ABOUT HOMOGENEITY IN COMBINED CATALOGS

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ABSTRACT. The IAU recommendations regarding the ICRF realizations require the construction of radio sources catalogs obtained using very-long-baseline interferometry (VLBI) methods. The improvement of these catalogs is a necessary procedure for the further densification of the ICRF over the celestial sphere. [1], [2].
The different positions obtained from several catalogs using common sources to the ICRF make it necessary to critically revise the different methods employed in improving the ICRF from several radio sources catalogs. In this sense, a revision of the analytical and the statistical methods is necessary in line with their advantages and disadvantages.
We define homogeneity as applied to our problem in a dual sense: the first deals with the spatial distribution of the data over the celestial sphere. The second has a statistical meaning, as we consider that homogeneity exists when the residual between a given catalog and the ICRF behaves as a unimodal pure Gaussian. We use a nonparametrical method, which enables us to homogeneously extend the statistical properties of the residual over the entire sphere.
A combination of catalogs can only be homogeneous if we configure the weights carefully. In addition, we provide a procedure to detect inhomogeneities, which could introduce deformities, in these combined catalogs.
An inappropriate use of analytical adjustment methods provides erroneous results. Analogously, it is not possible to obtain homogeneous-combined catalogs unless we use the adequate weights.
In this study, we considered only the sources which have at least 15 observations in two sessions. We have not included some reference sources in our calculus that present oddly high residuals. All values are given in mas.
With respect to the study of the residuals, we have chosen to carry out a preliminary kernel nonparametric adjustment [7] (KNP henceforth) for the $\Delta\alpha cos\delta$ and $\Delta\delta$ in both catalogs and a vectorial spherical harmonics (VSH henceforth) of first order for the adjustment model. Then, we apply our mixed method [4], [5]. The existence of deformations has required the use of a correction for each catalog given by

$$\min_{C^i} \int_{S^2} \left\{ \left[(\Delta\alpha\cos\delta)^{(i)} - m_\alpha^{[i]}(\alpha,\delta) \right]^2 + \left[(\Delta\delta)^{(i)} - m_\delta^{[i]}(\alpha,\delta) \right]^2 \right\} dS \tag{1}$$

where C^i are the coefficients of the models $m_\alpha^{[i]}$ and $m_\delta^{[i]}$ with $i = 1$ (USNO) and $i = 2$ (JPL). The results for the coefficients of the VSH of first order may be seen in [5]. This must be considered in future studies.
Next, we consider only the rotations. We subtract the corrections provided by the rotations to the initial position to obtain the intermediate catalogs $USNO^1$ and JPL^1 $Cat^1 = Cat - correction$, where these corrections depend only on the rotations. The adjustment itself is given by $cat_i^1 - (ICRF - Ext2) = m^{[i,1]} + e^{[i,1]}, i = 1, 2$.
Now, we use the term WRMS that denotes weighted root mean squared. In our case, the function uses the weights assigned by the KNP adjustment. With regard to the WRMS in the entire sphere where we have used numerical integration and a KNP adjustment, the results may be visually checked for the USNO in figures 1 and 2.
For further details see [5].

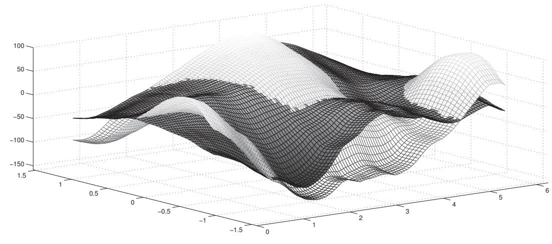

Figure 1: Differences in (ICRF-Ext2)-USNO for $\Delta\alpha cos\delta$ (in mas). The clear surface represents the initial differences, the dark surface represents the differences after the correction given by the rotations.

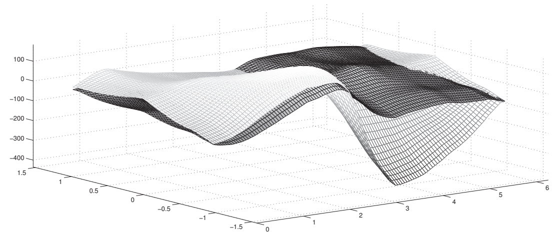

Figure 2: Differences in (ICRF-Ext2)-USNO for $\Delta\delta$ (in mas). The clear surface represents the initial differences, the dark surface represents the differences after the correction given by the rotations

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