USNO Analysis Center for Source Structure Report

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Abstract

This report summarizes the activities of the United States Naval Observatory Analysis Center for Source Structure from its inception in January 2000 to the end of the calendar year 2000. The report forecasts activities planned for the year 2001.

1. Analysis Center Operation

The Analysis Center for Source Structure is supported and operated by the United States Naval Observatory (USNO).

The main mission of the Analysis Center is to analyze VLBI data to extract intrinsic source structure information for use in maintaining the International Celestial Reference Frame (ICRF). Source structure information is provided in the form of synthesis images and source models suitable for evaluating sources for astrometric and/or geodetic use and for long–term monitoring of sources. Research into the effects of source structure on astrometric position determination is also carried out with emphasis on improving the long–term stability of the ICRF.

The web server for the Analysis Center is provided by the USNO. The temporary address is:

`http://www.usno.navy.mil/RRFID/`

The Radio Reference Frame Image Database (RRFID) web site holds information on the radio frequency intrinsic structure of most ICRF sources with declination greater than −30 degrees. Both the raw data and processed images (with their associated source models) can be obtained from this site. Links to the astrometric suitability of the sources, as derived by Fey & Charlot (2000, Astrophysical Journal Supplement Series, Vol. 128, pp. 17–83 and references therein), are also provided. A new web site devoted exclusively to the Analysis Center for Source Structure is planned.

2. Initial Activities

In December 1999, the USNO proposed to become an IVS Analysis Center. The USNO Analysis Center for Source Structure was accepted by the IVS as a Special Associate Analysis Center in January 2000.

The charter of the Analysis Center is to provide products directly related to the IVS determination of the "definition and maintenance of the celestial reference frame." These include, primarily, radio frequency images of ICRF sources, intrinsic structure models derived from the radio images, and an assessment of the astrometric quality of the ICRF sources based on their intrinsic structure.

The USNO has, since mid–1996, hosted the Radio Reference Frame Image Database (RRFID), a web accessible database of radio frequency images of most ICRF sources with declination greater than −30 degrees. Images are available at both S–band (13 cm) and X–band (3.6 cm), the standard frequencies used for VLBI astrometric and geodetic observations. Observations are taken from both the geodetic/astrometric database and from RDV observations. The RDV experiments are a joint collaboration between the USNO, Goddard Space Flight Center and the National Radio

Astronomy Observatory (NRAO). During each 24 hour RDV session, about 70 ICRF sources are observed at S/X band using the NRAO Very Long Baseline Array (VLBA) antennas together with up to 10 additional geodetic antennas. The resulting intrinsic source structure information provides a valuable resource for evaluating the astrometric suitability of the extragalactic sources used to define the ICRF.

The Analysis Center currently has a program of active research investigating the effects of intrinsic source structure on astrometric position determination. Results of this program are published in the scientific literature.

3. Current Activities

Since the inception of the USNO Analysis Center, three VLBA RDV experiments have been processed and imaged. These include the RDV07, RDV08 and RDV09 sessions. Processing of RDV10 is under way.

The RRFID has contributed data to the structure analysis of Fey & Charlot (2000). The resultant "Structure Index" is available from Patrick Charlot at

`http://www.observ.u-bordeaux.fr/public/radio/PCharlot/structure.html`

The USNO and the Australia Telescope National Facility (ATNF) are collaborating in a VLBI research program in Southern Hemisphere source imaging and astrometry using USNO, ATNF and ATNF–accessible facilities. These observations are aimed specifically toward improvement of the ICRF in the Southern Hemisphere. Plans include strengthening the ICRF in the Southern Hemisphere by a) increasing the reference source density with additional S/X band (2.3/8.4 GHz) bandwidth–synthesis astrometric VLBI observations, and b) VLBI imaging at 8.4 GHz of ICRF sources south of $\delta = -20°$. These observations will provide a strong tie between the Northern and Southern Hemisphere through the overlap with common sources measured from the north. One 48 hour imaging session has been carried out and is awaiting correlation.

Several summer students contributed to the Analysis Center. Sarah Zelechosky used geodetic VLBI observations to image 3C418, finding evidence of superluminal motion. Ginger Leonard used RRFID data to classify ICRF sources according to the variability of their intrinsic structure.

4. Staff

The staff of the Analysis Center is drawn from individuals who work at the USNO. The staff and their responsibilities are:

Name	Responsibilities
Alan L. Fey	Primary scientific contact, Web and data base design and content, Webmaster, Web server administration, VLBA data analysis (imaging), structure analysis
David A. Boboltz	VLBA data analysis (imaging), structure analysis
Ralph A. Gaume	Liaison to the ICRF Product Center of the IERS
Kerry A. Kingham	Web and data base design and content, Webmaster, Web server administration, geodetic data analysis (imaging), Mark 4 interface to imaging software, structure analysis

5. Future Activities

The following activities are planned:

- Continue imaging of VLBA RDV experiments
- Make additional astrometric and imaging observations in the Southern Hemisphere in collaboration with ATNF partners
- Continue research into the effects of intrinsic source structure on astrometric position determination
- Continue development of an interface between the Mark 4 correlator output and the imaging software
- Establish a new web site devoted exclusively to the Analysis Center for Source Structure

6. Relevant Publications

Analysis Center products of relevance which are currently available can be found in the scientific literature, e.g.:

- "VLBA Observations of Radio Reference Frame Sources. I.," Astrophysical Journal Supplement Series, August 1996 issue (Vol. 105, No. 2, Pages 299-330).
- "VLBA Observations of Radio Reference Frame Sources. II. Astrometric Suitability Based on Observed Structure," Astrophysical Journal Supplement Series, July 1997 issue (Vol. 111, No. 1, Pages 95-142).
- "The Proper Motion of 4C 39.25," Astronomical Journal, December 1997, (Vol. 114, No. 6, Pages 2284-2291).
- "Geodetic VLBI Observations of EGRET Blazars," Astrophysical Journal, November 1998, (Vol. 507, No. 2, Pages 706-725).
- "VLBA Observations of Radio Reference Frame Sources. III. Astrometric Suitability of an Additional 225 Sources," Astrophysical Journal Supplement Series, May 2000 (Vol. 128, No 1, Pages 17-83).