CRITICAL EVALUATION OF PHOTOMETRIC DATA

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ABSTRACT

Some problems encountered in the homogenization of photo-
metric data (especially for the $uvby\beta$ and UBV systems) are pre-
sented: sources of inhomogeneity, method to obtain a homogeneous
photometric value, establishment of a reference list, etc.

In many cases a homogeneous photometric value is necessary,
but cannot be simply an arithmetical mean, and for this purpose
it is necessary to make a critical evaluation of the data.

1. INTRODUCTION

The user of photometric (or other) data will not necessarily
need a literal compilation of measurements in a given photometric
system, but he will prefer often homogeneous data, in particular
if he is not a photometrist.

In this paper, we discuss the methods and problems in pre-
paring lists (more precisely files in magnetic tapes) of such
homogeneous data.

Today, we will turn our attention to the UBV and $uvby\beta$ sys-
tems, but of course, we apply the method described below to all
other photometric systems.

This work (compilation and homogenization of photometric
data) is undertaken in the framework of the Stellar Data Centre
(S.D.C.) (Hauck, 1974; Hauck and Jung, 1974).

All our catalogues on magnetic tapes are available from the
Stellar Data Centre at Strasbourg (see Information Bulletin No. 8,
p. 26).

2. SOURCES OF INHOMOGENEITIES

When many observers make and reduce measurements in a photo-metric system such as UBV, they use various instruments and techniques.

This diversity introduces unavoidable inhomogeneities be-tween published results.

Among the sources of such inhomogeneities, the following can be mentioned:

Differences between:

- photomultiplier
- filters
- extra-atmospheric reductions
- use and choice of standard stars (perhaps lack of standards)
- optical properties
- cooling of photomultiplier

3. THE REFERENCE LIST

In order to detect the inhomogeneities and to estimate their importance, we must first prepare a reference list which will be homogeneous and will contain a variety of stars (i.e. of various spectral types, luminosities, apparent magnitudes, positions).

The necessity of homogeneity is obvious in such a list.

Concerning the variety of the objects contained in the ref-erence list, we can remark that the estimation of systematic or standard deviation between a given list of measurements and the reference list becomes significant only if the intersection of these lists is sufficiently substantial (say, more than 20 stars).

Thus, a reference list plays a more distinct role than a standard list (used for measurements) and it should be more ex-tensive.

For example, in the $uvby\beta$, Lindemann and Hauck (1973) have included in their reference list some measurements of Crawford.

In the case of UBV, the reference list of Nicolet (1976), in-cluding the measurements of Johnson and those made with similar instruments and techniques, contains more than 13,000 stars.

Of course, variable stars, which disturb the estimation of deviations, have been eliminated from the reference lists.

4. COMPARISON BETWEEN LISTS

Each list is compared with the reference list.   Generally the computer programme gives for the ith colour C^i (= magnitude or index of colour)

- the mean deviation of ΔC^i
- the standard deviation of σ^i
- a (multi) linear regression such as

$$C^i_{ref} = a^i_o + a^i_i\, C^i_{list} + \sum_{j \neq i} a^i_j\, C^j_{list}$$

where $a^i_i \approx 1$, $a^i_o \approx o$ and $a^i_j \approx o$ if $j \neq i$.

5. HOMOGENIZATION

The numerical results of the comparison (i.e. ΔC^i, σ^i, a^i_o, a^i_i, a^i_j) can lead us either

- to eliminate the list, or
- to apply to it systematic corrections, or
- to conserve its measurements as published.

In both the second and third cases, the comparison of the list with the reference list permits us to attribute a weight w_j to the list.

For each star, the homogeneous i^{th} colour is obtained by the formula

$$\overline{C}_i = \frac{\sum\limits_j w_j\, n_j\, C^j_i}{\sum\limits_j w_j\, n_j}$$

with j rank of the list
        w_j weight of this list
        n_j number of measurements as indicated by the author
        C^j_i i^{th} colour in the list for the star with eventual systematic correction.

We can check the conformity of our list with the rest of the catalogue. This "rest of the catalogue" is surely less homogeneous than the reference list, but this check often reveals disagreement in remarks (variability, binarity) or in measurements. The critical determination of the causes of this disagreement (variability of the stars, inhomogeneities, errors) is important, but a tedious and delicate task.

6. FINAL CATALOGUES

For each photometric system we have, or are preparing, a catalogue on magnetic tape containing at least two parts:

- the first including the measurements as compiled from the literature,
- the second with the homogeneous data calculated with the method described before.

The final version will be sent to the S.D.C. at Strasbourg for distribution among the astronomical community.

In the case of the $uvby\beta$ system, this method has been used by Lindemann and Hauck (1973) with the lists of Crawford and Mander (1966), Crawford *et al.* (1970) and Crawford and Barnes (1971) as a reference list, as previously mentioned.

A second version has been published by Hauck and Mermilliod (1975). A third one is in preparation which will contain 7140 new measurements, including those of Grönbech and Olsen (1976).

For the UBV, the reference list (Nicolet, 1976) is ready on magnetic tape and we also have a tape containing all measurements in this system (more than 70,000) (Mermilliod and Nicolet, 1976), namely those included in the catalogue of Blanco *et al.* (1970) and those published later.

For some time we have been attacking, with the method described before, the tedious problem of homogenization of the UBV measurements included in the file.

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