SYSTEMATIC DIFFERENCES BETWEEN RADIO ASTROMETRIC SURVEYS

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ABSTRACT

A radio astronomical reference frame has been established from four interferometric position surveys of extragalactic objects. The resulting systematic differences between surveys were studied with different weighting schemes and averaged systematic corrections were derived.

1. INTRODUCTION

Four radio astrometric surveys of extragalactic objects accurate to a few hundredths of seconds of arc in both coordinates formed the basis for a reference frame with respect to which systematic differences of the independent surveys have been determined. The four lists of positions are due to Clark et al. (1976), Elsmore and Ryle (1976), Wade and Johnston (1977), and Fanselow et al. (1979); below they are called, in turn, C_1, C_2, C_3, C_4. Before solving simultaneously for corrections of the source positions and the zero points, allowance was made for the zero points adopted by the different authors (Elsmore, 1979). On adding 2 ms, 8 ms, 3 ms and 6 ms to the positions in C_1, C_2, C_3 and C_4, respectively, the right ascensions of the four surveys were adjusted to RA = $12^h26^m33^s.250$ as recently derived by de Vegt and Gehlich (1980) for 3C 273 B.

2. RESULTS AND DISCUSSION

Having made allowance for the different zero points, two weighting schemes (w_{ik}) were applied when constraining the sum of systematic differences to zero which is common astrometric practice in setting up the reference frame of a general catalogue, i.e.

$$\sum_i w_{ik} \Delta C_{ik} = 0, \quad k = 1, \ldots, N,$$

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where i is associated with the surveys and k with the observations comprised within each survey. In Model I, uniform weights are chosen while the weighting factors in Model II are related to the standard deviations of the observations quoted in the surveys, thus taking more directly account of the influences of baseline geometry and source positions on the precision of observations. Table 1 shows the averaged systematic differences of each survey.

Table 1. Systematic differences and errors obtained by averaging the differences (survey position - reference frame position).

Survey	Systematic differences Model I $\Delta\alpha\cos\delta$	Model I $\Delta\delta$	Model II $\Delta\alpha\cos\delta$	Model II $\Delta\delta$	Number of contributing objects
	[10^{-3} arcsec]		[10^{-3} arcsec]		
C_1	-10 ± 6	1 ±4	-2 ±4	-1 ±7	13
C_2	-4 ±8	14 ±9	-13 ±12	6 ±12	15
C_3	8 ±7	-19 ±6	0 ±9	-35 ±7	30
C_4	7 ±6	18 ±6	1 ±1	2 ±1	28

The individual systematic differences resulting from Model II are depicted in Figs. 1 and 2 versus RA and Dec for the more abundant surveys C_3 and C_4. Of course, C_4 dominates the results owing to observation accuracies superior to those of C_3. Nevertheless, the plots illustrate common features in as much as the residuals versus RA are notably noisy in the region $16^h < RA < 21^h$. It is not obvious how to explain the fluctuations. On the other hand, the residuals versus Dec diminish with increasing declination apart from a few exceptions. This behaviour may be interpreted as being due to the reduced sensitivity of radio interferometric measurements at declinations near zero. Another issue of the comparison is the discovery of a systematic difference in declination of about 0".03 between C_3 and C_4.

On the whole, the adoption of a zero point in RA common to all surveys and the introduction of an observation-dependent weighting scheme (Model II) in the conditional equations for the systematic differences led to a significant reduction of the noise in the residuals. This is underlined by comparing with an analogous study (Walter, 1980) which omitted introducing a common zero point and which omitted discriminating between weights of the surveys. It produced graphs corresponding to

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Figs. 1 and 2 of basically the same pattern but with larger amplitudes.

The source coordinates ensuing from the different models vary by about ±0".03 and stay comfortably within the 3σ limits of the positions defining the reference frame.

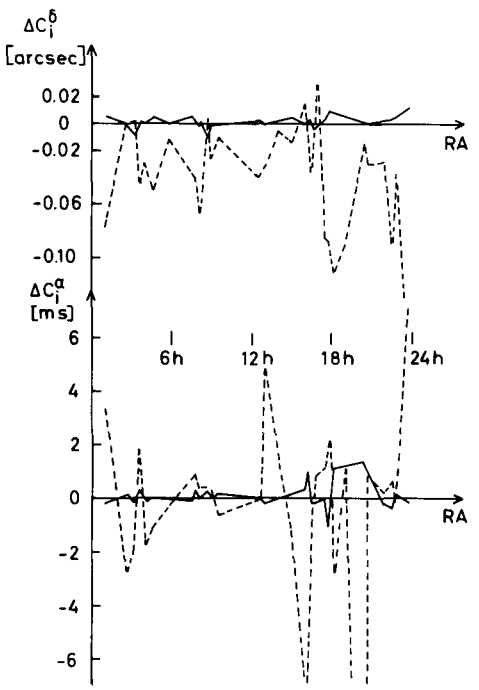

Figure 1. Systematic differences versus right ascension between C_3, C_4 and the reference frame. C_3: ---- C_4: ——

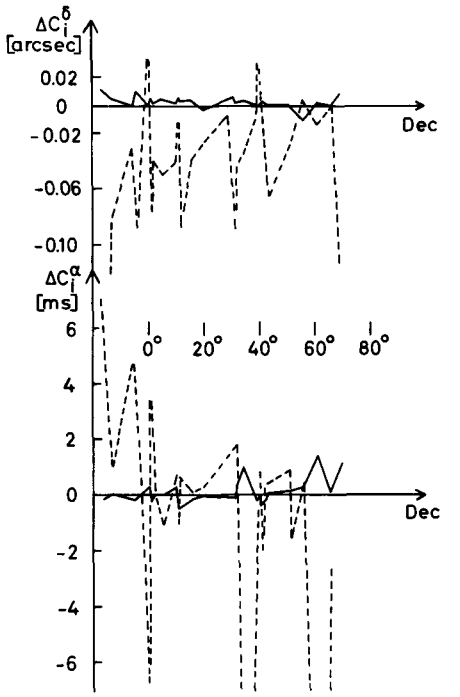

Figure 2. Systematic differences versus declination between C_3, C_4 and the reference frame. C_3: ---- C_4 ——

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