FFI Analysis Center

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Abstract

FFI's contribution to the IVS as an analysis center focuses primarily on a combined analysis at the observation level of data from VLBI, GPS, and SLR using the GEOSAT software. This report shortly summarizes the current status of analyses performed with the GEOSAT software. FFI is currently Analysis Center for IVS and ILRS, Technology Development Center for IVS, and Combination Research Center for IERS.

1. Introduction

A number of co-located stations with more than one observation technique have been established. In principle, all instruments at a given co-located station move with the same velocity and it should be possible to determine one set of coordinates and velocities for each co-located site. In addition, a constant eccentricity vector from the reference point of the co-located station to each of the individual phase centers of the co-located antennas is estimated using constraints in accordance with a priori information given by the ground surveys. One set of Earth orientation parameters (EOP) and geocenter coordinates can be estimated from all involved data types. The present dominating error source of VLBI is the water content of the atmosphere which must be estimated. The introduction of GPS data with a common VLBI and GPS parameterization of the zenith wet delay and atmospheric gradients will strengthen the solution for the atmospheric parameters. The inclusion of SLR data, which is nearly independent of water vapor, gives new information which will help in the de-correlation of atmospheric and other solve-for parameters and lead to more accurate parameter estimates. These, and many more advantages with the combination of independent and complementary space geodetic data at the observation level, are fully accounted for with the GEOSAT software developed by FFI.

After five years of development and extensive validation we are proud to announce that a major revision and extension of the GEOSAT software has been completed. The most important changes implemented have been described in recent IVS Annual Reports. Much more flexibility and automation have been added. Furthermore, the latest and "best" models (mostly following the IERS Standard) and "calibration tables" and "instrumental/geophysical events tables" have been included. Analysis of tracking data to S/C's in deep space has been added. For any technique, the delay due to the troposphere is determined with 3D raytracing using the European Center for Medium-range Weather Forcast Numerical Weather Model. No mapping functions are used and the corrections are determined directly from interpolation in the raytracing files.

2. Staff

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3. Combination of VLBI, GPS, and SLR Observations at the Observation Level

The processing of observations in GEOSAT is performed in three steps: 1) Omc step: for each individual technique generate files of residuals (observed minus calculated, omc) and partials for a period of "one arc" (usually 24 hours). Selected parameters are estimated to generate "small" residuals so that iterating in the filter is not necessary. 2) Comb step: combine omc files for all techniques at the epoch-by-epoch level using a UD (Upper-Diagonal factorized) sequential filter. The result is a SRIF (Square-Root-Information-Filter) array for that specific arc. 3) Global step: combine all arc SRIF arrays to generate a multi-year solution. The estimation is performed with a CSRIFS (Combined Square-Root-Information-Filter-and-Smoother factorized) sequential filter.

To perform the analyses we have a dedicated array of 10 state-of-the-art LINUX work stations, each with 4 cpu's, 6 GB RAM, and 1 TB disk space. The status of the analysis by Jan 2008 is as follows: The omc step is completed for the period 1 Jan 2000 to 31 Dec 2006 with approximately 175 GPS stations, 10-30 SLR stations, and 0-20 VLBI stations daily. This is a tremendeous computation task which took approximately 1 month of computation time. When new and better models become available the computation can automatically be repeated within half the time since the raytracing files can be re-used. The first tests at the Comb step level is presently being performed trying to determine an "optimal" mix of solve-for parameters, constraints, and weighting.

Our plan is to take the seven years of data through all three steps within 1-2 year. The outcome will be new realizations of TRF, CRF, and EOP relying on consistent models and estimation strategies. As a by-product a file of estimated eccentricity vectors will be produced. After that we plan to add 2007 and newer data and also data before 2000. We also plan to estimate GM and some low-order gravity coefficients simultaneously with all the other parameters. This type of analysis is along the lines of the ideas behind the GGOS project where geometry, gravity, and Earth orientation are to be simultaneously and consistently determined.