LaTeX2HTML
a.ax2

The UCAC astrometric survey

N. Zacharias, T. J. Rafferty, M. I. Zacharias[1]

U. S. Naval Observatory, Washington DC

Abstract.
The USNO CCD Astrograph Catalog (UCAC) project is a high precision, astrometric survey. Observations started in January 1998 at Cerro Tololo (CTIO). A preliminary catalog of 30 million stars has been prepared, covering most of the area between declinations -90 and -15. It has a 10 fold improvement in accuracy over the Guide Star Catalogue (GSC) and a larger density, reaching to 16th magnitude. The catalog is supplemented by preliminary proper motions.

1. The Project

The USNO CCD Astrograph Catalog (UCAC) project is a high precision, astrometric survey for the 7−16 magnitude range (in the 610/60 nm band), aiming at an accuracy of 20 mas for $9-14^m$ stars (Gauss et al. 1996, Zacharias et al. 1997). The observations are made with a 0.2m, 5-element astrograph (Tab. 1) equipped with a 4k by 4k CCD camera (Tab. 2). The observing strategy gives a mean density of about 2000 stars per square degree, higher than that of the Guide Star Catalog (GSC), with an improvement in positional accuracy of about a factor of 10. The ACT, Hipparcos and Tycho Catalogues are currently used as reference. The final system orientation will be based on extragalactic ICRF sources, tied to the UCAC data via CTIO 0.9-meter telescope observations.

Table 1. Telescope

clear aperture	206	mm
focal length	2057	mm
plate scale	100	"/mm
number of lens elements	5	
spectral bandpass of lens	550–710	nm
Airy disc diameter (610nm)	15	μm
usable flat field of view	≈ 9	degree

After one month of setup and testing the southern part of the survey started in February 1998 at Cerro Tololo Inter–American Observatory (CTIO). The

[1]Universities Space Research Association, Washington DC

Table 2. Camera

number of pixels	4096 x 4096	
field of view	61 x 61	arcmin
pixel size	9.0	μm
pixel scale	0.9	"/pixel
spectral bandpass used	579–642	nm
filter replaces window	λ /4	optical quality
readout	14	bit
readout noise	13	e^-
full well capacity	85,000	e^-
operating temperature	≈ -18	C
limiting magnitude	≈ 16.0	2 min.

project is scheduled for 3 years to completely cover the area from the South Celestial Pole to about +20 degrees declination. Another 2 years will be required to complete the entire sky from a Northern Hemisphere site. Through September 1999 over 30,000 fields have been taken in a 2–fold overlap pattern, covering over 70% of the Southern Hemisphere. For details on the procedures and software see (Zacharias & Zacharias 1999).

2. The Catalog

A preliminary astrometric catalog, UCAC1, is being produced, containing positions of 30 million stars. First results are presented in Figure 1. These data will be supplemented by proper motions using the USNO A2.0 catalog. These low precision proper motions ($\sigma_\mu \approx 10$ mas/yr) will be improved by about a factor of 2 in the near future, when the NPM and SPM data are included. A comparison of UCAC data with other catalogs (Figure 2) shows the large improvement in accuracy it the high star density region. A public release of UCAC1 is expected by the end of 1999; see http://ad.usno.navy.mil/ad/ for availability. Some properties of the catalog are summarized in Table 3.

3. Applications

In late 1998, UCAC data were used to tie the Hubble Deep Field South (HDF–S) to the ICRF (Hipparcos) system (Zacharias et al. 1998). The UCAC data will provide a dense net of high accuracy star positions at a recent epoch to be used for proper motion determinations. It also contains a huge amount of double star observations (separations $\geq$ 3"). The UCAC will assist the general astronomical community for a variety of applications, including Schmidt plate reductions, galactic studies, and minor planet observations. It will provide a reference frame for large telescope observations from direct imaging to fiber spectroscopy, to identify objects and to map out geometrical distortions of instruments. The UCAC1 catalog gives a first glimpse of the future final version. The UCAC data will be required for an input catalog of the FAME space mission and is likely to support other future space missions like SIM.

Table 3. UCAC1: first preliminary catalog

overlap pattern fields	2–fold	center in corner
exposures per field	1 short	1 long
exposure times	20 ... 150	seconds, guided
coverage	$\delta \leq$	$-26 ... -10° = f(\alpha)$
epoch of observations	Feb 1998	$\geq$ Sep 1999
average density	2000	stars / square degree
total	30	million stars
catalog accuracy	20	mas, R = 9.5^m ... 14^m
	70	mas, R = 16^m
proper motions	$\approx$ 10	mas/yr
number of CCD frames	$\approx$ 70,000	
raw data so far	1.5	TB compressed FITS
backup on	700	exabyte tapes
	2,400	CD–ROMs
detection output	7	GB compressed
astrometric catalog	1	GB

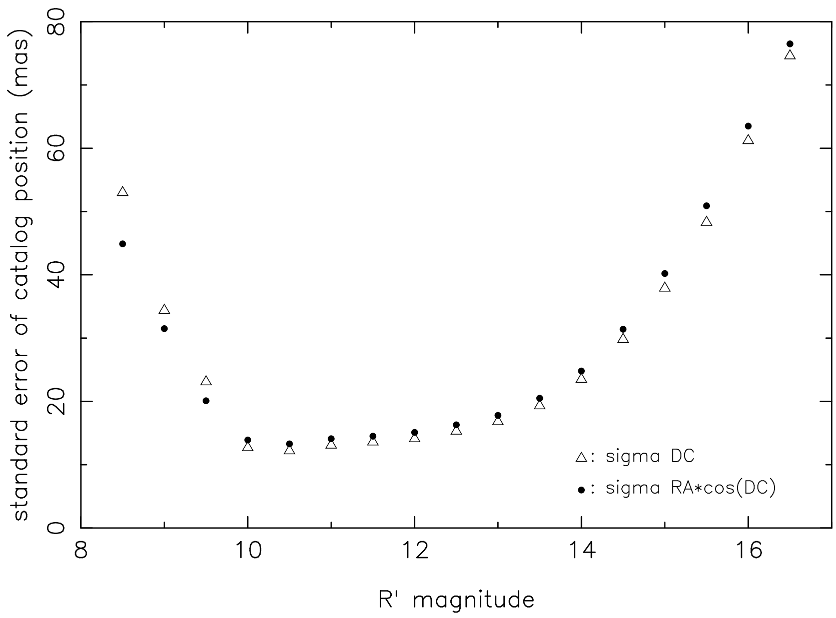

Figure 1. The UCAC1 positional precision.

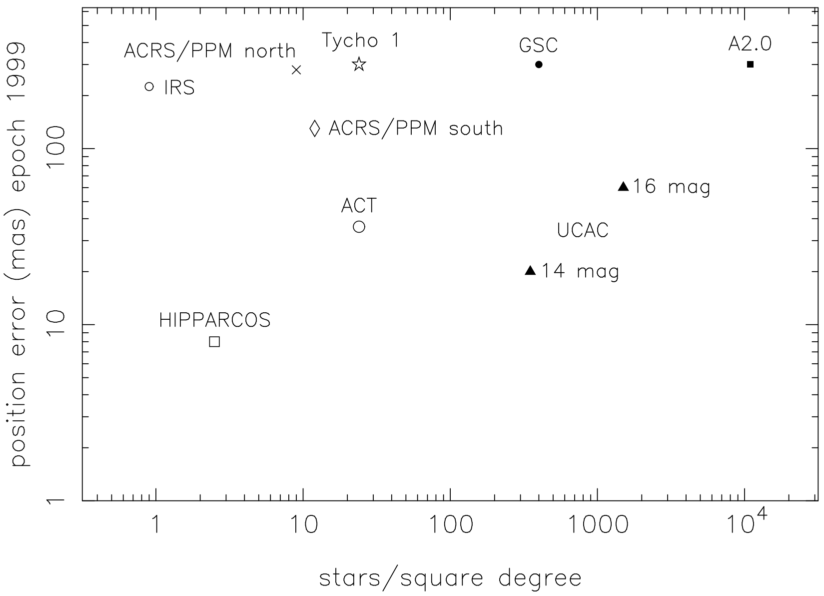

Figure 2. Comparison of positional catalogs.

Acknowledgments. The authors wish to thank the entire UCAC team and the CTIO staff, in particular the observers.

References

Gauss, F. S., Zacharias, N., Rafferty, T. J., Germain, M. E., Holdenried, E. R., Pohlman, J. W., & Zacharias, M. I. 1996, BAAS28, 1282

Zacharias, N., Germain, M. E., & Rafferty, T. J. 1997, in: Proceedings Hipparcos Venice 97 (ESA publication SP-402), 177

Zacharias, N., Corbin, T. E., Zacharias, M. I., Rafferty, T. J., Seidelmann, P. K., Gauss, F. S. 1998, BAAS, 30, 1367

Zacharias, N. & Zacharias, M. I. 1999, in ASP Conf. Ser., Vol. 172, Astronomical Data Analysis Software and Systems VIII, ed. David M. Mehringer, Raymond L. Plante, & Douglas A. Roberts (San Francisco: ASP), 345