Annex:
Share of task for operating the IERS ICRS Center

Abstract. This annex is an extract from the June 2000 agreement between Paris Observatory and the US Naval Observatory, with list of participants over 2001-2004.

Responsibilities

The Paris Observatory (OP) and the U.S. Naval Observatory (USNO) propose to act jointly as the International Celestial Reference System (ICRS) Center of the International Earth Rotation Service. The Product Center will have two co-directors (one from each institution), and a representative to the IERS Directing Board, which will rotate between institutions on a four-year term starting with the Paris Observatory. The proposing institutions will work together to provide the IERS Celestial Reference System. Each agency will perform specific tasks as described below to accomplish this goal.

The sharing of tasks, based on those originally proposed by OP and USNO, is listed hereafter. A capital X indicates the coordinating institution.

	OP	USNO
A. Reference system and frame		
1. Maintenance and extension of the ICRF	X	x
2. Investigation of future realizations of the ICRS	x	X
B. Extragalactic radio-sources		
3. Monitor structure to assess astrometric quality	x	X
4. Maintenance of the time stability of ICRF	X	x
C. Link of other reference frames to ICRS		
5. Maintenance of the link to the Hipparcos catalog	x	X
6. Linking the ICRF to frames at various wavelengths	X	x
7. Maintenance of the link to the solar system dynamical reference frame through millisecond pulsar analysis	X	
8. Maintenance of the link to the solar system dynamical reference frame through Lunar Laser Ranging analysis	X	
9. Maintenance of the link to the ITRF	X	
D. Information systems		
10. Dissemination of ICRS products	X	X

The ICRS Center will accomplish these tasks under direction of the IERS Directing Board and in coordination with the International VLBI Service for Geodesy and Astrometry (IVS) and the IAU Working Group on Reference Frames. It also expects to work closely with researchers of other institutions (with their agreement) who have already provided valuable contributions to reference systems.

Organization of activities

Maintaining the ICRF as the fundamental realization of the ICRS for the scientific community is the primary task of the ICRS Center. The IAU assigns this task to the IERS, therefore it will be performed in coordination with the concerned IAU bodies. As the current ICRF is based on VLBI data, the work will be performed in close collaboration with the IVS (both institutions are IVS Analysis Centers). Performing this primary task at the state of the art level requires a number of supporting activities that will be shared between OP and USNO. The following describes the distribution of efforts.

Task 1. Maintenance and Extension of the ICRF

A permanent VLBI observing program coordinated by the IVS continually brings in new observations of ICRF and prospective ICRF sources. The current coordinates of known sources will be checked for consistency and ICRS coordinates of the new sources will be derived. The ICRS Center will publish extensions to the ICRF as computed by the IVS. This work will be performed on a yearly basis, and results will be used to make recommendations on the relevance of possible revisions to the ICRF.

Revisions to the ICRF will occur only when improvements in modeling and data analysis strategies are sufficient to justify a complete reconstruction of the standard frame. The responsibility for this decision lies with the appropriate IAU and IVS groups of experts, of which ICRS PC personnel from both OP and USNO are members. The actual computation of the revised frame is performed in a single analysis following the specifications and recommendations issued by the above-mentioned groups of experts.

Personnel

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Task 2. Investigation of future realizations of the ICRS

Future astrometric satellite missions such as FAME, SIM and GAIA, may provide fundamental reference frames more accurate than the current VLBI-based ICRF. Proposal personnel have direct ties to both FAME and SIM. This puts Product Center personnel in the unique position to study these prospective reference frames and to prepare possible recommendations of future space-based realizations of the ICRF for adoption by the IAU.

Personnel

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Task 3. Monitor structure to assess astrometric quality

The task of imaging the sources and evaluating their quality will be shared between the two proposing organizations for this task. Proposal personnel have played key roles in assessing astrometric source quality through the use of the source "structure index" (see Boboltz, this volume). In addition, proposal personnel have recently developed an improved method for assessing astrometric source quality, which was used in the selection of sources for the SIM extragalactic frame. Both the images and the structure indices will be made available through the ICRS Center web site. These products will be updated regularly as new data become available. The ICRS Center will work closely with the IVS to provide improved means necessary to assess the astrometric quality of ICRF sources. Future work will be targeted at correcting astrometric positions for the effects of source structures.

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Task 4. Maintenance of the time stability of ICRF

In addition to source structure, the stability in time of the ICRF depends on many different aspects of the operation of VLBI programs, such as atmospheric corrections, scheduling of observations and analysis strategies. Its understanding and monitoring is crucial for high accuracy scientific applications in other domains, e.g. precession-nutation studies. Proposal personnel are engaged in an analysis program on this topic (see Feissel-Vernier, this volume). These studies will also be useful to prepare recommendations to the IAU for future ICRS realizations. They will be carried out in coordination with the IAU working group on the International Celestial Reference System and IVS components.

Personnel

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Task 5. Maintenance of the link to the Hipparcos catalog

The link between the ICRF and the reference frame resulting from the Hipparcos catalog is considered fundamental to both frames; it extends the ICRF to optical wavelengths by giving access to ICRS coordinates and proper motions for more than 100,000 stars over the entire sky at mas and mas/yr accuracy respectively. In fact, the Hipparcos catalog can be considered the optical counterpart to the ICRF, and the IAU has recommended the Hipparcos catalog as the optical realization of the ICRS. The proposed task will consist of gathering both old and new data concerning Hipparcos stars in order to provide complete information on these objects, and particularly, data enabling the determination of the stellar positions with respect to nearby extragalactic objects. The location of the Hipparcos axes with respect to the ICRF will be an object of particular attention, as well as the effect of Hipparcos proper motion uncertainties. One example is the UCAC program to link the optical and radio frames via extragalactic sources, which should provide a link at the level of 1 mas. This will be a significant improvement and check on the current ICRF/Hipparcos link via radio stars.

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Task 6. Linking the ICRF to frames at various wavelengths

The ICRS Center will also deal with the improvement of the link between the ICRF and the frames related to deep sky surveys at wavelengths not belonging to the radio spectra; that is to say in the optical, infrared, and X-ray bandwidths, based on the various surveys conducted around the world that are able to provide valuable astrometric data through output catalogs.

Personnel

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Task 7. Maintenance of the link to the solar system dynamical reference frame using millisecond pulsar analysis

Associating the pulsar timing technique with differential VLBI astrometry provides high quality information about the position and motion of the equator, the ecliptic, and the equinox of the ICRF. The proposed task will be to carry out a combined analysis of pulsar timing obtained by the OP/Nançay telescope and differential VLBI.

Personnel

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Task 8. Maintenance of the link to the solar system dynamical reference frame using Lunar Laser Ranging (LLR) analysis

When combined with VLBI analysis, the LLR technique is one of the most efficient ways to determine the orientation of the planetary reference frame relative to the extragalactic reference frame. The ICRS Center will gather the various data coming from LLR measurements in the framework of the ILRS in order to determine the orientation of the ecliptic in the ICRS.

Personnel

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Task 9. Maintenance of the link to the International Terrestrial Reference Frame (ITRF)

Long-term consistency of the ICRF, ITRF, and Earth Orientation time series is required by the user community. The ICRS PC will participate in this task in close cooperation with the IERS Analysis Coordinator and other IERS Product Centers.

Personnel

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Task 10. Dissemination of ICRS products

Dissemination of ICRS products will be done through the ICRS Center web sites (identical sites will be hosted at OP and USNO) and through the IERS Data Center proposed by Paris Observatory jointly with CDDIS and BKG. The existing web sites will be reorganized and interlinked in order to provide relevant information related on the ICRS and ICRF. Updating the contents related to each task will be under the responsibility of the corresponding task coordinator. The overall homogeneity of the web site and of the Data Center public files will be the joint responsibility of two local coordinators, one in each institution.

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