Bordeaux Observatory Analysis Center Report

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Abstract

This report summarizes the activities of the Bordeaux Observatory Analysis Center during the year 2001. During this period, our group has been strengthened by the arrival of a new engineer, allowing us to start routine IVS data analysis. On the research side, our achievements include processing of our initial ICRF densification experiment, the study of source structure index variations with time, and the first attempt to massively model source structure in actual VLBI data. Plans for the year 2002 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 are undertaking 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]. Just recently, we have also started regular IVS data analysis, with the ultimate goal of studying the ICRF source position stability and the physical phenomena that can affect this stability.

VLBI analyses are carried out with the MODEST software, developed and maintained by the Jet Propulsion Laboratory [3]. It is installed on a Compaq DS20 workstation. We also have the Goddard data base system and related software like SKED available on an old HP workstation. The AIPS and DIFMAP imaging software are installed on both workstations.

2. Scientific Staff

Our group, reduced to two individuals since July 2000 after the departure of Bruno Viateau, was greatly reinforced this year by the arrival of a new engineer (Antoine Bellanger) in September 2001. It is now composed of the following three individuals (see picture in Fig. 1), 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. In the future, he will also develop analysis tools and 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.

Figure 1. The Bordeaux Observatory Analysis Center team. From left to right: A. Bellanger, P. Charlot and A. Baudry.

3. Analysis and Research Activities During 2001

During the past few months, our level of activity has significantly increased thanks to the arrival of Antoine Bellanger in our group. His arrival has allowed us to start routine IVS data analysis. At the end of the year 2001, we had completed initial processing of the first 35 NEOS-A sessions of 1999. We expect to continue such routine analysis during the coming year and catch up with the most recent data.

Research activities have also been pursued along the lines described in our previous report [4]. These have focused on the ICRF densification, source structure index monitoring, and massive source structure modeling in actual VLBI data. A brief summary of our achievements in these areas is given below.

- ICRF densification:
  During the past year, the data of our initial experiment, which observed 50 new sources in the northern sky (see [4] for details on this experiment), have been correlated and fringe-fitted, and preliminary source positions have been obtained. Comparison of these preliminary positions with those of the recently published VLBA Calibrator Survey [5] indicates agreement at the milliarcsecond level for the majority of the sources. A new proposal has been submitted for observing the remaining 100 sources of our list. This proposal has just been approved, and the two additional 24-hour experiments requested should be carried out during the year 2002.

- Source structure index monitoring:
  As an extension to our previous work which estimated single-epoch structure indices for $\sim$ 400 ICRF sources (as an indicator of their astrometric suitability) [6], we have started to investigate the time evolution of these structure indices. For this investigation, we have used the series of dual-frequency S- and X-band maps available from the USNO data base. Based on a maximum of 10 map epochs per source spanning $\sim$ 1.5 years, our calculation indicates that source structure indices generally vary by no more than one unit. In the future we will continue such structure index monitoring as new maps become available.
- Massive source structure modeling in actual VLBI data:
  During a visit of O. J. Sovers to Bordeaux (September 2001), we have carried out the first-ever VLBI analysis with massive application of structure maps to correct for the effect of source structure in actual geodetic VLBI data. A total of 800 maps (from the USNO data base) have been used to derive structure corrections for $\sim$ 200000 delay and delay rate pairs observed during 10 RDV experiments from January 1997 to August 1998. Our preliminary results indicate a decrease of a few picoseconds in the postfit rms residuals when applying structure corrections, with a larger improvement for sources with a larger structure index.

In connection with these research activities, one of us (P. Charlot) spent a total of two weeks at MPIfR/Bonn in January and December 2001 to learn the basics of correlation and fringe-fitting with the new Bonn Mark IV correlator. The data processed during these visits include those of our ICRF densification experiment and those of a non-standard 5 GHz geodetic experiment aimed at improving the coordinates of three non-geodetic EVN telescopes [7].

Also to be mentioned is the participation of P. Charlot in the IVS Working Group 2 for Product Specification and Observing Programs, and as such his contribution to the writing and reviewing of the WG2 report (available in this volume).

4. Outlook

During the year 2002, our plans include the following:

- Continue the analysis of the NEOS-A sessions in 1999, 2000 and 2001, and begin to produce time series of source positions. As stated in our initial IVS proposal [8], the aim of such analyses is to study the ICRF source position stability.
- Terminate the analysis of our first ICRF densification experiment, assess the results, and prepare the two subsequent experiments (to be scheduled in 2002), which are dedicated to observe 100 additional new sources.
- Pursue further our analysis of the RDV data with massive source structure modeling, especially by searching for the most appropriate reference point within the structure of each source, and assess the overall impact of source structure in these data.
- Continue to evaluate the astrometric quality of the ICRF sources by calculating source structure indices and monitor these structure indices as new maps are available.
- Update our web page[1] by making multi-epoch structure indices and false color structure correction images publicly available for possible use by IVS operation centers and analysis centers.

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

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