GNSS PROCESSING IN INSTITUTE OF APPLIED ASTRONOMY RAS

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ABSTRACT. GPS processing at Institute of Applied Astronomy (IAA) of Russian Academy of Sciences runs from year 2000. For many years it has been based on the software package GRAPE which processed triple differenced GPS observations. At February 2014 GRAPE and service programs were replaced by a newly developed software package.

1. INTRODUCTION

In 2011 we started developing a new software for undifferenced GLONASS and GPS measurements processing (Gayazov et al., 2013). The main application of this software is daily EOP estimation. Updated at February 2014 IAA GNSS EOP Service provides daily estimates of Xp, Yp, Xp_rate, Yp_rate and LOD based on 24h data from about 50 sites within IGS network with 12h delay. It also estimates orbital parameters, troposphere delay, atmospheric gradients and clock biases of stations and satellites.

2. PROCESSING STRATEGY AND RESULTS

The processing strategy mainly corresponds to IERS and IGS recommendations. Working scheme is shown on Fig. 1.

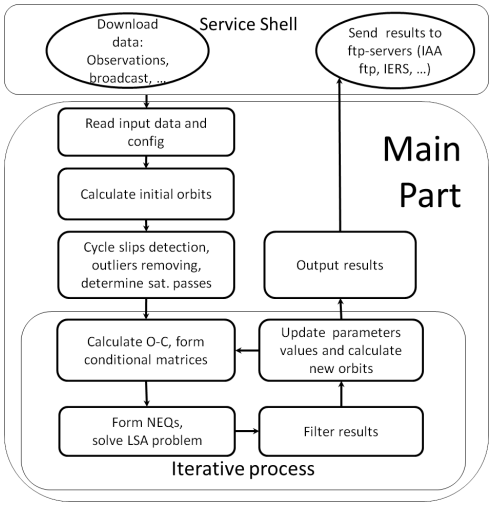

Figure 1: Scheme of GNSS-processing.

Key processing details:

- Data preprocessing: Melbourne-Wubbena combinations of code and phase measurements for cycle slip detection, outliers removing and forming satellite passes.
- Basic Observables: zero-differenced phase and code ionosphere-free combinations corrected by P1-C1 satellite code biases (cc2noncc); we use all measurements from daily RINEX-files with 30 seconds sampling rate.

- Sites coordinates: IGb08 reference frame coordinates and velocities; displacements: solid tides, ocean loading, pole tide loading (IERS 2010).
- Geometric model: receivers antennas eccentricities, absolute receiver and satellite (to CoM) antennas phase centres, elevation-dependent and azimuth-dependent corrections with accordance to absolute model IGS08.atx; wind-up effect.
- Signal propagation: troposphere total ZPD with GMF (IERS) mapping function, horizontal north and east gradients as linear trends with Herring mapping function.
- Relativistic: path range effect (Shapiro delay) and satellite clock corrections.
- Solar system bodies ephemeris: DE421.
- Terrestrial to Celestial frame transformations: IAU 2000A model, subdaily polar motion libration.
- Orbit modelling: GPS, GLONASS; EGM2008-based conventional (IERS 2010) static Geopotential model (truncated to degree and order 12) and tidal corrections; IAU 2000A precession-nutation model, Post-Newtonian relativistic corrections (Schwarzschild metric); empirical Solar radiation pressure model (Gayazov, 2002): a priori + 3 estimated parameters; numerical integration by DINCH integrator (single-step correction-prediction integration with Chebyshev approximation).
- Solution method: segmented Least Squares for two groups of parameters: daily polynomial and every-epoch (30s sampling); no a priory or continuity constraints; float ambiguities with no fixing.

In EOP Service regime we process about 50 stations. On the table 1 and 2 there are some results to show products quality.

Parameter	Accuracy
Satellite orbits (compared to IGS)	25–60 mm (RMS)
Troposphere ZPD (compared to IGS)	1.7–1.9 mm (RMS), 1.3–1.4 mm (St. dev.)
Clock biases (compared to IGS)	80–100 ps (RMS), 25–35 ps (St. dev.)

Table 1: IAA GNSS EOP Service products quality.

Time span, MJD	Xp, μas	Yp, μas	LOD, μs
56659.50 to 56688.50	39	48	10
56690.50 to 56716.50	59	59	16
56718.50 to 56747.50	60	62	14
56749.50 to 56777.50	50	50	15
56779.50 to 56808.50	57	50	9
56810.50 to 56838.50	42	48	17
56840.50 to 56869.50	38	55	11

Table 2: EOP RMS agreement with IERS Bulletins B 313–319.

The accuracy level of our products almost matches to those from other worldwide GNSS-analysis centers. We are going to improve it by introducing a new SRP model (12 parameters and without a priory model) which is under testing at the present time. Also we intend to implement models of yaw-attitudes, Earth albedo, atmospheric loading and 2nd order ionosphere effects. We are going to extend IAA GNSS Service products by weekly station coordinates solutions and SINEX-format output for further combinations within IAA Analysis Center.

3. REFERENCES

Gayazov, I.S., 2002, "Parametrization of the Solar Radiation Pressure model for GPS satellites", IAA Transactions, No. 8, "Celestial Mechanics", pp. 77–78.

Gayazov, I.S., Suvorkin, V.V., Kurdubov, S.L., Pshenkin, V.S., 2013, "A new version of software package GRAPE for GNSS phase measurements processing", IAA Transactions, No. 27, pp. 414–418.