EFFECT OF SAMPLING RADIUS ON THE DETERMINATION OF MEMBERSHIP IN OPEN CLUSTERS

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MOTIVATION

The aim of this work is to analyze the dependence of the membership probabilities obtained from kinematical variables (Sanders' method) on the radius of the field of view around open clusters (the sampling radius, Rs).

PROCEDURE

(1) **Simulations:**

We randomly distribute cluster and field stars according to bivariate Gaussian distributions in the proper motion space.

Rc: true cluster radius

Rs: sampling radius

(2) **Real data:**

We use the CdC-SF Catalogue (Vicente et al. 2010), with a mean precision in proper motion of 2.0 mas/yr.

Two open clusters: NGC 2323 (M 50) and NGC 2311.

(3) **Membership determination:**

We use the algorithm proposed by Cabrera-Caño & Alfaro (1985) based on the commonly used Sanders' method (Vasilevskis et al. 1958; Sanders 1971).

MAIN RESULTS

For the simulated clusters, the fraction of assigned cluster stars is a decreasing function of Rs (Figure 1).

The highest value of the net proportion of cluster stars that are well classified (the matching fraction, Mc) occurs exactly when the sampling radius equals the cluster radius (Figure 2).

For real data, there is an optimal Rs value (Rs,opt) from which the fraction of cluster members increases as Rs increases (Figure 3).

The clearest separation between cluster and field stars, i.e. the highest effectiveness of membership determination (Tian et al. 1998; Wu et al. 2002), is achieved at Rs ~ Rs,opt (Figure 4).

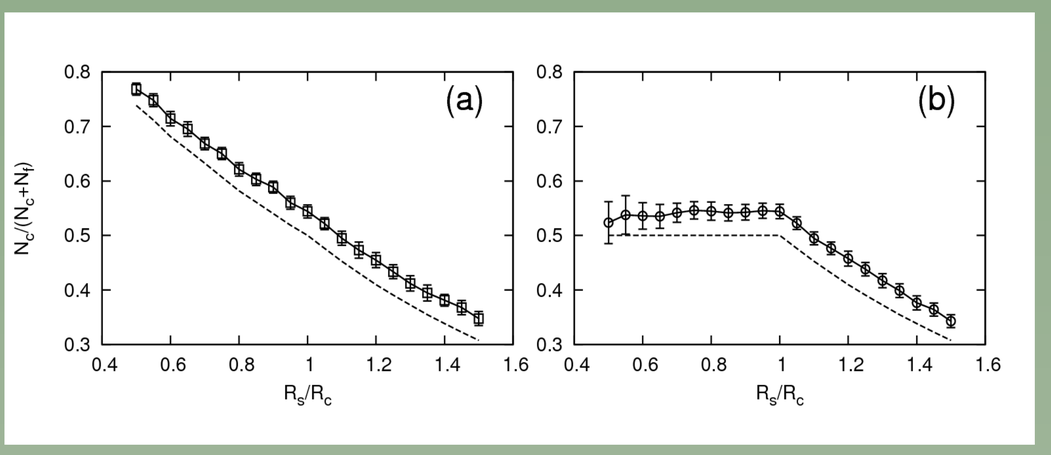

Figure 1: Calculated fraction of cluster stars as a function of the sampling radius in units of the cluster radius, Rs/Rc, for simulations with (a) peaked density profile and (b) flat density profile. Assigned members are indicated by open symbols connected by lines and the real numbers of simulated stars are shown by dashed lines.

DISCUSSION

In general, star cluster memberships depend on the radius of the field containing the sampled cluster (Rs).

The main reason for this dependence is the difference between the assumed Gaussian and the true underlying proper motion distributions.

The contamination of cluster members by field stars increases as the sampling radius increases, although the rate at which this effect occurs depends on the intrinsic characteristics of the data set.

There is a threshold value of Rs above which the identified cluster members are highly contaminated by field stars and the effectiveness of membership determination is relatively small.

If this type of effect is not taken into consideration in automated data analysis then significant biases may arise in the derived cluster parameters.

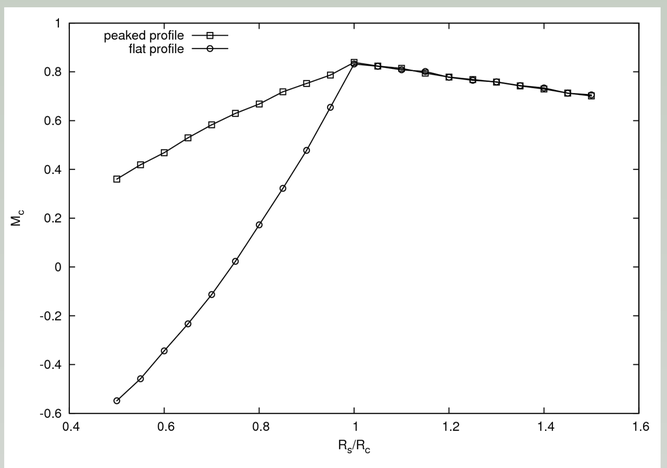

Figure 2: Matching fraction of the cluster (see text) as function of the sampling radius for simulations with different kinds of density profiles. The error bars are of the order of the symbol sizes but are not shown for clarity.

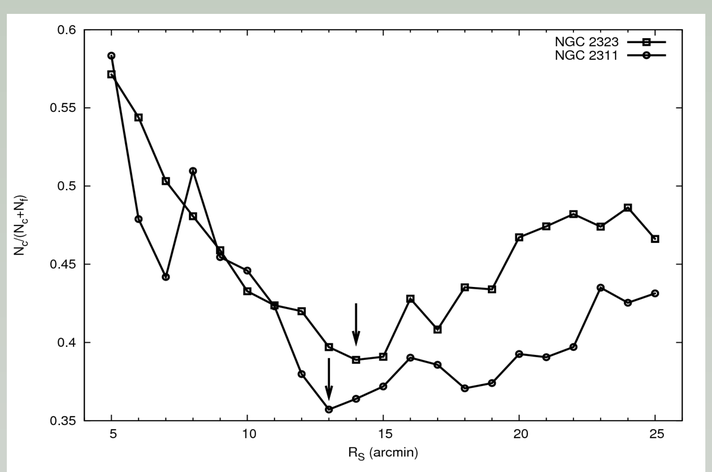

Figure 3: Fraction of cluster stars as a function of the sampling radius for NGC 2323 (squares connected by lines) and NGC 2311 (circles connected by lines). Vertical arrows indicate the optimal sampling radii (see text).

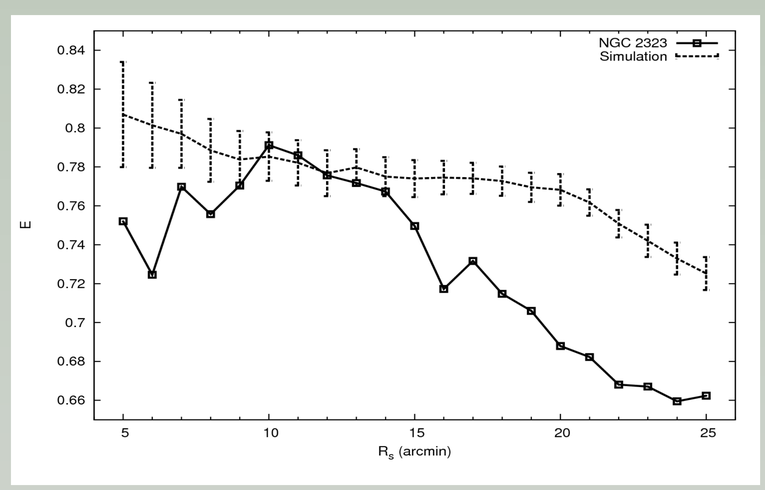

Figure 4: Effectiveness of membership determination as a function of the sampling radius for the open cluster NGC 2323 (open squares connected by solid lines) and for simulations using parameter values corresponding to those obtained for NGC 2323 (dashed lines).

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Note: These results have been published in the February issue of Astronomy and Astrophysis (Sánchez, Vicente & Alfaro, A&A, 510, 78, 2010).