KTU-GEOD IVS Analysis Center Annual Report 2013

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Abstract This report summarizes the activities of the KTU-GEOD IVS Analysis Center (AC) in 2013 and outlines the planned activities for the year 2014. Determination of optimal weights of constraints on VLBI auxiliary parameters as well as estimation interval lengths have been our specific interests in 2013.

1 General Information

KTU-GEOD IVS Analysis Center (AC) is located at the Department of Geomatics Engineering, Karadeniz Technical University, Trabzon, Turkey.

2 Staff at KTU-GEOD Contributing to the IVS Analysis Center

The staff who are contributing to the research at the KTU-GEOD IVS Analysis Center (AC) in 2013 are listed in Table 1 with their working location.

Table 1 Staff.

Name	Working Location
Emine Tanır Kayıkçı	Karadeniz Technical University, Dept. of Geomatics Engineering, Trabzon, Turkey.
Kamil Teke	Hacettepe University, Dept. of Geomatics Engineering, Ankara, Turkey.

3 Current Status and Activities

During 2013, we focused on determining estimation intervals and the optimal weights of constraints on the estimated VLBI auxiliary parameters. The main part of this study was conducted during the research stay of AC member Dr. Tanır Kayıkçı at Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum GFZ from July to September 2013. The first results of this study were presented at the International Association of Geodesy (IAG) Scientific Assembly held at Potsdam from 1st to 6th of September 2013 [4]. The proceedings paper of this report was submitted to the International Association of Geodesy Symposia Series (still under review process).

The variety of the parameterizations in VLBI analysis causes significant differences in the estimates even if the same observations (sessions) are involved (c.f. [2]). The space geodetic technique specific parameters in a least-squares adjustment are not standardized — e.g., several reduction models are recommended by the IERS Conventions 2010 ([3]). The current version of Vienna VLBI Software (VieVS, [1]) in the least-squares adjustment mode uses a standard parameterization for the auxiliary parameters, i.e., a piece-wise linear offset representation with a default temporal resolution of e.g. 60 minutes for clocks and zenith wet delays (ZWD) and six hours for troposphere horizontal north and east gradients (NGR and EGR). From the physical point of view, the interval length should be

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as short as possible to optimally represent the behaviors of the underlying processes: from the mathematical point of view, however, the interval length should be long enough to achieve an appropriate redundancy of observations required to obtain a stable (regular) normal equation system. In this study, three different approaches are investigated for achieving optimized parameterizations of the auxiliary parameters per station for each session. The performance of the three approaches is investigated by analyzing VLBI data with the least-squares adjustment model of VieVS.

3.1 Approach1: Solution Intervals Considering the Time Dependent Behaviours of the Parameters

In the standard VLBI least-squares solution, the estimation intervals of the auxiliary parameters are usually set to be constant for the sake of simplicity, because there is no a priori information about the variability of the modelled phenomena, e.g. troposphere. Consequently, our first optimization (*approach1*) realizes the idea of a flexible parameter estimation interval depending on the behavior of the parameters determined with a prior estimation featuring an equally spaced standard parameterization. Thus, if the variation is relatively large, the parameter estimation interval will be decreased to allow for a larger degree of freedom for this specific parameter over an appropriate duration. With this approach it is possible to flexibly handle the parameter estimation interval according to a first standard solution while keeping the overall number of parameters constant. It would also be possible to repeat the application of *approach1* in an iterative way whenever the session is reanalyzed. This iterative optimization will be considered in future, but it is not treated in this report.

3.2 Approach2: Solution Intervals Considering Data Gaps

There is a usual time difference of several minutes or more between successive VLBI observations. A significant number of VLBI sessions show gaps between successive observations at certain stations. For example, during the CONT08 session WETTZELL stopped and performed an Intensive VLBI session of about one hour duration together with another network station (see Figure 1). In our investigation, we consider a time difference of at least 45 minutes between successive observations at a station as a data gap. With our second approach (*approach2*), in the case of a data gap between observations, our method considers the observation data in two subsets, the one before and the one after the data gap while leaving the data gap empty.

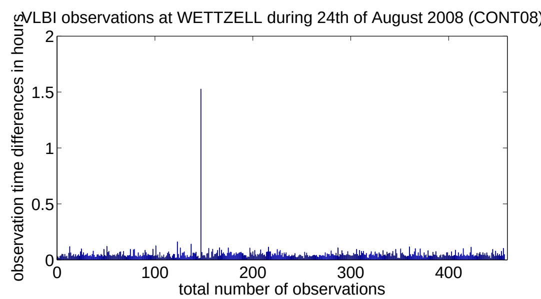

Fig. 1 Time differences in hours between successive observations at station WETTZELL during a daily CONT08 session, 08AUG24.

3.3 Approach3: Solution Intervals Considering the Total Number of Observations

We determine the estimation intervals depending on the number of observations in our third approach (*approach3*). This approach ensures an equal redundancy for each auxiliary parameter. Figures 2 and 3 show how much the total number of observations supporting an auxiliary parameter can vary, in the case of having equally spaced time intervals for auxiliary parameter estimation by the standard parameterization. The number and geometry of observations in equally spaced estimation intervals of a VLBI station, specific parameter should be optimized when, for example, scheduling a session or the estimation intervals for a specific parameter at each antenna should be optimized considering the number and geometry of observations when analyzing a session.

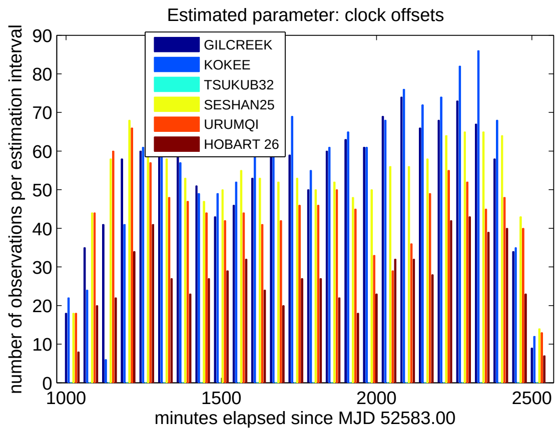

Fig. 2 Total number of observations per clock offset estimation interval: 60 minutes (as a standard parameterization) during session 02NOV05.

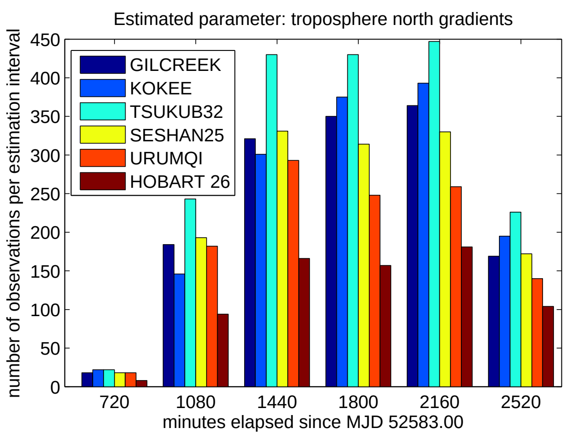

Fig. 3 Total number of observations per troposphere gradient offset estimation interval: 360 minutes (as a standard parameterization) during session 02NOV05.

4 Future Plans

Our preliminary results show that *approach1* and *approach3* provide better results for VLBI single session analysis than the standard parameterization. The next step will be to practically assess the *approach2*. Thereafter we will develop an optimized parameterization for auxiliary parameters in VLBI single session least-squares analysis probably based on all three approaches.

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