SOME RESULTS OF TEN YEAR OPERATION OF THE AUTOMATIC MEASURING COMPLEXES PARSEC

T.P. Sergeeva[1], A.V. Sergeev[2]
[1] Main Astronomical Observatory, National Academy of Sciences of Ukraine, Golosiiv, Kiev, 252650, Ukraine
[2] Centre of Astronomical and Medico-Ecological Investigations, Golosiiv, Kiev, 252650, Ukraine

ABSTRACT. The brief description of the automatic measuring complexes PARSEC and some results of their ten years operation have been repoted in the paper.

Key words: Instrumentation

In 1986 four automatic measuring complex (AMC) PARSEC (Programming Automatic Radial-Scaning Coordinatometers) have been installed at the observatories of Golosiiv, Pulkovo, Nikolaev and Sternberg Institute in Moscow. The main purpose of their development was the determination of the precise coordinates of images on photographic glass plates with simultaneous precise photometry. The basic assignment of the complexes was the maintenance of the measurements of large files of plates for the creation of survey catalogues of positions, proper motions and magnitudes of stars.

The observational projects which requiered the automatic measuring machines for measurements about twenty thousands plates had been in progress to that time in seven observatories of the fomer USSR (Nesterov et al.1990). The wide-angle astrographs have being used for realisation of these projects were installed in the places with astroclimatic conditions far from an ideal ones. The plates had been available for observations (ORWO ZU-21) were not of high quality. In a consequence of that reasons the astronegatives obtained were of very wide range of density of sky background and of image contrast and quality. Having such plate material was necessary to ensure the precise automatic measurements of positions and magnitudes of many thousands plates with minimum expenses of time and resourses.

All that has defined the strategy and ideology of being created automatic measuring complexes and have been embodied in the method of radial-angular scanning (Sergeev et al.1984). At this method the image processing is carried out lagely by fast optical-mechanic equipment with hardware integration of radial densities of the image. The software realize the control and management of the prosess. Such method does not require enormous computer resourses. The basic units of AMC PARSEC are as follows. The carriage with a plate is moved by system of positioning with the independent movements in two perpendicular directions. The readout of coordinate of the carriage is realised by amplitude-phase-sine-cosine interpolation of signals from raster gauges. Light from standard halogen lamp, passing through a plate, is divided on two flows. One of them transports the image of measuring area of a plate to the screen of the operator, other passes through the scanning system and is registered by means of the photoelectronic multiplier. The hardware and micro-computer carry out the control and management of process of measurements. The PC IBM-486, connected in a line with PARSEC, provides the data interchange (the input files of preliminary coordinates and output files with results of measurements) and provides the intermediate storage of the data.

The software of AMC PARSEC has the modular structure and provides the flexibility of

functioning of the complex. That gives the opportunity to develop various measuring modes. At the present time AMC PARSEC has three basic modes of measurements.

1. *Fully Automatic Measuring Mode.* Carries out an automatic measurements of coordinates and effective diameters of images accordinly to the initial list of preliminary coordinates.

2. *Automatic Installation and Registration Mode.* Carries out an automatic installation of the image in a point given by the preliminary coordinates, visual centering of the image and automatic registration of measured coordinates. The mode can be used for measurements of objects with complex form (lunar craters, for example).

3. *Automatic Registration Mode.* Allows to form files of preliminary coordinates through manual installation of the preselected images with help of the control panel and automatic registration of their coordinates.

The speed of measurements of AMC PARSEC are from 500 to 1200 images per hour. It depends on the accuracy of the input preliminary coordinates and on the density of stars on a plate.

The accuracy of measurements with AMC PARSEC was defined by special researches (Bystrov et al.1989, Dick et al. 1989, Ivanov et al.1988, Ivanov et al.1990) The plates have been measured with PARSEC for hardly more than ten years of operation were obtained with various telescopes. As already was mentioned, the quality of the plates and images on them varied over a wide range. The results of the researches testified, that the method of processing of the images, realized in PARSEC, provides measurements with acceptable accuracy of very dark plates with density of a background up to 1.5D, and of the images with very low contrast. The repeatability of the position determination extremely rare exceeds 2mkm even for the most dark plates with very sharpless images. For the images of weak objects close to plate limit some kind of magnitude error may arise which can be completely eliminated by measurement of plates in opposite direction.

For some objective and subjective reasons AMC PARSEC at Pulkovo and Nikolaev observatories are not functioning with full possibility, but the observatory of Golosiiv and Sternberg Institute carry out the measurements of their survey plates. At present Golosiiv almost finished the measurements of the Kiev part FON-project plates. The accuracy of FON positions and proper motions of star from the measurements of the onefold coverage plates is estimated to be 0.35 arcsec and 0.006 arcsec/yr, respectively.

The measurements of the plates containing the images of clasters wich have photoelectric standards have been carried out for estimation of photometric properties of PARSEC (Voroshilov et al.1992). The results of measuremens are presented in Table 1. The observation on two telescopes (60 and 200 inch refractors) were used to develope NGC-188 standard. The PARSEC measurements showed the systematic difference of two raws of observations. For this reason the comparison on all 58 stars of the standard has given greater error, then comparison on group of stars, photometric parameters of which have been received with one telescope. Probably, it is imposible to receive the best result within the photographic photometry method for a single plate. Smaller almost on the order the r.m.s. error of one measurement, determined on five series, speaks about good tool opportunities of PARSEC as photometer. This conclusion was independently confirmed at creation of the B-magnitude catalogue with the purpose of search of chemically peculiar star clasters (Marchenko et al. 1991, Marchenko et al. 1994). The material for measurements were the plate of Double Wideangle Astrograph with very different quality. But the applied philosophy of measurement had allowed to receive very good results (Table 2).

The results of using of automatic measuring complexes PARSEC for various astronomical investigations obviously testify them as a very effective system capable to determine the precise coordinates of star-similar images on photographic glass plates with simultaneous precise photometry. They can be used for measurements of plates of various quality at fulfilment of a wide range of investigations both astrometry and astrophysics. Applications of

Table 1. Estimation of photometric properties of the PARSEC

Cluster	Tele-scope	Color system	Plate	Magnitude range	NS	Unit weight r.m.s.	Repeata-bility
NGC-188	STB	U	ZU-21	$8^m.6$ -$17^m.2$	58	$0^m.133$	
				8.6 -15.0	29	0.059	
NGC-6913	AMT	V	Codak	8.59-17.23	29	0.070	0.014

NS - the number of the cluster stars used for accuracy estimations

Table 2. The accuracy of B-magnitude catalogue

Magnitude range	Internal convergence	NS	External error	NS
6^m - 7^m	$0^m.08$	13	-	
7 - 8	0.08	17	$0^m.09$	3
8 - 9	0.07	39	0.15	6
9 - 10	0.05	159	0.11	20
10 - 11	0.05	458	0.08	47
11 - 12	0.05	694	0.14	22
beyond 12	0.06	77	-	

PARSEC in biology, medicine, geodesy and optical researches are also possible. The original systems of readout of coordinates - Interpolators have been realized in PARSEC can be used in developments of precise readout systems for wide range of astronomy purposes as well as in optical technologies, geodetic devices, mechanical engineering.

References

Bystrov N.F., Sergeev A.V., Sergeeva T.P.: 1989, *Kinematika i fizika nebes. tel.*, **5**, N 2, 70.

Dick V.R., Ivanov G.A., Sergeeva T.P., Yatsenko A.I.: 1989, *Kinematika i fizika nebes. tel.*, **5**, N 2, 88.

Ivanov G.A., Kislyuk V.S., Pakulyak L.K., Sergeeva T.P., Yatsenko A.I.: 1994, in: *Galactic and Solar System Optical Astrometry. Proc. of the Royal Greenwich Observatory and the Institute of Astrometry Workshop. Cambridge, UK, June 21-24, 1993. Cambr.Univ.Press.*, 31.

Ivanov G.A., Sergeev A.V., Sergeeva T.P., Tcelischev I.E.: 1988, *Kinematika i fizika nebes. tel.*, **4**, N 4, 53.

Ivanov G.A., Sergeeva T.P., Yatsenko A.I.: 1990, *Kinematika i fizika nebes. tel.*, **6**, N 1, 79.

Marchenko S.V., Merkulova G.L., Sergeeva T.P. : 1993, *Kinematika i fizika nebes. tel.*, **9**, N 1, 51.

Marchenko S.V., Sergeeva T.P.: 1991, *Kinematika i fizika nebes. tel.*, **7**, N 5, 87.

Nesterov V.V., Kislyuk V.S., Potter H.I.: 1990, *In: Proc. IAU Symp. N 141*, 482.

Sergeev A.V., Spiridonov A.V., Shornikov O.E.: 1984, in: *Novaja tehnika v astronomii., Leningrad, Nauka*, 98.

Voroshilov V.I., Pakyliak L.K., Sergeeva T.P.: 1992, *Kinematika i fizika nebes. tel.*, **8**, N 2, 89.