Conventions and Combinations

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Abstract: In the future improvement of the IERS combination solutions it will be necessary to address the role of the adopted conventions on the precision and accuracy of the product. It is suggested that the first step be the establishment of clear conventions within each technique followed by a joint effort of the Conventions Center and the Analysis Coordinator to determine the relative importance of the component conventions to the final IERS combined solution.

1 Concepts

In general, the combination of data describing the same phenomenon but derived using different techniques will be compromised unless all of the data contributed to the combination are referred to a common "system." To accomplish this, we use our knowledge of the systematic differences among the results of the different observational and analysis processes. These results are derived through procedures that may involve many sub-procedures. The procedures and sub-procedures rely, to differing degrees, on information regarding phenomena that may, or may not be, related directly to the derived data that are the objects of the analysis procedures. This information may range from observed *ad hoc* assumptions through sophisticated physical models.

In the IERS experience, much of the information that enables the analysis procedures is contained in the *IERS Conventions*. For this reason, and to provide the consumer of IERS products the background necessary to make proper use of those products, the *IERS Conventions* attempts to provide those constants, models, and software that have the most significance to IERS products. Less significant, technique-dependent conventions are left to the technique coordinators.

It is not straightforward, however, to understand the effect of the *IERS Conventions* on the final combination solutions without having a clear understanding of their effect on the contributed data. To accomplish that, it is important that technique analysts first establish clear conventions within their technique. Starting at this level allows each technique to establish the relative importance of numerous conventions to their analysis. Comparing the results of different analysts within the technique to determine the effect of possibly different conventions on their respective solutions can do this most efficiently.

Following the establishment of the importance of various conventions to each technique, it is possible to determine those conventions that affect more than one technique and, in addition, to determine the relative importance to the final combination solution. The Analysis Coordinator in conjunction with the IERS Conventions Center is the best suited to provide this contribution.

It is important to understand that we use the term "conventions" to describe generally the agreed upon constants, concepts, models, procedures, *etc.* that are used in the analyses and, therefore, become part of the reference system of the final product. We can list the conventions in the following basic categories from the most basic to the most technique specific.

Units

Common units are used to enable the products to be used in context with other scientific and technical representations. The SI system is used throughout the Conventions.

Coordinate System Conventions

These are the conventional concepts regarding the definition of the coordinate systems that permit the interpretation of the IERS products. Generally the choice of coordinate system conventions does not affect the precision of the results, but it is more likely to affect the accuracy.

Models

Models refer to the various mathematical descriptions of physical phenomena that affect the IERS products. This category can, in turn, be subdivided into general models and technique-specific models. They generally affect the precision of the products but might have only a minimal affect on the accuracy. An important consequence of the set of models is the accompanying set of Constants, the numerical values of parameters of common interest.

Software

This category refers to the consensus implementation of the categories above through computer software code.

Procedures

This category refers to the actual application of all of the above categories of conventions to produce the final products. This includes conventions regarding the parameters to be constrained, the parameters to be determined, the data span to be used, *etc*. In general, choices here affect the precision of the results with little affect on accuracy.

The *IERS Conventions* makes contributions to each of the categories except for item (6). This item can be the role of the Analysis Coordinator but it is important that (1) the effect of the various conventions on the analysis products be understood within the context of improving observational and analysis techniques and (2) the IERS Conventions work in conjunction with the Analysis Coordinator to ensure an improved combination solution.

2 Product

The Conventions Center is provided jointly by the U.S. Naval Observatory (USNO) and the Bureau International des Poids et Mesures (BIPM), who are working on the new edition of the *IERS Conventions*. The new edition of the conventions has been re-organized with respect to *IERS Conventions 1996*, and numerous updates have been introduced. The work accomplished or in progress is the following:

Chapter 1 General Definitions and Numerical Standards

The chapter has been updated for consistency of notation and concepts with other sections according to IAG and IAU working groups and expanded to provide definitions for concepts used throughout the document.

Chapter 2 Conventional Celestial Reference System and Frame

The chapter has been updated to incorporate the effects of the IAU 2000 24th General Assembly.

Chapter 3 Conventional Dynamical Realization of ICRF

The chapter has been updated to be consistent with notation and concepts of other sections.

Chapter 4 Conventional Terrestrial Reference System

The Chapter has been updated for ITRF2000.

Chapter 5 Transformation Between the Celestial and Terrestrial Systems

The chapter is being modified to be consistent with resolutions adopted at the 24th IAU General Assembly and the 2002 IERS Workshop.

Chapter 6 Geopotential

The chapter has been updated to include the EGM96 conventional geopotential model and for the treatment of tides.

Chapter 7 Site Displacement

The chapter has been updated to account for models used in IERS analysis centers and to ensure consistency with chapters 4 and 6.

Chapter 8 Tidal Variations in the Earth's Rotation

The chapter has been updated to be consistent with resolutions adopted at the 24th IAU General Assembly.

Chapter 9 Tropospheric Model

The chapter has been updated.

Chapter 10 General Relativistic Models for Time, Coordinates and Equations of Motion

The chapter has been updated for consistency of notation and concepts with other sections.

Chapter 11 General Relativistic Models for Propagation

The chapter has been updated for consistency of notation and concepts with other sections.

Appendix Resolutions of the 24th IAU General Assembly

New versions of chapters and accompanying software are posted on the web as they become available, see http://maia.usno.navy.mil/conv2000.html.

The Conventions are now ready for possible last-minute additions, final approval by the contributors, and for final format organization.

3 Future

The BIPM will provide funding for a "Visiting scientist" position to address the issues regarding the relative effects of the conventions on the official products of the IERS. Details have been provided through an IERS Message.