EXTENSION OF THE CELESTIAL REFERENCE FRAME

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ABSTRACT. A set of VLBI observations carried out since 1992 till August 2004 were analyzed to construct a Celestial Reference Frame. Data processing was conducted according to IERS Conventions 2003 with the software SteelBreeze. Coordinates of stations and Earth Rotation Parameters were fixed and their values were taken as a priori from the VTRF2003 and EOP(IERS) C 04 solutions. In total, the obtained extension of Celestial Reference Frame consists of positions of 2028 radio sources.

1. CONSTRUCTION OF EXTENDED CELESTIAL REFERENCE FRAME

In common practice of Very Long Baseline Interferometry (VLBI) observations a set of determined radio sources are used. These 667 radio sources from ICRF-Ext.1 catalogue are defining the realization of the International Celestial Reference System (IERS, 1999). However, there are VLBI experiments which are aimed on observing and determining positions of new radio sources (Beasley at al., 2002).

Available geodetic VLBI observations contain about 2300 radio sources. Most of them were observed during one or two sessions, and, usually, these sessions are not suitable for determining TRF, CRF and EOP in common solution due to geometry of network.

In order to extend the Celestial Reference Frame on these rarely observed radio sources we fixed Terrestrial Reference Frame (TRF) by the values from VTRF2003 catalogue, the motion of the Celestial Intermediate Pole (CIP) in TRF by the EOP(IERS) C 04 solution and the motion of the CIP in Celestial Reference Frame by the model of IAU-2000A Nutation-Precession Theory.

2. OBSERVATIONS AND ANALYSIS

Almost all available VLBI observations, which were conducted since begin of 1992 till the end of August 2004 were processed. In total, 3,830,124 dual frequency delays acquired on 1,911 VLBI sessions were analyzed. Observations of 2256 radio sources were carried out by 72 stations.

Data analysis was performed by the software SteelBreeze. Coordinates of radio sources were estimated as global parameters. Station clock function, wet zenith delay and its gradients were estimated as the stochastic ones.

VLBI data processing was performed according to models which are described in IERS Conventions (2003): the IAU-2000A Nutation-Precession Theory with non-rotating origin procedure was applied for transformation between CRF and TRF; hydrostatic zenith delays were modeled according to Saastamoinen (1972) and wet zenith delays were estimated from the observations; mapping functions for hydrostatic and wet zenith delays were calculated according to: MTT mapping functions (Herring, 1992), if meteoparameters of a station were reliable, and NMF2 mapping functions (Niell, 1996), if the meteoparameters were suspicious. Stochastic parameters were modeled as random walk process.

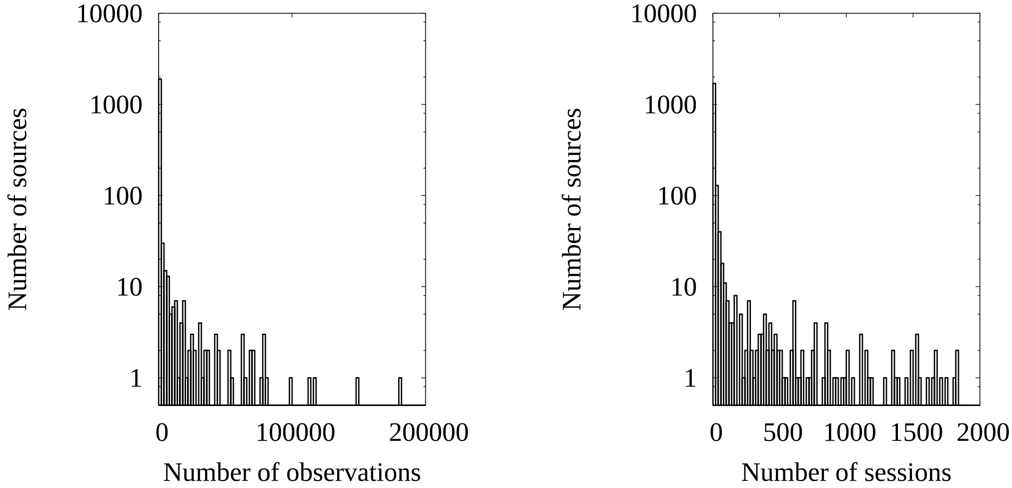

Figure 1: Distribution of observations.

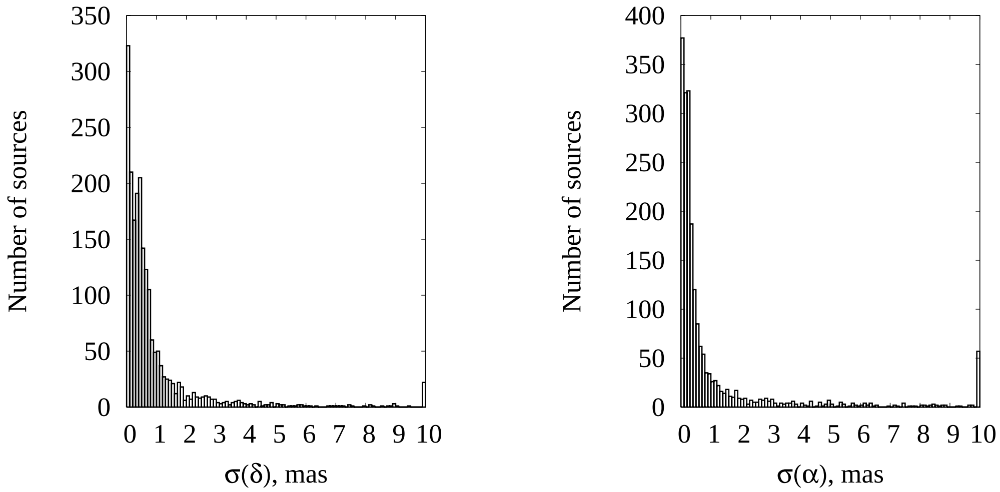

Figure 2: Distribution of errors.

After eliminating outliers during pre-processing, VLBI data were analyzed. Coordinates of radio sources which were observed 5 or more times were estimated. The results are based on 3,447,906 time delays acquired by 71 VLBI stations. Constructed Celestial Reference Frame consist 2028 radio sources. Weighted post fit residuals were 8.8 ps.

The histograms of distribution of numbers of observed radio sources are shown on the Fig. 1. The distributions of the uncertainties of the coordinates of radio sources are presented on the Fig. 2.

Obtained solution of the extended CRF is available online on the following URL:

$$ftp://ftp.mao.kiev.ua/pub/users/bolotin/VLBI/mao\_new.crf$$

3. CONCLUSIONS

Data analysis of the VLBI observations 1992–2004 were performed to extend CRF on rarely observed radio sources. The orientation of the obtained CRF is defined by VTRF2003, the solution EOP(IERS) C 04 and IAU-2000A Nutation-Precession Theory. Extended CRF contains positions of 2028 radio sources.

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4. REFERENCES

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