RADIO STRUCTURE EFFECTS ON THE OPTICAL AND RADIO REPRESENTATIONS OF THE ICRF

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ABSTRACT.

Silva Neto et al. (SNAAVM: 2002) show that comparing the ICRF Ext1 sources standard radio position (Ma et al., 1998) against their optical counterpart position (ZZHJVW: Zacharias et al., 1999; USNO A2.0: Monet et al., 1998), a systematic pattern appears, which depends on the radio structure index (Fey and Charlot, 2000). The optical to radio offsets produce a distribution suggestive of a coincidence of the optical and radio centroids worse for the radio extended than for the radio compact sources. On average, the coincidence between the optical and radio centroids is found 7.9 ± 1.1 mas smaller for the compact than for the extended sources.

Such an effect is reasonably large, and certainly much too large to be due to errors on the VLBI radio position. On the other hand, it is too small to be accounted to the errors on the optical position, which moreover should be independent from the radio structure. Thus, other than a true pattern of centroids non-coincidence, the remaining explanation is of a hazard result. This paper summarizes the several statistical tests used to discard the hazard explanation.

1. STATISTICAL TESTS

The main data set used in SNAAVM analysis comprises 234 ICRF sources, with measured radio structure index, for which ZZHJVW determined the optical counterpart position, at the level of 50mas. There are 127 compact sources and 107 extended sources. Most of them (177) lie in the northern sky, while the division between defining (94) and non-defining (140) is more even. The method used for the analysis is to compare the averages of the optical and radio arclength difference distributions (Li and Jin, 1995) for the extended and compact sources subsets. As an optically independent sample, there are 288 ICRF sources in the A2.0 catalogue, to a 220mas precision level, for which the radio structure index is known. Again, most of them are northern sources and the defining to non-defining sources proportion is even enough. One third of this sample does not belong in the ZZHJVW sample. Finally, the RORF (Johnston et al., 1995) radio positions list, although highly redundant with the ICRF positions, is also used, as the only choice for a radio to radio positions comparison.

On Tables 2, 3, and 4 of SNAAVM, the arclength method is applied for the distributions produced by the ZZHJVW and A2.0 lists, without or with different weighting schemes, giving allways rise to larger averages for the extended sources subsamples. Even the simple root square

differences indicate the same tendency. In the tests below, the radio to optical residuals are juggled with to verify that those results are never seen as a chance outcome.

Sky location from ZZHJVW - The optical minus radio offsets from compact sources were assigned to the extended sources, and vice-versa. **The extended to compact sources difference remains.** E-C = 10.5 ± 1.4mas (11.3 ± 1.4mas, removing 2.5σ tails)

Sky location at random - The true offsets from the compact and extended sources populations were assigned to ICRF positions draw at random. **The extended to compact sources difference remains.** E-C = 7.8 ± 1.2mas (8.8 ± 1.0mas, removing 2.5σ tails)

Fake data (Gaussian) - Fake offsets drawn from a Gaussian distribution, with same mean and standard deviation as the real offsets distribution, were assigned to the actual compact and extended sources. **The extended to compact sources difference vanishes.** E-C = 0.3 ± 0.9mas (0.1 ± 0.6mas, removing 2.5σ tails)

Fake data (Random) - Fake random offsets, varying between ±10 and ±30 mas, were assigned to the actual compact and extended sources. **The extended to compact sources difference shows up.** E-C = 7.5 ± 0.9mas (8.2 ± 0.6mas, removing 2.5σ tails)

Changing categories - Standard arc length procedures applied to the defining and non-defining sources, instead of to the compact sources and extended sources. **The difference vanishes.** ND-D = 1.0 ± 0.9mas

Segregation (Non-Defining Sources) - Standard arc length procedures applied for the non-defining sources only (66 compact sources and 74 extended sources). **The extended to compact sources difference remains.** E-C = 7.3 ± 1.8mas

Segregation (Defining Sources) - Standard arc length procedures applied for the defining sources only (limited in scope, since there are 61 compact sources, but only 33 extended sources). **The extended to compact sources difference remains.** E-C = 7.3 ± 3.2mas

The same tests applied to the USNO A2.0 sources distribution show equivalent results.

Optical to optical - Standard arc length procedures applied, using the ZZHJVW and the USNO A2.0 positions. **The difference vanishes.** E-C = 2.6 ± 3.8mas

Radio to radio - Standard arc length procedures applied, using the ICRF and the RORF positions **The difference vanishes.** E-C = 0.6 ± 1.1mas

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