VÉRON & VÉRON BASED EXTRAGALACTIC REFERENCE FRAME

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ABSTRACT. The Gaia Extragalactic Celestial Reference Frame (GCRF) will be formed by about 500,000 quasars, up to magnitude G=20, to typical precision of 100 μas. It is pivotal for many of the mission objectives, starting with the astrometry catalogue. We present a restricted representation of the GCRF, based on the Véron-Cetty & Véron list of 48,921 quasars. This representation brings the original list to a fully coherent placement on the ICRS. The sources positions have been collected from the USNO B1.0 catalog, which is complete to V=20. Around each source, fields of size as small as 6' were detailed, in which were picked up B1.0 stars and their corresponding positions from catalogs extending the HCRS to dimmer magnitudes. The UCAC2 (48 million stars, to R=16, precise to 50 mas) and the 2MASS (470 million objects, complete to J=16, precise to 100 mas) acted as the astrometric reference catalogs. Taking as paradigm the B1.0 positions corrected by the UCAC2, it is obtained a reference frame containing 37,513 quasars, globally aligned to 1 mas with the ICRF. The optical minus radio standard deviation is at 150 mas, much smaller than the nominal 200 mas B1.0 accuracy (the o-r standard deviation is above 300 mas for the original V&V entries). The extragalactic reference frame so obtained enables to gather insights on the distribution and luminosity of the GCRF. At the same time it provides an useful frame for all purpose observations.

1. METHOD AND RESULTS

To find the B1.0 (Monet et al., 2003) position for the V&V (Véron-Cetty & Véron, 2003) quasars three conditions have been enforced. That the positions would match below 1", which guarantees to be within the combined 2.5σ level. That the corresponding B1.0 entry had proper motions smaller than the proper motions error. And that the B1.0 and V&V magnitudes would not differ by more than 3. The process is fully automated and, in case of more than one candidate fulfilling the criteria, the closest to the V&V position was chosen. Next, B1.0 positions were picked up for UCAC2 stars (Zacharias et al., 2004) around the quasar. For that the UCAC2 positions were placed at the date of the B1.0 original plate containing the quasar. Then the same recognizing criteria of position and magnitude matching were used. Extensive tests have shown

that first degree independent complete polynomials suffice, and indeed are more indicated, to obtain the UCAC2 corrections to the B1.0 positions (Andrei et al., 2004). The present status of the extragalactic optical frame is shown in Figure 1. Note the limitation due to the currently incomplete UCAC2 northern stellar coverage. Supplementary, B1.0 corrections by 2MASS (Cutri et al., 2003) stars were also essayed with encouraging results.

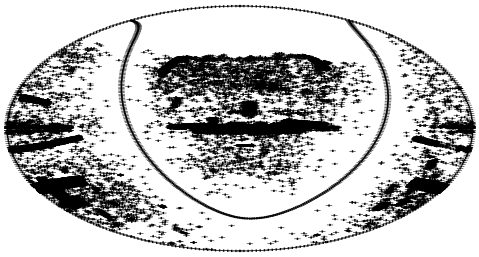

Figure 1: Sky distribution of the 37,513 V&V quasars. The positions were here determined from B1.0 entries as locally corrected on local UCAC2 stars frames.

2. CONCLUSION AND PERSPECTIVES

The combination of the V&V list with the positions from the B1.0 catalog enables to obtain an optical extragalactic reference frame, with one hundred times the number of the ICRF sources. The B1.0 systematic errors can be removed by local corrections using UCAC2 stars. As both the B1.0 and the UCAC2 catalogues are tied to the HCRS, it equally is the so formed extragalactic reference. The UCAC2 local correction mimics a plate reduction, and, due to the smallness of the required fields, it can be performed by independent (X,Y) first degree polynomials.

Presently, the formed extragalactic reference frame contains 37,513 sources. The adherence to the ICRF is -32 ± 10 mas on right ascension and $+8 \pm 9$ mas on declination. The standard deviations of the offsets to the ICRF positions are at the level of 150 mas. No systematic differences to the ICRF are apparent at this level. To compare, the corresponding standard deviation from the direct V&V entries to the ICRF positions is at the level of 320 mas.

The next steps, already being tackled, are to complete the northern part of the V&V list, for which UCAC2 stars are not yet available. A way to do it is by using preliminary UCAC2 positions, provided that a study of proper motion is made. Alternatively, 2MASS stars can be used. At any rate, a thorough reduction using 2MASS stars is planned, for the sake of comparison and study of the 2MASS astrometry. The analysis of residuals is also planned relatively to the sources characteristics, as color, magnitude, and redshift. For the final version of the optical extragalactic reference frame, the adherence to VLBI positions is to be used to furnish harmonic corrections, to tie the optical reference frame directly to the ICRF.

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