

ILRS s/w Benchmark Tests for Candidate ACs

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Background

- The ILRS AWG established the benchmark process over the 2002-2003 period
 - Initially, four tests were required:
 - (0) Zeroth-order Model integration
 - (A) Nominal Model integration
 - (B) Iteration of (A) for state vector and constant along-track accelerations, (Fixed EOP and Station Coordinates)
 - (C) Final Orbit Standard Version (as in (B) but adjusting EOP and Station Coordinates)
 - (D) Final Orbit Optimal Version using AC-dependent modeling
 - This was later revised, and we are currently requesting only two cases:
 - Case “D” for a one-month-long arc of LAGEOS data from Oct./Nov. 1999, and
 - A “blind” test, which we usually choose to be one of the weekly submissions

- The ILRS AWG comprises of eight ACs and two CCs at present:

- ACs :

- **ASI, Matera, Italy**
 - BKG, Bonn, Germany
 - **DGFI, München, Germany**
 - GA, Australia
 - **GFZ, Potsdam, Germany**
 - GRGS, Grasse, France
 - **JCET, Baltimore, USA, and,**
 - **NSGF, Herstmonceux, UK**

- Software:

- GEODYN**
 - UTOPIA
 - DOGS**
 - GEODYN
 - EPOS**
 - GIN
 - GEODYN**
 - SATAN**

- **The parameterization for each set of orbits is listed below, if something is not mentioned explicitly, it is NOT to be adjusted:**
 - (O) Initial orbit, NOTHING adjusted during the run (use the a priori state vector, DO NOT use any a priori along-track empirical accelerations). Follow "0"-order force model !!!
 - (A) Initial orbit, NOTHING adjusted during the run (use the a priori state vector, DO NOT use any a priori along-track empirical accelerations)
 - (B) Iterated orbit, ONLY: state vector and 4-day constant along-track empirical accelerations adjusted!
 - (C) Standard Orbit, ALL adjusted: State vector, 4-day constant along-track empirical accelerations, Station Positions, EOP values (i.e. PM and UT1, NO RATES!)
 - **(D) Optimal Orbit, adjusted parameters chosen by the Analysis Center and FULLY DOCUMENTED in the SINEX file!**

- **Candidate ACs are requested to provide the following files with each solution:**
 - 0) Orbital parameters
 - A) Orbital parameters, station residuals and data corrections
 - B) Orbital parameters, station residuals and data corrections
 - C) Orbital parameters, station residuals and data corrections, and SINEX file with estimated station coordinates and EOP
 - **D) Orbital parameters, station residuals and data corrections, and SINEX file with estimated station coordinates and EOP**

Guidelines for Submissions-1

- Residuals are “observed minus the calculated” range, OMCs.
- The satellite center of mass correction(CoM), the tropospheric refraction correction (TRC), the relativistic delay correction (RDC), and the total observation-applied correction (TOT) are to be supplied with each normal point residual.
- In the file header, please note if these range corrections are applied to the "observed range" or the "computed range", so it is clear what is the sign convention used.
- Station residuals and corrections (epoch, OMC, CoM, TRC, RDC, TOT) are to be supplied in ASCII text columns including column labels.
- The OMC, CoM, TRC, and RDC, and TOT corrections are to be provided to at least ~~0.001 meter resolution (1mm), but 0.1mm is preferred.~~

Guidelines for Submissions-2

- Orbital parameters are satellite positions and velocities:
 - Epoch, X, Y, Z , XDOT, YDOT, ZDOT every 2 minutes, "Earth-Center-Fixed-ECF"-referenced (i.e. ITRF).
- For transformation from inertial to ECF, the IERS conventions should be followed and the IERS C04 EOP series should be used, if EOP are not adjusted.
- When EOP are adjusted, as in cases C and D, there you should use your ADJUSTED EOP.
- X, Y and Z satellite positions are to be provided in meters in E25.16 format. XDOT, YDOT, ZDOT satellite velocities are to be provided in m/s in E25.16 format. The epoch of the satellite parameters are to be provided in two parts (an integer MJD plus a fraction of day in E25.16 format).
- Station coordinates and EOP are to be provided in the SINEX format.

- The characteristics of the input dataset follow for CASES A to C:
 - SLR normal points on LAGEOS-1 (**already screened**, disable EDITING! use **ALL** data)
 - Data period is Sunday October 10, 1999 until Saturday November 6, 1999 (inclusive)
 - The benchmark LAGEOS-1 data set is at:

<ftp://cddis.gsfc.nasa.gov/pub/slr/products/ilrsac/data/benchmark/qldata.991010-991106.lageos1.sp.Z>

- The initial LAGEOS-1 state vector in Mean of J2000:

- X POS=	-4513795.544003874 M	S.M.A. =	12268352.56501043 M
- Y POS=	-6344716.787838221 M	ECCEN. =	0.003777673237072
- Z POS=	-9421426.113215506 M	INCLIN =	109.8424092802734 DEG
- X VEL=	-321.8785391564888 M/S	NODE =	80.45983691877154 DEG
- Y VEL=	4806.189484181581 M/S	PERG =	225.4757981388448 DEG
- Z VEL=	-3087.081394784778 M/S	MEAN A =	9.484248397791930 DEG

Pass/Fail Criteria - 1

- Each solution will be compared to the combination solution in the following areas:
 - **Orbital Parameters**
 - Radial RMS Diff.: $\leq 2 * \text{RMS of the Combination Solution}$
 - Along Track RMS Diff.: $\leq 2 * \text{RMS of the Combination Solution}$
 - Cross Track RMS Diff.: $\leq 2 * \text{RMS of the Combination Solution}$
 - **Range Corrections**
 - **Center of Mass Correction:** Perfect Agreement (no exceptions)
 - **Relativity Correction:**
 - RMS Difference $< 0.1 \text{ mm of the combined solution}$
 - Mean Difference $< 0.1 \text{ mm of the combined solution}$
 - **Tropospheric Correction:**
 - RMS Difference $< 0.1 \text{ mm of the combined solution}$
 - Mean Difference $< 0.1 \text{ mm of the combined solution}$

Pass/Fail Criteria - 2

- Residuals
 - Residuals will be analyzed, but will have NO pass/fail criteria for any of the solutions.
- Station Coordinates
 - X, Y, Z Positions: RMS agreement $\leq 2 * \text{RMS of the Combination Solution}$
 - N, E, U Positions: RMS agreement $\leq 2 * \text{RMS of the Combination Solution}$
- Earth Orientation Parameters
 - X_P, Y_P, LOD : RMS agreement $\leq 2 * \text{RMS of the Combination Solution}$
 - No criterion on UT1-UTC

- ILRS s/w & analysis benchmark process used to qualify candidate ACs since ~2002
- Initially a five-test and two-step process
 - We now use only test “D” in the first step, and
 - In the second step the “blind” test is the submission of a weekly standard SINEX
- We find the process useful for the AWG and the new applicants
 - The process helps candidates identify errors or inconsistencies in their s/w and processing practices
 - It helps the AWG maintain a consistent set of contributions to its standard products
- The description and documentation of the benchmark process will be soon revised and updated on the ILRS page which currently describes the “2003-era” process