

PROSPECTIVE IMPROVEMENTS OF IVS PRODUCTS AND EVOLVEMENT OF OBSERVING PROGRAMS

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ABSTRACT. Geodetic and astrometric VLBI is fundamental for the establishment and maintenance of the ICRF and contributes extensively to the generation of the ITRF. It plays an essential role in geodesy and astrometry due to its uniqueness in observing the complete set of Earth orientation parameters (EOPs) which describes the transformation between the ICRF and ITRF stable over a time span longer than a few days. VLBI provides the reference frames and EOPs consistent over decades on the highest accuracy level. Within the International VLBI Service for Geodesy and Astrometry (IVS) a Working Group (WG2) reviewed the usefulness and appropriateness of the current generation of IVS products and the quality and appropriateness of existing observing programs with respect to accuracy, timeliness and redundancy. A report of the WG2 was presented in November 2001. The report is the basis for continuous improvements and for related research within IVS over the next few years. The results of the report will help IVS to meet the objectives and future requirements set up by the IAG and IAU for research in the geosciences and astronomy.

1. INTRODUCTION

The International VLBI Service for Geodesy and Astrometry (IVS) is a Service of the International Association of Geodesy (IAG), International Astronomical Union (IAU) and of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS). The charter and the basis for international collaboration is given by the Terms of Reference (ToR) accepted by IAG and IAU and by the proposals provided by individual agencies in response to the call for participation.

IVS is an international collaboration of organizations that operate or support Very Long Baseline Interferometry (VLBI) components. The goals are

- to provide a service to support geodetic, geophysical and astrometric research and operational activities,
- to promote research and development activities in all aspects of the geodetic and astrometric VLBI technique,

- to interact with the community of users of VLBI products and to integrate VLBI into a global Earth observing system.

As IVS has no funds of its own, but is tasked by IAG and IAU for the provision of timely, highly accurate products (Earth Orientation Parameters (EOPs), Terrestrial Reference Frame (TRF), Celestial Reference Frame (CRF), etc.), IVS is dependent on the support of individual agencies.

In order to maintain the strong requirement for consistency, which is the basis for realizing and maintaining global reference frames such as the CRF and TRF, IVS initially employed and accepted existing infrastructure, observing programs such as the National Earth Orientation Service (NEOS), coordinated by the US Naval Observatory, or the Continuous Observations of the Rotation of the Earth (CORE), initiated by NASA. During its first two years of existence, the efforts of IVS were concentrated on the installation of new components and adoption of new IVS tasks. Coordination of activities within the service took effort, resources and time to mature.

All the activities of the first years are documented in the Annual Reports of the IVS for the years 1999, 2000 and 2001 [1], [2], [3]. The first General Meeting was held in Kötzing/Germany in February 2000, the second General Meeting was held in Tsukuba/Japan in February 2002 and several technical meetings concerning analysis and technology aspects were conducted. Proceedings of the General Meetings are available [4],[5].

Emphasis was placed on data analysis, coordinated by the Analysis Coordinator. Today six analysis centers provide a timely, reliable, continuous solution for the entire set of five Earth Orientation Parameters (EOPs) - two polar motion coordinates, Universal Time 1 determined by the rotation of the Earth minus Coordinated Universal Time (UT1-UTC), two celestial pole coordinates. The IVS Analysis Coordinator makes a combined solution - the official IVS product - as timely input for the IERS and its combination with the GPS-, SLR/LLR- and DORIS solutions. It turns out that the IVS combined solution gains 20% in accuracy over the single VLBI solutions.

2. REVIEW OF PRODUCTS AND OBSERVING PROGRAMS

At the 4th IVS Directing Board meeting held in September 2000 in Paris, the requirement for reviewing the products and the related observing programs was discussed with the view that IVS must meet its service requirements and improve its products. Because such a review requires overall expertise, a broad discussion and acceptance within the entire community, a Working Group (WG2) for Product Specification and Observing Programs was established at the 5th Directing Board Meeting in February 2001. (The Minutes of all meetings are published and made available on the IVS web site.) The assignment of WG2 was to

- review the usefulness and appropriateness of the current definition of IVS products and suggest modifications,
- recommend guidelines for accuracy, timeliness, and redundancy of products,
- review the quality and appropriateness of existing observing programs with respect to the desired products,
- suggest a realistic set of observing programs which should result in achieving the desired products, taking into account existing agency programs,
- set goals for improvements in IVS products and suggest how these may possibly be achieved in the future,

- present a written report to the IVS Directing Board at its next meeting.

The Working Group suggested a realistic set of observing programs, in order to achieve the desired products by taking into account existing agency programs. Moreover goals were set for improvements and suggestions were made as to how the improvements may possibly be realized in the future. A report of the WG2 was presented in November 2001. The IVS Directing Board reviewed the final version and accepted it for publication, which is available under <http://ivscc.gsfc.nasa.gov/WG/wg2> or in the Annual Report 2001 [6].

Based on the WG report the IVS observing program for 2002 - 2005 was established, with the overall observing time increasing by 30% in 2002 to more than 100% in 2005. The IVS observing program includes components equipped with Mk4, S2 and K4 technology. Significant improvements in accuracy and in timeliness, i.e. shorter time delay from observation to the availability of products, can be expected. Involving all internationally available IVS components the observing program will enable IVS to provide continuous temporal coverage.

3. CONCLUSIONS

IVS has the capacity to meet the requirements set up by IAG and IAU in the realization of the reference frames and related products. In general, precise time series of the products, with sufficient accuracy (bias free), density, and timeliness must be generated. IVS as a Technique Center of IERS must guarantee the realization of precise celestial and terrestrial reference frames that are consistent over decades.

To meet this guarantee, improvements are required in the availability and reliability of the network stations. Automation for unattended observing will help to overcome the weekend gaps. More capacity is required in data transmission media, which will be solved by the development of a modern disk based recording system (Mk5) and by the ability to transfer data via the Internet (e-VLBI). These new systems will reduce the time delay and dramatically reduce expenses currently needed for tapes and tape drives. The global network configuration has to be improved, especially in the southern hemisphere, and more observing time is required. Encouraging additional related institutions and including the S2 and K4 technologies will also improve the situation. High priority has to be placed on rapid turnaround sessions at the correlator. To avoid backlogs the throughput at the correlators has to be improved. More analysis centers with different software are required to improve the analysis and to increase the robustness of the products.

IVS's primary duty is to provide the best possible results through optimized and efficient coordination of all the resources available. The new product specifications and the new related observing programs should give the basis for cooperation and for contributions by collaborating institutions. Nevertheless, the current IVS situation is highly dependent on only a few institutions and requires the strong, continued support and contributions of those key players.

4. REFERENCES

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All references can be downloaded from the IVS homepage (<http://ivscc.gsfc.nasa.gov>)