ONE POSSIBLE REALIZATION OF THE ICRF BEFORE THE GAIA FRAME

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ABSTRACT. A brief overview of current state of densification and extension of the HCRF (Hipparcos Celestial Reference Frame) is given. For a first step in this matter the XPM catalogue could be used. The XPM system of proper motions has been obtained by direct link of about 300 millions of stars to extragalactic sources. This catalogue has no significant magnitude equation. As a result of the comparison of the XPM with catalogues compiled in the HCRF system, a residual rotation of the HCRF system was derived. The parameters of this residual rotation could be used for combining the catalogues computed in the HCRF system and the XPM catalogue for creation of a new optical realization of the ICRF.

1. INTRODUCTION

An overview of current state and future ground and space-based projects for realization of the ICRS is given in the IERS Technical Note No. 36 (pp. 21–27), see IERS (2010). The 24^{th} IAU General Assembly adopted Resolution B 1.2, which defines the Hipparcos Celestial Reference Frame (HCRF) for the optical realization of the ICRS. The Resolution B3 of the 27^{th} IAU General Assambly resolved that from 1 January 2010 the realization of the ICRS is the ICRF2. The alignment of the HCRF to the ICRF was realized with an error of about 0.6 mas for the orientation and 0.25 mas/yr for the spin. For practical use, it is necessary to bridge the large gaps between the ICRF sources, i.e. to densify the HCRF and ICRF2. All current optical densification catalogs rely on a set of the HCRF stars (see Table 1).

Name of catalogue	Number of stars (in million)	Ranges of δ and m	Uncertainties at epoch 2000.0	
			Position (in mas)	Proper motion (in mas/yr)
Tycho-2	2.5	$-90° < \delta < +90°$ $B < 13.5$; $V+$	~ 60	~ 2.5
UCAC-3	100.8	$-90° < \delta < +90°$ $R < 16$	15-100	1-10
PPMXL	910	$-90° < \delta < +90°$ $V < 20$; $R+; I+$	80-300	7-15 (N) 15-30(S)
SPM-4	103.3	$-90° < \delta < -20°$ $V < 17.5$	30-150	2-10
USNO-B1.0	1042.6	$-90° < \delta < +90°$ $B < 22$; $R+; I+$	200	unknown

Table 1: Overview of some densification catalogues based on the HCRF

2. THE XPM CATALOGUE

The XPM catalogue of positions and absolute proper motions of about 300 million objects distributed over the whole celestial sphere without gaps in the magnitude range 10 m < B < 22 m was created at the

Institute of Astronomy of Kharkiv National University in Ukraine. It was shown that the uncertainties of absolute proper motions of the XPM stars are equal to about 5 mas/yr and about 8 mas/yr for the northern and southern hemispheres, respectively (Fedorov et al., 2009). Using positions of about 1 million galaxies taken from the 2MASS and the USNO-A2.0 catalogues, the zero-point of the XPM absolute proper motions was derived with a mean formal error of about 1 mas/yr. Based on comparisons of the proper motions of stars in the XPM and the Tycho-2, PPMXL and UCAC3, we concluded that the relative rotation of the HCRF system around the Z axis is about -1.8 ± 0.16 mas/yr (Fedorov et al., 2011). The residual rotation vectors (ω) are different for the catalogues mentioned above (see ω_z component in Figure 1).

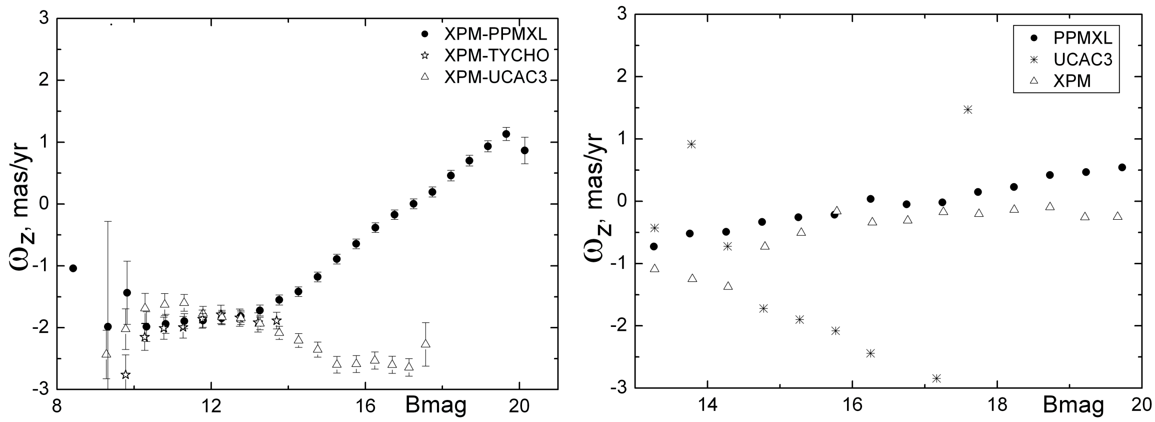

Figure 1: Component ω_z derived from the comparison of stellar proper motions of XPM with those of PPMXL, Tycho-2 and UCAC3 (left panel) and from the determination of formal proper motions of extragalactic objects of XPM, PPMXL and UCAC3 (right panel)

3. CONCLUSION

There are several densification catalogues at optical and near-IR wavelengths derived from the HCRF. The comparison of these catalogues with the XPM resulted in a determination of residual rotation components of catalogue coordinate systems with respect to an inertial system. The values of these residual rotation components could be used for combining the catalogues under considerations and making further steps with regard to the densification of the optical reference frame.

4. REFERENCES

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