ON THE HOMOGENIZATION OF PHOTOMETRIC DATA

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ABSTRACT. Catalogs of averaged photometric data have been published for several photometric systems. The homogenizing procedures used to produce them are not without pitfalls. We question the accuracy of these methods with the available data.

1. INTRODUCTION

The quantity of photometric data available in many systems is growing steadily. The General Catalogue of Photometric Data (Hauck 1982; Mermilliod 1984) already lists more than 100,000 stars and 75 photometric systems. While many systems have been used by only one author and for a few hundred stars, several others (UBV, Geneva, uvby) have from 20,000 to 70,000 stars. The measurements are scattered among hundreds of publications and involve different equipment, telescopes and observers. The Geneva system shows a very good homogeneity, but this is not true for most of the others. The variations between equipment used for the same system gives a wide dispersion in the resulting data. Poor reduction techniques and observing procedures also occasionally account for part of this scatter.

This situation has lead to the compilation of homogenized catalogues of averaged values (see for instance in uvby: Lindemann and Hauck, 1973; Hauck and Mermilliod 1975, 1980; in UBV: Nicolet 1978). However, these catalogues cannot be completely satisfactory because of the data on which they are based.

2. HOMOGENIZING IMMISCIBLE DATA

The largest causes of deviation between different observations are instrumental: filter profiles, temperature variations affecting

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the filters and producing summer-winter variations, cathode response, humidity, altitude, etc. This leaves some doubts concerning the difficulties of transforming all of the data to a common standard system (see for instance Bessell 1983; Straižys 1983; Manfroid 1985a and b).

Published observations have generally been reduced to a standard system by a regression method using standard stars. The first step in the homogenizing method (Lindemann and Hauck 1973) is to compare the published values with a reference list and to use color-by-color regressions to improve the original transformations. Except for rare cases of bad reductions we do not see how this method could give better results than the original one used by the astronomer since (1) it uses the same kind of regression analysis, or even a cruder one (no intercolor terms) and (2) the original measurements and especially those of the standard stars are not often available to the homogenizers.

The quality of the data is then estimated (Lindemann and Hauck 1973) (1) by the standard error obtained in the color transformation, which is mainly a measure of the departure between the reference and the instrumental system of the observer and (2) in the case of the uvby system, by the slope and the y intercept, which is more a measure of the size of the data set: only very small data sets could deviate from the 1 and 0 values.

The second step of the homogenization consists in averaging the observations weighted according to their estimated quality. The role of a quality index is to select preferentially (1) instrumental systems which are close to the standard one or (2) observational material which overlaps with the reference lists only over easily transformable groups of stars. In the latter case data can be included which deviate significantly from the standard values even though their quality index is high.

Those errors due to the peculiarities of the instrumental systems can be very large. They will remain undetected. They can propagate throughout the catalogues if those data are used as secondary references, a very likely hypothesis since they concern underrepresented stellar groups.

The overall divergence would be smaller if the original reductions by the observers were preferred, since they involved standard stars covering the whole range of program stars. More generally all data introduced with small weighting factor are not transformable and their contribution is to degrade the average value because the number of independent data for any star is usually very small.

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3. CONCLUSION

The homogenizing procedure generally does not improve individual measurements, unless the latter are badly reduced by their authors, or were kept in the instrumental system. The resulting homogenized catalogues can be considered to be lists of values averaged between the larger catalogues already firmly tied to the standard system. Hence their usefulness can be questioned.

All other observational data, even if very accurate, spanning a wide range of stellar types and classes and, hence, showing a large scatter after color transformation, are either eliminated or (worse) included with small weighting coefficients. Some categories of stars can show large systematic deviations from the standard system.

It would be advantageous to compile separate lists for each instrumental system and any set of observational material showing good internal accuracy. All standard stars should be listed and the best available information concerning the system (filters, photomultiplier, etc.) should be given. This would leave open the possibility of retrieving a great deal of high quality data.

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