

3.6.2.2 Deutsches Geodätisches Forschungsinstitut (DGFI)

Introduction

The IERS Combination Research Centres (CRC) are responsible for the development of methods for combining data and/or products emanating from the different techniques (VLBI, SLR, GPS, DORIS, etc.). The aim is to achieve further improvements for the combination of all space techniques involved in order to generate highly accurate and consistent IERS products. Within the new IERS the Forschungsgruppe Satellitengeodäsie, FGS (DGFI, FESG, GIUB) acts as a joint CRC. In this report we summarize the major activities of the CRC at DGFI. The work within the CRC is closely related to the ITRS Combination Centre at DGFI. During the year 2001 the activities were mainly concentrated on investigations and developments with regard to ITRS relevant issues. More information is available at the DGFI web site, at URL <http://www.dgfi.badw.de/dgfi/IERS/>.

Software Development

DGFI has developed and/or employs various software packages for processing different space-technique observations, e.g. Bernese (GPS), DOGS (SLR, in future also DORIS), OCCAM (VLBI) and DOGS-CS for the combination. Further improvements of these software packages, including documentation and detailed description have been performed to fulfill the tasks of a CRC properly. Furthermore software for validation and analysis of input solutions (e.g. SINEX format, constraints, rank defects) and for the quality control of the combination results has been developed.

Combination methodology

Some major activities are summarized below:

- In principle, the combination strategy can be performed on different levels (e.g. observations, normal equations, solutions). From our experience within the ITRS Combination Centre it follows that the reconstruction of unconstrained normal equations from the individual SINEX solutions is in many cases difficult or even impossible. Therefore we recommend that unconstrained normal equations in addition to / or instead of solutions with variance-covariance matrices should be provided. Then the combination could be performed directly on the normal equation level without removing constraints.
- Regarding the parameter definition we investigated whether the current ITRS products (positions and linear station velocities) are appropriate also for the future. In this context we analysed site position time series with regard to non-linear effects, periodic signals, etc.
- Investigations and software developments concerning the weighting of solutions for intra- and inter-technique combination were performed.

- The eccentricities (local ties) are important to combine different space technique solutions into a common reference frame. Therefore, we concentrated on the validation of local ties and on their handling in the combination. In DOGS-CS the eccentricities are applied as observations with appropriate weights or with variance-covariance matrix.
- Concerning the datum definition we analysed the contribution of individual space techniques. For the definition of the kinematic datum we propose to use kinematic models based on geodetic observations (e.g. APKIM2000) instead of geophysical models (e.g. NNR NUVEL-1A) to ensure that the no net rotation condition is more accurately fulfilled.

Analysis of ITRF2000 input solutions

The analysis of ITRF2000 input solutions is related to the work of the ITRS Combination Centre at DGFI. Major activities were:

- Analysis of individual solutions with regard to constraints, reconstruction of unconstrained normal equations, rank defects, etc.
- Reviewing the differences between individual solutions which reach up to 5 cm for the origin and a few ppb for the global scale (see <http://lareg.ensg.ign.fr/ITRF/ITRF2000/T.gif> and [D.gif](http://lareg.ensg.ign.fr/ITRF/ITRF2000/D.gif)). Further improvements of the ITRF require the analysis of these differences with respect to systematic effects, model differences, constraints, solution strategies, etc.

VLBI solution

DGFI re-analysed 2230 single VLBI sessions with the software OCCAM 5.0. The normal equations of these single session solutions were accumulated with DOGS-CS to a 18 years solution for coordinates and velocities for 47 stations. The results were used to analyse position time series of the VLBI stations and to participate in IVS pilot projects on comparison/combination of EOPs.

SLR solution

With the software package DOGS we computed a 20 years SLR solution based on laser ranging data to Lageos-1 & 2 of the global ILRS tracking network in the form of weekly arc solutions to investigate the time evolution of an SLR reference frame and site position time series.

Intra-technique combination: ILRS pilot projects (station positions and EOPs)

DGFI participated in the ILRS pilot projects (positions and EOPs) aiming at the computation of a time series of 4-weeks coordinates solutions for the global network of SLR stations and of daily EOPs, and the comparison and/or combination of the solutions provided by individual ILRS Analysis Centres and Associate Analysis Centres <ftp://ilrs.gsfc.nasa.gov/pub/slr/ilrsac/products/pos+eop>.

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