On Systematic Differences in Individual Solutions and IERS Products

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1 Present status

Proper determination, modelling, and accounting for systematic differences between contributed series is of the great importance in compilation of the IERS products. In this paper some problems in handling of systematic differences are discussed and possible improvements of commonly used procedures are proposed.

Possible sources of systematic differences are:

- Different reference systems (e.g. TRF, CRF, geopotential, time scale).
- Different models (e.g. short-term EOP variations, ocean loading, atmospheric pressure, VLBI antenna thermal deformations, pole tide).
- Different strategy of parameter estimation (e.g. atmosphere gradients, seasonal variations, constraints).
- Different data set (e.g. Lageos, Lageos 1&2, Lageos&Etalon).
- Dependence on a priory values of estimated and non-estimated parameters (mainly for satellite techniques).
- Technique-related errors (e.g. network configuration in VLBI, short-term periodic terms in EOP obtained with satellite techniques).
- Errors in software.

Analysis of individual EOP, TRF and CRF series shows that systematic differences between them often are much more complicated than it is supposed in most of commonly used combining procedures:

- Systematic differences between individual TRF and CRF solutions modelled as simple rotation/translation(/scaling) model depend on subset of stations/sources used for comparison, they differ for geographical regions (TRF) and parts of celestial sphere (CRF).
- Different models of pole tide, daily and subdaily EOP variations, atmospheric loading used in individual series produced by various ACs cause systematic differences in (mainly) pole coordinates.
- Results of determination of station coordinates and velocities depend on parameterisation used during computation. In particular, final station positions depend, sometimes heavily, on including seasonal variations in the estimation procedure.
- Differences between EOP and TRF time series show, almost in all cases, seasonal variations caused mainly by different modelling of various geophysical effects and sometimes by different astronomical models.
- Long-time term mutual trends between individual EOP series are mostly non-linear.

2 Models of systematic differences

2.1 EOP

Linear trend
Most commonly used, but not appropriate for most cases.

Linear trend + seasonal variations
More adequate, but not always appropriate for long-time series.

Optimal model
Non-linear trend + periodic terms determined from spectral/covariance analysis.

2.2 TRF

Linear translation-rotation-scaling model
Commonly used, but not appropriate for all cases.

Optimal model
Piece-wise coordinate / velocity model; regional deformations determined from analysis of 2D or 3D difference field.

2.3 CRF

Slope-rotation-scaling model
Seems not adequate for local / regional deformations.

Optimal model
To be advanced. Optical astrometry and TRF combination techniques with appropriate modifications can be used for compiling ICRF "Fundamental Catalog".

3 Conclusions

- Advanced models of systematic errors in input EOP/TRF/CRF time series/catalogues based on adequate models of long term variations (including discontinues) and covariance analysis of discrepancies fields should be implemented.
- Individual combined EOP+TRF(+CRF)(+GP) solutions should be used for compilation of ITRF and ICRF, however all EOP solutions routinely submitted to the IERS should be computed in fixed ITRF and ICRF which should be timely updated for new stations, sources, and events.
- More detailed description of input solutions is needed (corresponding IERS questionnaire and/or SINEX format should be extended).
- All non-conventional models used by ACs should be tested (by authors or coordinators) for systematic differences of results with conventional models.

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