

DGFI Special Analysis Center Annual Report 2002

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Abstract

This report summarizes the activities of the DGFI Special Analysis Center in 2002 and outlines the planned activities for the year 2003.

1. Special Analysis Center Operation

The Deutsches Geodätisches Forschungsinstitut (DGFI) is a non-governmental research institute under the auspices of the Deutsche Geodätische Kommission (DGK) and is financed by the State of Bavaria (see DGFI web server <http://www.dgfi.badw.de>). As a member of the IVS, DGFI supports and improves VLBI data analysis and generates VLBI products.

2. Activities in 2002

1. Application of robust estimators in VLBI data analysis

The standard approach to handle outliers in VLBI data analysis at DGFI with the software OCCAM is to delete observations whose residuals exceed a 3-sigma criterion. In order to find a procedure which is more sophisticated and theoretically founded, several robust estimators (BIBER, Huber, etc.) were tested and some of them were implemented in OCCAM. Numerical tests were carried out by introducing artificial outliers into standard CORE-A sessions. The BIBER estimator (Wicki, 2001) was the one which detected most of the introduced outliers. It additionally downweighted the smallest number of non-falsified observations, and it provided the fastest algorithm.

2. Estimation of variance components to test parameter constraints

In VLBI data analysis, parameter constraints are often used to stabilise the piecewise linear functions (pwlf) for modelling the temporal behaviour of the zenith path delay, station clocks or the tropospheric gradients. The weights of the pseudo-observations are usually subject of decisions which are based on the data processing skills of the analyst. Therefore, variance components were estimated for the 'real' VLBI observations as well as for the pseudo-observations of the respective constraints.

The results confirm the a priori level of precision of the 'real' observations. They indicate that the following standard deviations for the constraints are more or less suitable: 15 mm/h for the 1-hourly pwlf zenith delay rates and 40 mm/h for the 1-hourly pwlf clock rates. The estimation of the standard deviations of the constraints of the gradients yields rather instable values: the older sessions, in particular before 1989, led to much higher weights. This indicates that the temporal density and geometrical distribution of the observations of these sessions are too weak to solve for gradients.

3. Statistical assessment of subdiurnal EOP from VLBI

When analysing VLBI estimates and their variances and covariances using statistical methods, VLBI turns out to be capable to determine Earth orientation parameters in a high

temporal resolution. If a station network is globally distributed and each telescope points to all directions, 1-hourly EOP estimates can be assumed as almost independent from each other. Additionally it can be stated that usually no significant episodic variations of the EOP can be found below a 1-day resolution. For details see Kutterer and Tesmer (2002).

4. DGFI VLBI solution DGFI02R02

The DGFI VLBI solution includes 2230 VLBI sessions between 1984 and the end of 2001. It comprises the positions and the velocities of 47 telescopes and the EOP of each session. The observation data were selected from NASA's 'Crustal Dynamics Data Information System (CDDIS)' and the IVS data servers: Only 24 h or longer sessions were used in which at least three telescopes provided more than 250 observations. We chose to use only non-mobile telescopes with a representative number of observations over a sufficiently long time span in order to determine reliable velocities.

Datum-free normal equations for each session were set up using the software OCCAM 5.0 (LSM 5.1) for the reduction calculations and in a second step the software DOGS-CS to accumulate the normal equation systems. The datum defect of the accumulated normal equation system was removed by applying NNT and NNR conditions for coordinates and velocities to 12 well-determined telescopes w.r.t. ITRF2000. In contrast to the older solution DGFI01R01 (Tesmer 2002), a 14 parameter Helmert transformation of DGFI02R02 w.r.t. ITRF2000 using all 47 telescopes as identical ones did not show any significant differences either in the rotation or in the translation or the scale components.

5. Other contributions to international geodetic efforts

In the year 2002, DGFI contributed to the IERS Alignment Campaign with a series of EOP, determined from 1790 suitable VLBI sessions between 1984 and the end of 2001. Additionally, datum-free normal equations in SINEX 2.0 format of 120 single 24-h sessions including epoch coordinates as well as EOP were submitted to the IERS SINEX Combination Campaign. As DGFI also hosts an IERS Combination Research Center, the work of the DGFI IVS Special Analysis Center supports the IERS combination research objectives.

3. Staff

In 2002, the same personnel of DGFI was involved in the IVS Analysis Center as during 2001, notably Hermann Drewes, Hansjörg Kutterer and Volker Tesmer. Volker Tesmer was funded externally by the German research association 'Deutsche Forschungsgemeinschaft (DFG)' under the contracts DR 143/9-1 until May 2002 and DR 143/11-1 from June 2002, respectively.

4. Plans for 2003

- The investigations concerning the stochastic model in VLBI data analysis will be continued. Earlier studies (Schuh and Tesmer 2000) and results from GPS (e.g., Howind et al. 1999) showed that the use of a refined stochastic model of geodetic observations yields more realistic formal errors as well as more stable parameter estimates.
- DGFI will set up a VLBI solution in which the positions and velocities of a TRF, the EOP as well as the source coordinates of a CRF will be determined homogeneously and simultaneously in one solution. The datum of the frames will be defined by non-deforming

conditions which ensure consistency with existing frames such as ITRF2000 and ICRF ext-1. The results will be checked in detail w.r.t. ITRF2000, IERS EOP and ICRF ext-1 regarding consistency, accuracy and reliability using statistical methods.

- It is planned to contribute to forthcoming IVS Pilot Projects and to the IVS working group on geophysical models as well as to a number of combination research activities.
- Both the introduced values of parameter constraints and the respective weights influence the VLBI target parameters. It is planned to quantify these effects by statistical means.
- Previous studies on highly resolved EOP showed a significant dependence of the stochastic properties of the estimated parameters on the observation geometry. Further work will focus on scheduling strategies which are optimised regarding temporally highly resolved parameters such as troposphere and EOP.

5. References

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