FFI Technology Development Center - Software Development

Per Helge Andersen

Abstract

FFI's contribution to the IVS as a Technology Development Center focuses primarily on the development and validation of the GEOSAT software for a combined analysis at the observation level of data from VLBI, GPS and SLR. This report shortly summarises the latest improvements of the GEOSAT software. FFI is currently Analysis Center for IVS and ILRS, Technology Development Center for IVS, and Combination Research Center for IERS.

1. The GEOSAT Software

The advantages of the combination of independent and complementary space geodetic data at the observation level is discussed in Andersen ([1]). The models of GEOSAT are listed in Andersen ([2]). The most important changes implemented in 2006 are described in the following.

The GEOSAT software is presently undergoing extensive development. The IERS-2003 Conventions have been implemented including all extensions/corrections up to 20 Jan 2007. Also included is pressure loading corrections produced by Petrov and Boy. The validation of GEOSAT with VLBI and SLR tracking data is completed with very promissing results. Right now the GNSS part of GEOSAT is in the validation phase.

Regarding SLR: The use of a detector-dependent center of mass corrections, correction for the non-linearity of the Stanford counter, 3D raytracing, and taking into account a signal strength dependent range bias for some stations, lead to a slight change in the value of GM as determined from SLR data. The use of multicolor laser data has been implemented and gives excellent post-fit residuals. The results indicate that for some periods station biases at the level of 5 mm still exist.

Also the GNSS part of GEOSAT has undergone extensive changes, e.g. with the inclusion of a second and third order ionospheric correction, absolute phase center corrections for all antennas etc.

A new software component for the generation of a Geophysical Events file has been included in GEOSAT. This file contains information about earthquakes, the magnitude, and distance to stations included in the ITRF. Based on this information we plan to develop an estimation strategy where noise, dependent on the distance to the epicenter, is added to the station reference point motion for stations affected by earthquakes.

Instrumental Events files for VLBI, GPS, and SLR have also been included in GEOSAT. These files give the epochs of changes in software or hardware of the instrument and the type of change. Every time an instrumental event occur noise will be added to the relevant estimated eccentricity vector.

The new version of GEOSAT is expected to be ready for routine processing within 1 year. The new version of GEOSAT will have two additional very usefull features: 1) It can simultaneously combine data from virtually any number of VLBI, SLR, and GPS instruments at a co-located 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. 2) The station-related solve-for model parameters in a combined processing of the VLBI + SLR + GNSS can either be instrument-dependent, technique-dependent, microwave-dependent,

optical-dependent, site-dependent, satellite/spacecraft-dependent, or radio source-dependent. The switching between the different types is extremely simple. A typical application would be to, in a first run, treat the zenith wet delay parameters as instrument-dependent parameters. This means that e.g. a station with two GPS receivers and one VLBI instrument will have three estimates of these parameters. If the results look consistent, all these parameters can be estimated as one single parameter represented by a microwave-dependent parameter in a second run. The same can be tested for clock parameters for co-located clocks etc. Since the raytracing starts at the position of the phase center for each instrument/antenna, the effect of different antenna heights will automatically be accounted for to the level of accuracy of the numerical weather model rescaled by the in-situ observed pressure values from the surfmet data.

2. Staff

Dr. Per Helge Andersen - Research Professor of Forsvarets forskningsinstitutt (FFI) and Institute of Theoretical Astrophysics, University of Oslo.

References

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

[2] Andersen, P. H. High-precision station positioning and satellite orbit determination. PhD Thesis, NDRE/Publication 95/01094.