

# **IERS Working Group on Combination (IERS WG 3)**

## **Charter**

### **Introduction**

Currently the International Terrestrial Reference Frame (ITRF), the International Celestial Reference Frame (ICRF) and the Earth Orientation Parameter (EOP) series, are combined separately. With the exception of the ITRF and the IGS products neither intra-technique nor inter-technique combinations are performed including the full variance-covariance information. As a result neither the consistency of the products can be guaranteed rigorously, nor can the different strengths of the individual space geodetic techniques be exploited to provide improved products. In view of the challenges that the IERS is facing in support of new satellite missions for gravity, altimetry, and astrometry it is crucial to proceed towards a fully rigorous combination of all the parameters common to more than one space geodetic technique.

This IERS WG on Combination (IERS WG3) will coordinate the steps towards a very consistent, highly accurate set of IERS products and will be a forum for the discussion of all relevant combination aspects. The major task of IERS WG3 will be the coordination of the new IERS Combination Pilot Project that is expected to start routine product generation in Spring, 2004. Within the framework of this program, a rigorous combination of "weekly" SINEX files (containing station coordinates, EOPs and eventually quasar coordinates) from all space geodetic techniques is planned. The new products resulting from these combination procedures are expected eventually to replace a considerable part of the current IERS products if the IERS Combination Pilot Project is successful.

This WG shall work closely together with the IERS WG on Site Survey and Co-Location (IERS WG 2), the IERS WG on Datum Definition of Global Terrestrial Reference Frames (IERS WG 1), the ITRF Combination Centers, the Product Centers, the Combination Research Centers, and the Technique Services.

### **Goals and Objectives**

The major goals and objectives of the WG are listed below.

#### *1) Coordination of the Combination Pilot Project (CPP)*

- The major task of the WG is the preparation and coordination of the IERS Combination Pilot Project to be started in Spring, 2004. The WG will prepare the Call for Participation (CfP), evaluate the responses to the CfP, and decide on the steps to be taken in order to make the CPP a success. The issue of SINEX file collection, distribution and archiving will be addressed, also. The goal is to realize a new set of highly consistent IERS products around 2005.

#### *2) Standards for a Rigorous Combination*

- The Working Group will define standards concerning the models to be used by the individual techniques, the parameterization for various parameter types, the *a priori* representation of the parameters, and the processing strategies in order to

- ensure consistency of the individual contributions with the combined products and to avoid systematic biases due to inconsistencies in processing.
- It will define also standards and guidelines for the input solutions to be contributed by the individual technique services.
- 3) *Document on “Rigorous Combination of the IERS Products”*
- The Working Group will produce a document describing in detail the procedures, problems, and steps for a rigorous combination of the IERS core products. This document will contain the general guidelines for the different groups and centers that are involved in the combination tasks.
  - It will provide an annual report of its activities to the IERS Directing Board on the anniversary of its formation.
- 4) *Systematic Biases, Local Ties and Co-Location*
- The WG will investigate systematic biases between the individual space geodetic techniques and develop procedures and methods to handle these biases.
  - It will develop combination strategies concerning all the relevant parameters (e.g., the quasar coordinates; UT1 from VLBI and LOD from satellite techniques; nutation offsets and rates from different techniques; ...)
  - The WG will study strategies for weighting, datum definition, use of local ties, *etc.*
  - It will check the quality of the local ties available using the results of the individual or combined space geodetic technique solutions and discuss the possible deficiencies with the IERS WG on Site Co-Locations.
  - The Working Group will document the histories of station coordinate time series and develop approaches and guidelines to handle non-linear station behavior.
- 5) *Validation of Combined Products*
- Validation of the rigorously combined IERS products will be difficult. The WG will therefore establish methods to validate the products. Possible approaches are repeatability studies, use of independent information from the Global Geophysical Fluids Center (GGFC), accurate geophysical or geodynamical models, *etc.*
- 6) *Long-Term Series of SINEX Files*
- The Working Group will organize activities to obtain complete series of “weekly” SINEX files from all space geodetic techniques for multi-year solutions and consistent long-term ITRF, EOP, and ICRF realizations based on these “weekly” SINEX series.
- 7) *Definition of future IERS products*
- The Working Group will recommend the set of consistent IERS products to be routinely generated by the IERS Combination Centers in the future.
  - It will also consider possible procedures to allow a transition from the present IERS Product Centers to a future organization.
- 8) *Additional Combination Aspects*
- The WG will stimulate research and studies in the field of the combination of space geodetic techniques. This includes combination aspects such as the combination of atmospheric information, subdaily EOP series, nutation series

from GPS and VLBI, station clocks used for both, VLBI and GPS instruments, *etc.*

- It will study the interactions between gravity field coefficients and the ITRF and EOPs in close cooperation with the IERS WG on Datum Definition of Global Terrestrial Reference Frames (IERS WG 1).
- The Working Group will organize intensive observation campaigns (similar to CONT'02 for VLBI), where all major space geodetic techniques participate, in order to collect special data sets necessary to study details of the combination process.

### **Schedule (draft proposal; to be reviewed by the WG)**

- January 12, 2004: Finalize preparation of Call for Participation (CfP) for the IERS Combination Pilot Project (CPP)
- January 12, 2004: Begin development of the Document "Rigorous Combination of the IERS Products"
- January 26, 2004: Issue Call for Participation for the IERS Combination Pilot Project
- March 2004: Start of IERS CPP (exact date to be fixed by the WG)
- April 25, 2004: WG Meeting (before European Geophysical Union Meeting in Nice)
- October 2004: CPP Progress Meeting at the IERS Workshop 2004
- October 2005: Presentation of final report and recommendations to IERS Directing Board

### **Chair:**

Markus Rothacher (Analysis Coordinator)

### **Members:**

(representatives from groups with accepted proposals prepared in response to the CfP will be added to the member list)

Zuheir Altamimi (ITRS CC)  
Detlef Angermann (ITRS CC)  
Claude Boucher (ITRS Centre)  
Remi Ferland (ITRS CC)  
Daniel Gambis (Earth Orientation Centre)  
Gerd Gendt (IGS)  
Richard Gross (GGFC)  
Chopo Ma (IVS)  
Ron Noomen (ILRS)  
Axel Nothnagel (IVS)  
Gerard Petit (Convention Centre)  
Jim Ray (Convention Centre)  
Bernd Richter (IERS CB)  
Jean Souchay (ICRS Centre)  
Pascal Willis (IDS)  
William Wooden (Rapid Service/Predictions Centre)  
Shengyuan Zhu (CRCs)