Archiving of photometric data

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Abstract

Lausanne University's Institute of Astronomy has been collecting stellar photometric data since 1970. Our collection contains data for some 170,000 stars in 78 photometric systems. This database has been used in various applications: comparison of systems, Hipparcos Input Catalogue, studies of star samples, etc. With CCD detectors we are facing a new challenge, since a great deal of information is obtained, mainly for star clusters. But unfortunately, a policy for archiving these data has not yet been established. This is an urgent problem to solve, all the more so as in many cases only a part of the data is published. A solution to this problem is discussed here.

1. Introduction

Since the first work of Stebbins at the beginning of the century, photoelectric photometry has faced many changes, the latest being the use of CCD detectors. Technical improvement has not only made it possible to obtain more precise data and to observe fainter stars, but it is also responsible for a large growth of data. Growth of photometric data is also due to the increase of photometric telescopes, particularly in the southern hemisphere. In a study on the growth of data in stellar astronomy, Jaschek (1978) has shown that photometric data increase exponentially. Confirmation of this is to be seen in Table 1.

Table 1. Growth of photometric data

Strömgren system:		Geneva system:	
1965	$1.2\ 10^3$	1964	$3.4\ 10^2$
1973	$7.5\ 10^3$	1966	$6.8\ 10^2$
1975	$9.3\ 10^3$	1971	$1.4\ 10^3$
1977	$1.4\ 10^3$	1976	$4.6\ 10^3$
1978	$1.9\ 10^4$	1978	$1.3\ 10^4$
1985	$4.0\ 10^4$	1980	$1.5\ 10^4$
1990	$4.5\ 10^4$	1988	$2.9\ 10^4$

Before the 1970s, photometric data were dispersed in various publications and no systematic efforts were made to archive them. This situation encouraged us to collaborate with the Strasbourg Data Center and to compile all stellar photoelectric photometric data, with the exception of light curves for variable stars (they are now

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collected by Dr M. Breger at Vienna Observatory). Our database now contains data for about 166,000 stars. With CCD detectors we are facing a new challenge, since a great deal of information is obtained but unfortunately no policy for archiving these data is currently established.

2. The general catalogue of photometric data

For nearly twenty years we have been compiling all the photoelectric photometric data for stars. At the end of 1989 our database contained nearly 410,000 measurements for 166,000 stars. No fewer than 78 photometric systems were found! This database is the result of the merging of the various catalogues we have established (e.g. Hauck and Mermilliod, 1990, for the Strömgren system, Mermilliod & Mermilliod 1992 for the UBV). Our catalogues are formed in two parts: the first contains the original data and the second the weighted mean values. Both parts are available from the CDS, while only the second is published in some cases. In order to establish the second part, it is necessary to make a critical evaluation of the data. To do that, we follow the method described by Nicolet and Hauck (1977). Each list of new data is compared to a reference list. On the basis of this comparison we can define a weight for the new publication and eventually a systematic correction to the data of the new list.

Our photometric database runs on a Vax machine. Its master index is our General Catalogue of Photometric Data, which can be obtained from the CDS. The contents of this catalogue is for each star an identification number (Mermilliod 1978), equatorial coordinates (if available), V magnitude and photometric keys. Each photometric system has its own key. For small samples it is possible to send us by e-mail (mermia@obs.unige.ch) a table with a list of identification numbers according to Mermilliod. Thus with such a catalogue we can know in which system a star is measured. We can also obtain various samples, for example all stars having UBV, Geneva and Vilnius data.

3. CCD Data

The future of photometry lies undoubtedly in the use of CCD detectors. Observations with a CCD camera are currently made with the Strömgren, Geneva, UBV, Washington and Cousins systems. With the development of this new kind of detector we are facing an important problem: what to archive and where? Huenemoerder (1992) and Mermilliod (1992) have already briefly discussed this matter and have made some interesting suggestions. Huenemoerder has quoted that

> ... "photographic plates can be stored in a vault for posterity. The primary archive is not then a question of medium but of organization. With CCDs or other electronic data, both the storage media and organization of data are open issues".

Huenemoerder is right. However, even in the case of photographic plates it is difficult to know where the information is archived. An attempt was made some years ago

by the working group on astronomical data of IAU Commission 5 (Hauck 1982a,b) to centralize the information about plate vaults. Unfortunately, it was not possible to give a good follow-up to this initiative. An attempt is now being made for stellar spectra by the members of a working group of IAU Commission 29. This working group is chaired by Dr E. Griffin. Concerning the photometric data, we can assume that at least nearly all photoelectric data for stars are published somewhere and that our database reflects the situation reasonably well! But with CCDs we are facing a very disturbing problem. In many papers none of the data, or only some, are published. Data are used for plotting the diagrams which are printed, but this excludes access to the primary data! We can easily understand the reason for this situation, but we should be concerned about the archiving of these data and their accessibility, not only now but also in the future, even in a century from now! But what should we do? It seems that a good policy would be the following:

1. After reduction data have to be archived in an astronomical data centre. A description of the reduction method must be a part of the archive.

2. Each data centre should establish a list of fields archived, with an indication of the central position, types of filters, ... An updated version of the list should be published regularly, or at least available by e-mail. The list is communicated to the other data centres.

3. Before accepting for publication a paper based on new CCD data, the editors of the journal have to check, or at least to receive the assurance that point 1 is fulfilled.

Now we have to persuade the ADC to accept points 1 and 2 and the editors to accept point 3! An interesting attempt has been made by Acta Astronomica, who do not publish voluminous tables of CCD data, but make the file available by FTP through a computer. This seems to be a very attractive solution, but journals must have a financial equilibrium. Thus I doubt whether this solution could be generalised and that publishing companies will spend time and money on archiving astronomical data. An alternative solution would be to increase the subscription price! But we can forget that immediately as librarians already have enough problems today raising finance.

4. Conclusions

The situation is fairly satisfactory for photoelectric data and the astronomical community will surely appreciate the new catalogue of UBV data prepared by J.-C. Mermilliod and M. Mermilliod and published by Springer-Verlag. Our database is deposited in various locations and is easily accessible. Our main problem is that we cannot assume that all the published data are included in the database. That is the reason we appreciate it when authors send us their data directly in computer-readable form. However the position is rather bad concerning the CCD data and I fear that we are

losing primary data. It is becoming urgent to find a solution not only for photometric data obtained with a CCD camera, but for all CCD data. I.A.U. Commission 5 (Documentation and Astronomical Data) will be discussing this matter and I would appreciate receiving suggestions.

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Discussion

A. T. Young: *The problem of archiving CCD data is very similar to the problem NASA has had in archiving old spacecraft data. The descriptions of the processing used to produce the archive have often turned out to be inadequate. I suggest that the actual computer programme used be stored as part of the archive.*

Hauck: I think you are right and you made a good suggestion. However the problem with CCD data is more complicated because the data are in many locations.

J. Baruch: *The Robotic Telescope we are building at Bradford is designed for profile fitting faint object CCD photometry. It will extract photometric data from faint objects in crowded fields and generate target acquisition assurance from pattern recognition algorithms. It will also produce indices of image quality. The original image will not generally be stored.*

S.B. Howell: *I would just like to make a point in agreement with the above. A CCD light curve time-series can generate 200-400, or more, Mbytes/night. I forsee that many of us, as well as many of the APT CCD telescopes, will perform real time data reduction and not keep the image themselves.*

Hauck: Light curves are perhaps a special case and, if you keep them, (not the images) and archive them in a data centre they are saved!

D.L. Crawford: *Another example is the Search for Extra Solar System Planets, which will generate an immense amount of CCD data, most of which it is not possible to archive.*

We should always offer all the encouragement we can to those who are archiving, such as the groups at Lausanne and Strasbourg.

W. Tobin: *If one wishes to archive all CCD data acquired, it will be necessary for unreduced data to be stored too, because the fact is (1) not all potentially useful frames are reduced, and (2) when a frame is reduced, not all objects in it may be reduced. At Mt John we have no plans to archive our CCD data until the hardware problem of a suitable archival medium has been solved. To add to Dave Crawford's comment, a friend who works for an insurance company tells me their company archivists spend their time deciding what to throw away from the archive, not what to save!*

Hauck: I agree with you it could be a huge problem, but I think we should archive at least all magnitudes, colours (and coordinates) we have obtained. In many cases we have only plots. The storage of all frames is now a problem but I think it will be resolved and we have to be ready!

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Russ Genet shares his birthday cake with Phil Hill and Gene Milone

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