Bordeaux Observatory Analysis Center Report

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Abstract

This report summarizes the activities of the Bordeaux Observatory Analysis Center during the year 2003. On the analysis side, we have completed processing of five years of NEOS-A/IVS-R4 data (1999–2003) and obtained preliminary results for the temporal evolution of the source positions over this period. On the research side, our major achievements include the organisation and scheduling of a third experiment as part of our ICRF densification project in the northern sky, and evaluation of astrometric suitability for additional sources at S, X, K and Q bands. Plans for the year 2004 follow the same analysis and research lines.

1. General Information

The Bordeaux Observatory Analysis Center is located in Floirac, near the city of Bordeaux, in the southwest of France. It is funded by the University of Bordeaux and the CNRS (National Center for Scientific Research).

Our work is focused on the maintenance, extension, and improvement of the celestial reference frame. In particular, we lead an observing program on the European VLBI Network (EVN) to densify the International Celestial Reference Frame (ICRF) [1] and conduct research related to the effect of source structure in geodetic VLBI data [2]. Additionally, we develop routine analyses of IVS data with the aim of studying the ICRF source position stability and the physical phenomena that can affect this stability.

VLBI analyses are conducted with the MODEST software, developed and maintained by the Jet Propulsion Laboratory [3]. It is installed on a Compaq DS20 workstation along with the AIPS and DIFMAP imaging software.

As a result of reorganisation of the University network, the Observatory www address and all email adresses for people at the Observatory changed in June 2003. These are now:

name@obs.u-bordeaux1.fr
http://www.obs.u-bordeaux1.fr

2. Scientific Staff

Our group is composed of the following three individuals, who are involved part or full time in IVS analysis and research activities, as described below:

- Patrick Charlot (50%): overall responsibility for Analysis Center work and data processing. He is the PI of the ICRF densification project on the EVN. He is also involved in radio source imaging and has a major interest in studying source structure effects in geodetic VLBI data.
- Antoine Bellanger (100%): engineer with background in statistics and computer science. His main role is to conduct initial data processing and develop analysis tools as needed. In the future, he will also maintain a web site dedicated to our analysis activities.
- Alain Baudry (10%): radioastronomy expert. He is involved in the ICRF densification project and has interest in radio source imaging.

3. Analysis and Research Activities during 2003

During the past year, our level of activity has been stable. On the analysis side, we have completed initial processing of all NEOS-A and IVS-R4 sessions conducted between 1999 and 2003 and have started to analyze the 2003 IVS-R1 sessions. Additionally, we have derived preliminary time series of source positions based on this data set. Figure 1 shows an example of such "arc" positions (monthly estimates) for the source 0229+131. These results will be refined in the future while we keep on analyzing new sessions as they become available.

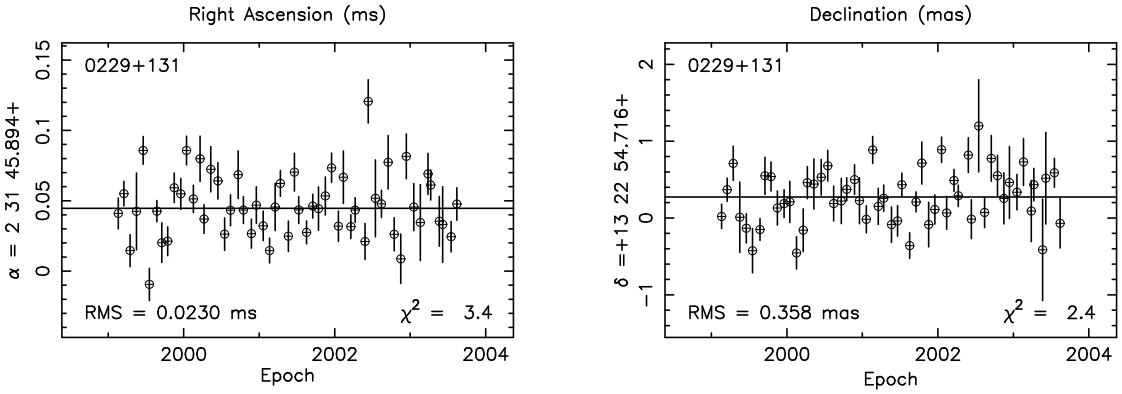

Figure 1. Estimated monthly coordinates for the source 0229+131 between 1999 and 2003.

On the research side, we have pursued further our observing program for densifying the ICRF in the northern sky. As described in [1], the aim of this project is to add 150 new sources at carefully selected sky locations to fill the "empty" regions of the frame and improve the overall source distribution. Following our initial two experiments in 2000 and 2002 (each observing 50 new sources) [4, 5], an additional third experiment was carried out on October 27, 2003, to complete this project. The network used for the latter comprised seven telescopes from the European VLBI Network (EVN) along with three external non-EVN geodetic stations that agreed to join this project. The participating telescopes are listed in Table 1. The data from this experiment have just been correlated with the Bonn Mark IV correlator. Final fringe-fitting, data export, and astrometric analysis should be conducted shortly.

Table 1. Network used in third ICRF densification experiment.

EVN telescopes	Non-EVN telescopes
Effelsberg	Algonquin Park
Medicina	Goldstone (DSS 13)
Noto	Ny Alesund
Onsala	
Hartebeestoek	
Urumqi	
Shanghai	

Another achievement is the evaluation of astrometric suitability for an additional 60 ICRF sources based on newly-available X- and S-band maps in the Radio Reference Frame Image Database. Structure indices were derived according to the average structural delay effects for these sources following our standard scheme [6]. Overall, structure indices are now available for 450 ICRF sources, about 75% of the total number of ICRF sources [7]. Analysis of the structure index distribution shows that 57% of the sources in this sample have a structure index value of either 1 or 2 at X band, indicating compact or very compact structure. At S band, structural effects are less significant (89% of the sources have a structure index value of either 1 or 2), a consequence of the fact that the S-band structure corrections are scaled down as a result of the dual-frequency group-delay calibration applied to eliminate propagation effects in the ionosphere.

Additionally, we have also evaluated the astrometric suitability of 108 ICRF sources at K band (24 GHz) and Q band (43 GHz) based on data acquired by the VLBA K-Q Survey collaboration [8] in May, August and December 2002. The major goals of this project are to extend the ICRF in the 24–43 GHz range and to enhance VLBI phase-referencing at high frequency by increasing the number of calibrators available at these frequencies. As reported in [7], comparison of the structure index distribution at K and Q bands with that at the standard X band frequency is striking, indicating a larger portion of structure index values of 1 as observing frequency increases (32% at 8 GHz, 56% at 24 GHz, and 71% at 43 GHz). Hence, these initial results already suggest that the astrometric suitability of the sources is significantly better at 24 GHz and 43 GHz than at the standard 8 GHz geodetic observing frequency.

4. Outlook

During the year 2004, our plans include the following:

- Refine our "arc position" analysis of the 1999–2003 NEOS-A and IVS-R4 sessions to monitor the temporal evolution of the source coordinates, and keep on analyzing the new IVS 2004 sessions as they become available.
- Finish up post-processing and analysis for all three ICRF densification experiments, and compare the derived astrometric positions with those from the VLBA Calibrator Survey.
- Continue to evaluate the astrometric suitability of the ICRF sources as new maps become available at S, X, K and Q bands, and make the corresponding structure indices and structure correction images available through our web page.
- Assess more precisely the impact of massive source structure modeling in astrometric data analysis by repeating our previous test on the RDV data [9] after identification of the most appropriate structural reference feature for each source.
- Start processing RDV experiments in cooperation with the USNO team to monitor the X- and S-band structural evolution of the ICRF sources and extend the time basis of the current image data base.
- Re-design our web page[1] to make multi-epoch and multi-frequency structure indices and false color structure correction images publicly available, along with results of source position stability, for possible use by IVS operation and analysis centers.

[1] http://www.obs.u-bordeaux1.fr/public/radio/PCharlot/structure.html

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