3.6.2.4 Forsvarets forskningsinstitutt (FFI)

Introduction

FFI has during the last 25 years developed a software package called GEOSAT (Andersen, 1995) for the combined analysis of VLBI, GNSS (GPS, GALILEO, GLONASS), SLR and other types of satellite tracking data (DORIS, PRARE and altimetry). The observations are combined at the observation level with a consistent model and consistent analyses strategies. The data processing is automated except for some manual editing of the SLR observations.

In the combined analysis of VLBI, GNSS and SLR observations, the data are processed in arcs of 24 hours defined by the duration of the VLBI session. The result of each analyzed arc is a state vector of estimated parameter corrections and a Square Root Information Filter array (SRIF) containing parameter variances and correlations. The individual arc results are combined into a multiyear global solution using a Combined Square Root Information Filter and Smoother program called CSRIFS. With the CSRIFS program any parameter can either be treated as a constant or a stochastic parameter between the arcs. The estimation of multiday stochastic parameters is possible and extensively used in the analyses. The advantages of the combination of independent and complementary space geodetic data at the observation level is discussed in (Andersen, 2000).

Status

After five years of development and validation a completely new version of the GEOSAT software is ready for routine processing of space geodesy observations and tracking data towards spacecrafts in the Solar system.

The most important improvements and changes were described in previous IERS Annual Reports.

The new version of GEOSAT has two very useful features:

1) It can simultaneously combine data from virtually any number of VLBI, SLR, and GNSS instruments at a collocated site either observing simultaneously or in different time windows. All information will contribute to the estimation of the migration of an automatically selected master reference point at each station. Time series of eccentricity vectors will also be estimated.

2) The solve-for model parameters in combined processing of the VLBI + SLR + GNSS can either be instrument-dependent, technique-dependent, microwave-dependent, optical-dependent, or site-dependent. The switching between the different types is extremely simple. A simple application would be to in a first run treat the zenith wet delay parameters as instrument-dependent parameters which means that f ex a station with two GPS receivers and one VLBI instrument will have three estimates of this parameter. If the results are consistent, these parameters can be estimated as a

single parameter represented by a microwave-dependent parameter in a second run. The same can be tested for clock parameters for collocated clocks etc.

The goal several years ago was to demonstrate the concept of simultaneous combination of different types of data at the single observation level with very limited amounts of data. Now we plan to go one step further with the processing of several years of VLBI+SLR+GNSS data including 100-200 GNSS stations per day. We have for this purpose recently installed an array of 10 new computers with altogether 40 cpu's, 60 GB Ram, and 10 TB disk space. A number of scripts have been written so that analysis of years of data can be initiated and distributed to the cpu's by a single command.

Future plans

Observations from the GALILEO navigation system will be applied when available. Only minor changes in GEOSAT are required for this extension.

References

Andersen, P. H. (2000) Multi-level arc combination with stochastic parameters. Journal of Geodesy (2000) 74: 531-551.

Andersen, P. H. (1995) High-precision station positioning and satellite orbit determination. PhD Thesis, NDRE/Publication 95/01094.

Per-Helge Andersen