestial reference frame ICRF, modelling of the Free Core Nutation and software development. Other projects, such as regular contribution to the IVS products and radio source mapping, are underway.

1. General Information

The PUL IVS Analysis Center is located at the Central (Pulkovo) Astronomical Observatory of the Russian Academy of Sciences, widely known as Pulkovo Observatory. It was established in September 2006. Its main activities are:

- Improvement of the International Celestial Reference Frame (ICRF), including investigations of radio source catalogues, construction of combined catalogues, investigation of the ICRF stability, and investigation of radio source structure and its variability.

- Computation and investigation of EOP, station position, and baseline length time series.

- Comparison of VLBI products with other space geodesy techniques.

The analysis center supports a web page at `http://www.gao.spb.ru/english/as/ac_vlbi/`.

2. Scientific Staff

The PUL team consists of three scientists:

1. Zinovy Malkin (90%) — team coordinator, computation and analysis of EOP, station coordinates and baseline length, development of algorithms and software for data processing;

2. Julia Sokolova (100%) — global data analysis for deriving radio source catalogues and source position time series, comparison and combination of radio source catalogues, development of algorithms and software for CRF studies;

3. Anisa Bajkova (10%) — image processing and analysis, development of algorithms and software for image processing.

3. Analysis Activities

The activities of the PUL IVS Analysis Center during 2006 included:

- Investigations in the framework of the IVS Pilot Project "Next ICRF" (now IERS/IVS Working Group on the Second Realization of the ICRF) were started. Main emphasis in this activity was on the computation of radio source catalogues, their comparison and combination:

  - The impact of radio source instability on celestial pole offset estimates was investigated [1]. No significant effect was found.

- The first version of the radio source catalogue and source position time series from a global analysis of the VLBI data with the OCCAM 6.2 software was completed. An investigation of the results is underway.

- Four methods of representation of the systematic part of the position differences in radio source catalogues were examined [2]. These were simple rotation, rotation plus deformation (used at the IERS ICRS Product Center since 1995), and expansion in orthogonal functions (Legendre-Fourier polynomials and spherical functions). Using Legendre-Fourier functions proved to be the most accurate method. The method of comparison of radio source catalogues used by the IERS evidently does not provide adequate representation of the systematic differences in the modern VLBI catalogues.

- Initial versions of two combined radio source catalogues were constructed [2]. The first of them provides an improvement of the current realization of the ICRF in terms of random errors, and the second one allows us to account for possible ICRF systematic errors. A comparison of celestial pole offsets obtained from processing of VLBI observations using ITRF and the second combined catalog showed that even using this initial version improves the results by about 5%. Further improvement is expected after refining our combination procedures.

- A regular computation of two refined Free Core Nutation (FCN) time series was started in the end of 2006. The first series makes use of an empirical model with variable amplitude and phase [3, 4]. This model is provided for the period from 1984.0 to two years before the current date to obtain geophysically meaningful data without edge effect. The IVS combined EOP series is used for the computation of the differences between observations and the IAU2000A nutation model. The model is aimed primarily at users who are interested in the geophysical interpretation of the observations.

  The second FCN series is computed by smoothing the IVS combined EOP series, and includes a forward and backward prediction covering the period from 1976 to two years beyond the current date. It is aimed primarily at users who need maximum accuracy for the CRF↔TRF transformation, including real-time applications, without bothering about theoretical background and geophysical meaning.

- Development of software for data processing was continued.

- PUL archive of VLBI observations and products was originated. At present, all available databases and X-band NGS cards have been stored.

- PUL staff members participated in the activities of various IVS projects, Working Groups and Committees.

4. Outlook

Plans for the coming year include:

- Further improvement of algorithms and software for processing of VLBI observations.

- Start of regular processing of VLBI data.

- Continuation of the investigations listed above.

- Support of the PUL archive for data and products.

References

[1] Sokolova, Ju. Influence of the unstable radiosources on the celestial pole offset estimations. Proc. Journées Systèmes de Référence Spatio-temporels 2005, Paris, 2006, 125-126.

[2] Sokolova, Ju. and Malkin, Z. Systematic Errors and Combination of the Individual CRF Solutions in the Framework of the IVS ICRF Pilot Project. XXVIth IAU General Assembly, Prague, Czech Republic, 14-25 Aug 2006.

[3] Malkin Z. M. Comparison of VLBI nutation series with the IAU2000A model. In: Proc. Journées Systèmes de Référence Spatio-temporels 2003, St. Petersburg, Russia, Sep 22–25, 2003, Eds. A. Finkelstein, N. Capitaine, 2004, 24–31.

[4] Malkin Z. A New Free Core Nutation Model with Variable Amplitude and Period. In: IVS 2004 General Meeting Proc., Eds. N. R. Vandenberg, K. D. Baver, NASA/CP-2004-212255, 2004, 388–392.