TWO INDEPENDENT ESTIMATIONS FOR THE ϵ_z VALUES IN THE HIPPARCOS-FK5 CATALOGUES

M.J. MARTINEZ[1], F.J. MARCO[2], J.A. LOPEZ[2]

[1]Universidad Politécnica de Valencia
Camino de Vera. Dep de Matemática Aplicada. E.T.S.I.I. Valencia. Spain
e-mail: mjmartin@mat.upv.es

[2]Universidad Jaume I
Campus de Riu Sec. Dep. Matemáticas. Castellón. Spain
e-mail: marco@mat.uji.es, lopez@mat.uji.es

ABSTRACT. After the publication of the Hipparcos catalogue and its acceptation as the fundamental reference frame the questions of the homogenization of catalogues reemerged, because the IAU recommended that necessary studies should be arranged in order to obtain as thorough relationships as possible with the rest of catalogues. A first step to arrange the comparative study of two catalogues (in particular Hipparcos and FK5 which are the reference frames of the new and old reference system, respectively) is the application of a global rotation of one catalogue into the other. We employed two different models, including bias (GLAD model) or not (GL model) to obtain the infinitesimal rotations between the different catalogues (namely Hipparcos and other catalogue) They provide different ϵ_z values, which is an important problem to be solved. To this aim, we use two different verification methods based on nonparametrical adjustment employing kernel regression (KNP) and spherical harmonics of order n (SHn). These methods are independent of the previously employed (GL or GLAD) and they give us an idea of the true magnitude order of the parameter.

1. INTEGRAL NUMERICAL ESTIMATIONS OVER THE SPHERE FOR THE ϵ_z VALUES

The difference between the GLAD and the GL model lies in the difference between the corresponding ϵ_z values. The main intrinsecal difference between them rests on whether or not a value for DA and DD is included As a consequence, we need an independent method that gives us an idea of the true magnitude order of this parameter. This will be the KNP method. Nonparametrical adjustments by kernels compute the conditional mean of a certain random variable that depends on other variables. Let X be a random variable ($\Delta\alpha\cos\delta$ or $\Delta\delta$). If D is the spherical domain of X, $f(x,\alpha,\delta)$ the joint density function and $f_{(\alpha,\delta)}(\alpha,\delta)$ the marginal density, the method consists of finding:

$$m_X(\alpha,\delta) = E(X|(\alpha,\delta)) = \int_D x\frac{f(x,\alpha,\delta)}{f_{(\alpha,\delta)}(\alpha,\delta)}dx$$

In the previous equation it may be necessary to approximate the unknowns and selecting the Kernel, we arrive at an expression similar to the one of Nadaraya-Watson, but in the sphere:

$$m_X(\alpha,\delta) = \sum_{i=1}^{n} w_i x_i, \;\; w_i = \frac{K_\alpha\left(\frac{\alpha-\alpha_i}{h_\alpha}\right) K_\delta\left(\frac{\sin\delta-\sin\delta_i}{h_{\sin\delta}}\right)}{\sum\limits_{j=1}^{n} K_\alpha\left(\frac{\alpha-\alpha_i}{h_\alpha}\right) K_\delta\left(\frac{\sin\delta-\sin\delta_i}{h_{\sin\delta}}\right)}$$

2. CONCLUSION

The models usually employed search for infinitesimal rotations using the least squares method, but they do not remove the bias. The existence of the bias in $\Delta\alpha\cos\delta$ and $\Delta\delta$ makes the introduction of the Δ A and Δ D coefficients in the adjustment, cause a variation in the ϵ_z value. The SH and KNP models do not make any supposition about dependence on right ascension and declination residuals. Therefore, we can use them to see the GL and GLAD coefficients that they imply and to decide the ϵ_z values for two independent methods. The ϵ_z estimations are very different for the corresponding values obtained using the GL (Marco et al. 2004, Mignard & Froeschlé 2000,Schwan, H. 2001) or GLAD [1] and it is very important to reconsider the adopted model regarding further applications

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3. REFERENCES

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