

Combination of Results at FFI – Data Analysis

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Abstract

FFI's contribution to the IVS as an analysis center will focus primarily on a combined analysis at the observation level of data from VLBI, GPS and SLR using the GEOSAT software. This report shortly summarises the current status of analyses performed with the GEOSAT software.

1. Introduction

FFI is centrally located in the Kjeller area, 30 minutes east of Oslo (near Lillestrøm). Here approximately 2400 people are engaged in several research establishments, technical institutions, university branches and Air Force Material Command. FFI is a state operated, civilian research establishment reporting directly to the Ministry of Defence. The number of employees is approximately 550.

For many years FFI has performed research in space science and remote sensing using satellites. As a part of this research FFI has developed a highly sophisticated software (GEOSAT, [2]) for satellite orbit determination and space geodesy. With this software all types of high precision space geodetic observations can be combined and analyzed at the observation level.

2. Status of FFI's Contribution to the IVS

FFI is presently establishing using GEOSAT a database of VLBI, GPS, and SLR observations, residuals, partial derivatives, and arc-by-arc state vectors and covariance matrices estimated on the basis of a combination of VLBI, GPS and SLR data at the observation level. The arc-by-arc state vectors and complete covariance matrices will be combined into a multi-year solution using a highly sophisticated and flexible Square-Root-Information-Filter-and-Smoother, CSRIFS ([1]), which is a part of the GEOSAT software (GEOSAT, [2]).

Our first combined contributions to IVS and IERS will primarily be based on some selected high-quality datasets. In the future the analysis will be extended to a large number of arcs covering many years.

The GEOSAT software will be used in all analyses. All major components of GEOSAT have been successfully validated with a combination of data from VLBI, GPS and SLR. Consistent models for all techniques have been verified at the sub-ppb level. The processing at the arc or session level is completely automated using C-shell scripts.

The CSRIFS program for combining arcs has been successfully applied in the generation of a VLBI-only solution covering 623 sessions during the last 10 years. A paper containing the mathematics of CSRIFS and the results of the VLBI analysis has recently been submitted for publication in Journal of Geodesy [1]. Results from a combined analysis of 12 days of VLBI, GPS, and SLR observations in the period Jan 12 - 23, 1994 (CONT94), were presented at the IERS Symposium at GFZ in 1998. Both the VLBI-only solution and the combined solution were submitted to the IERS at the end of March 1999. More complete analyses will be presented at international meetings later in 1999.

We plan, as part of the IVS analysis, to test different analysis strategies related to especially the weighting of the a priori information (observations and a priori parameter estimates), the selection of dynamical parameters to be estimated for the GPS satellites, data editing, the estimation of eccentricity vectors, the use of multi-arc orbital elements for the GPS and the LAGEOS satellites, and the estimation of geophysical parameters.

3. Technical Staff

Table 1 lists the FFI staff involved in IVS activities. The development and validation of GEOSAT have resulted in a substantial theoretical understanding and practical experience with all available types of high-precision space geodetic data (VLBI, GPS, SLR, PRARE, DORIS and radar altimetry).

Table 1. Staff working at the FFI AC and TDC

Name	Background	Dedication	Agency
Per Helge Andersen	geodesy	40%	FFI

4. Outlook

The computation time for the processing of 24 hours of VLBI, GPS, and SLR data is presently approximately 14 hours using a HP C180 (one CPU) computer. We plan to buy a new computer within the end of this year or early next year, probably a HP J5000 (with two CPU's) or a HP J7000 (with four CPU's) including 1 Gb RAM. This should give an increase of a factor 5 or 10 in processing capacity. The disk storage capacity will be extended from 65 Gb to 100 Gb with additional 30 Gb each year. With such a computation power it should be possible to generate global combined multi-technique solutions based on a large number of arcs.

References

- [1] Andersen, P. H. (1999) Multi-level arc combination with stochastic parameters. Paper submitted for publication in *Journal of Geodesy*.
- [2] Andersen, P. H. (1995) High-precision station positioning and satellite orbit determination. PhD Thesis, NDRE/Publication 95/01094.