RESULTS OF PROCESSING OF ASTRONEGATIVES WITH COMMERCIAL SCANNER

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ABSTRACT. Astrometric errors depending on the method of scanning with different spatial resolutions were studied with commercial scanner such as Epson Perfection V750 Pro. Accuracy, time of processing, volume of storage were tested using software package described in (Protsyuk, 2014). The best results of scanning were obtained with a resolution of 1200 – 1600 dpi.

Keywords: astrometry – methods: data analysis – virtual observatory tools – catalogs

1. Introduction

We used three photographic plates of (20x20) cm in size, taken from archive of the Zonal Astrograph (D= 120 mm, F= 2040 mm, FoV = 5° x 5°), which was in operation from 1929 to 1999 at Nikolaev Astronomical Observatory (NAO). The archive of plates with preview images is available online at the UkrVO website (http://ukr-vo.org) (Vavilova, 2012, Mazhaev, 2013).

We also used the EPSON PERFECTION V750 Pro scanner (made in 2011) with: A4 format in size, maximum dynamic range of 4.0D, optical resolution of 4800 x 9600 dpi, transparent area of 10" x 8" in size.

The current version of the software package for image processing has the following limitations: up to 400,000 objects on a plate, the size of a plate up to 20K x 20K pixel.

To choose optimal options for data processing, each of three plates was scanned six times in two modes:

• with resolution from 600 to 2400 dpi and increments of 300 dpi, with the signal to noise ratio of 3 in the MIDAS software;

• with resolution of 1800 dpi, with the signal to noise ratio from 3 to 12 in the MIDAS software.

Three personal computers (PC) on LINUX platform were used for data processing with the MIDAS software:

L1 – Main: Lubuntu 12.04 in a virtual machine (VM) with 2.5GB of RAM, disc volume (DV) of 20GB on host i3-2.4GGts, 16GB of RAM;

L2 – Lubuntu 12.04 in a VM with 2.5GB of RAM and DV of 80GB on host i5-3.2GGts, 8GB of RAM;

L3 – Mandriva 10.04 on Core Duo processor with a clock speed of 2.5GHz, 2GB of RAM, DV of 275GB.

Values of time for data processing are approximately equal for L1 and L2. The speed of data processing for L3 is less by 10-20% than for L1 and L2.

Three PC on Windows platform were used for data processing in the following configurations:

W1 – Main: i3 at 2.4GHz, 16GB of RAM;

W2 – i5 3.2GHz, 8GB of RAM;

W3 – Core2Duo 2.66GHz, 8GB of RAM.

Data processing on the L1/W1 was performed using: 5.5GB of RAM as cache of disk operations with delay in writing for 5 minutes. Volume of disk reading on L1/W1 during the test was 6.1TB including 4.4TB from the cache (more than 70%). Volume of recorded data was 19.1TB including physical data recording of 13.4TB, which is less on 30%.

We carried out image processing and obtained 17 catalogs of equatorial coordinates in the HCRF system for three given plates. Information about photometric precision of another commercial scanner was given by Andruk (2010).

2. Results of testing

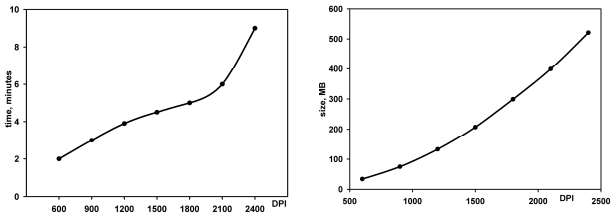

Figure 1: Time of plate scanning in minutes vs resolution – left, and size of image in MB vs resolution – right

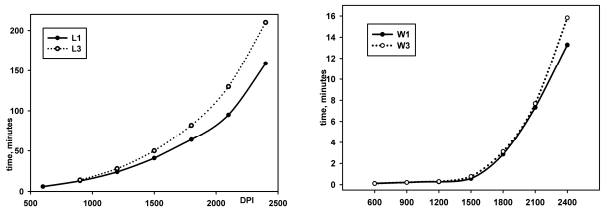

Figure 2: Time of one plate reduction in MIDAS vs resolution – left, and time of preparations for identification vs resolution – right

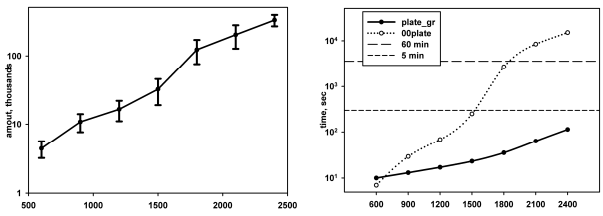

Figure 3: Number of objects on images vs resolution – left, and time of reduction in different programs – right

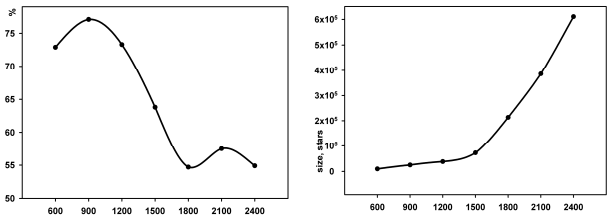

Figure 4: Percent of objects registered 5 or 6 times vs resolution – left, size of the catalog for three plates – right

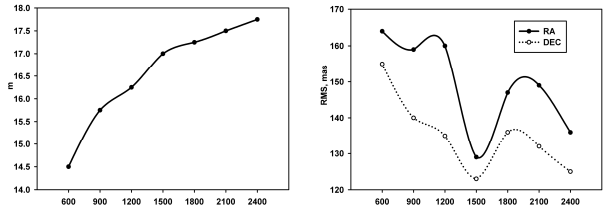

Figure 5: Limited magnitude in catalogs vs resolution – left, and mean RMS of catalogs vs resolution – right

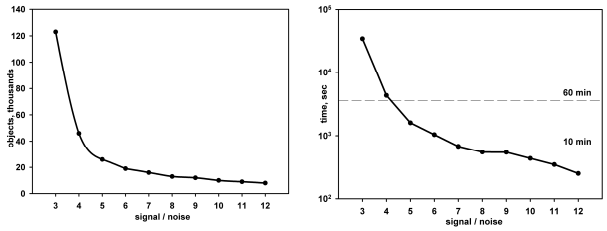

Figure 6: Number of detected objects for 1800dpi vs signal/noise – left, and time of reduction of 18 plates in 00plate program vs signal/noise – right

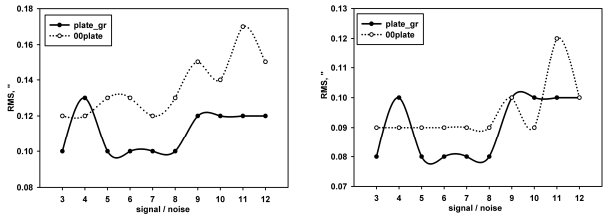

Figure 7: Mean RMS of coordinates for 1800dpi using two programs in RA vs S/N – left, and in DEC – right

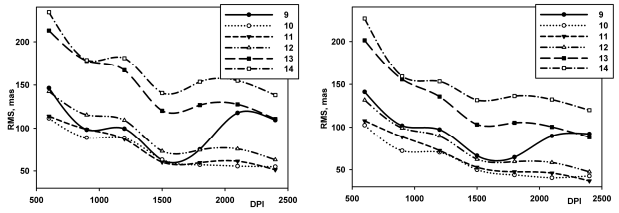

Figure 8: Distribution of the RMS in catalogs for different mag. in RA vs resolution – left, and in DEC – right

3. Determination of the processing time and the optimal processing options

If we have overlapping observation of the same sky region on 4 plates, we may make one scan for each plate. In other case, we must make 5 or 6 scans for one plate.

One scanner can approximately make 24 or 48 scans per day, respectively. We spend additional time in the first case for the search of plates, their preparation, removal of dust and inscriptions.

The volume of raw data for scanning with resolution of 600 to 2400dpi may amount from 2.4-4.8GB to 13-26GB. For processing in MIDAS, we must have the free space on the HDD in two times larger than initial data volume, and 0.5 to 5 GB for temporary files. With the current size of hard disks, daily work does not cause problems. To store the entire scan array obtained for a long period of time, we will need a special solution.

Usually, raw images must not be stored for more than two days without processing.

The processing time for all plates with scanning resolution of 600 to 2400 dpi consists of:

– preparation for initial data processing – from 20 to 100 minutes including time for making copy via the LAN;

– initial data processing in MIDAS – from 3 to 128 hours (over 5 days);

– preparations for identification – from 1 to 30 minutes;

– elimination of the image defects, image processing only for a single exposure, the identification of the several exposures and diffraction satellites – from 3 (8x6) to 6 (24x1) hours;

– reduction: by the program plate_gr – from 5 to 100 minutes; by the 00plate – 1 to 200 hours (over 8 days).

The analysis of the accuracy of data processing showed a bad result for resolutions less than 1200dpi, and we exclude resolutions of 600 and 900 dpi.

Eight working hours are enough for all steps that require a human attention, namely: preparation for initial data processing, preparation for the identification and identification.

We must select such resolutions that fit into the remaining 40 hours if 24h PC work is possible for batch processing. In this case we can use 3 resolutions: 1200dpi – with time processing of 11-21 hours, 1500dpi – 17-33 hours, 1800dpi – 27-53 hours.

The calculations were performed for plates of (20x20) cm in size. For other sizes, the results will be different.

5. Conclusion

If there is a possibility to use one PC for scanning for 8 hours and another PC for 24 hours of processing, we will use the resolution of 1500 to 1600dpi.

If we use single PC for scanning and processing, or one PC for scanning and one PC for processing during 8 hours per day, we should use the resolution of 1200dpi as the most balanced in terms of accuracy per unit of time.

References

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