UV STANDARD STARS BY THE VARIABLE PROCRUSTEAN BED APPROACH

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ABSTRACT. Statistical algorithms have been appplied to a set of stellar low-dispersion IUE spectra in order to derive objective spectral classification schemes in the UV. This paper describes how standard stars can be selected, particularly in the context of the VPB approach. Comparisons to existing schemes proved quite satisfactory.

1. INTRODUCTION

The preparation of the IUE Low-Dispersion Spectra Reference Atlas (Heck et al. 1984a) put at our disposal a large set of representative IUE low-dispersion stellar spectra. With this sample, we investigated the possibilities of constructing an objective clasification scheme in the UV (Egret and Heck 1983; Egret et al. 1984a,b; Heck et al. 1984b) which could be confronted with existing schemes, i.e., with the sequences published in the Atlas and established by a classical morphological approach (Heck et al. 1984a; Jaschek and Jaschek, 1984). We also explored how standard stars could be selected statistically.

2. THE VPB APPROACH

The VPB approach is essentially based on an information condensation at the level of the spectral-continuum shape and an objective selection of the most discriminant spectral features. It is described in detail in Heck et al. (1984b) and has been applied to our original set of 384 IUE spectra. By spectrum we understand here a table of 410 absolute flux values covering the whole IUE range (1150-

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3200 Å) and binned by 5 Å steps. We must point out here that the VPB approach can deal with both reddened and unreddened spectra.

3. UV SPECTRAL GROUPS AND STANDARDS

In this application, an exploratory analysis has been carried out on the sample of reddened and unreddened normal stars with the SPAD package (Lebart and Morineau, 1982; Lebart et al., 1982) consisting of a principal component analysis (PCA) establishing the number of significant dimensions in the problem and then a cluster analysis aggregating the stars in groups around moving centers.

Thirty groups have been requested of the algorithm and aggregated on the basis of the mutual distances of the stars in the multivariate space defined by the first twenty PCA factors. The groups obtained are quite homogeneous and their distribution is illustrated in the planes of the first two PCA factors (Fig. 1a) and of the first and third PCA factors (Fig. 1b).

The first factor given by the PCA is strongly correlated with the effective temperature, while the second one has a functional relationship with it, and can be considered as parasitic. The third factor discriminates the luminosity among hot stars, but not among cool ones (likely due to the under-representation of these stars in the original sample). Other factors reveal no clear tendencies, apart from individual stellar influences.

Each group on the graphs has been named according to the stars closest to its barycenter where standard stars have also to be looked for. A comparison with the standards selected for the Atlas proved to be quite satisfactory, in the sense that Atlas standards lie close to the barycenters of the groups they should naturally belong to.

It is difficult to quantify the homogeneity in the groups, but the one achieved in this application is the best so far, and this, for a sample containing also reddened stars. In the earlier types, the groups rarely cover more than two subtypes. The discrimination is not as good in the later types for the reason stated earlier. The discrimination between the luminosity classes is of the same quality.

Requesting more groups of the cluster analysis might be a way to obtain a better discrimination both in spectral type and luminosity class, but we must keep in mind the limitations imposed by the size of the original sample if we want to derive statistically significant results. As to the peculiar stars, they are still a problem, but we think of dealing with them by an appropriate comparative weighting of the different variables.

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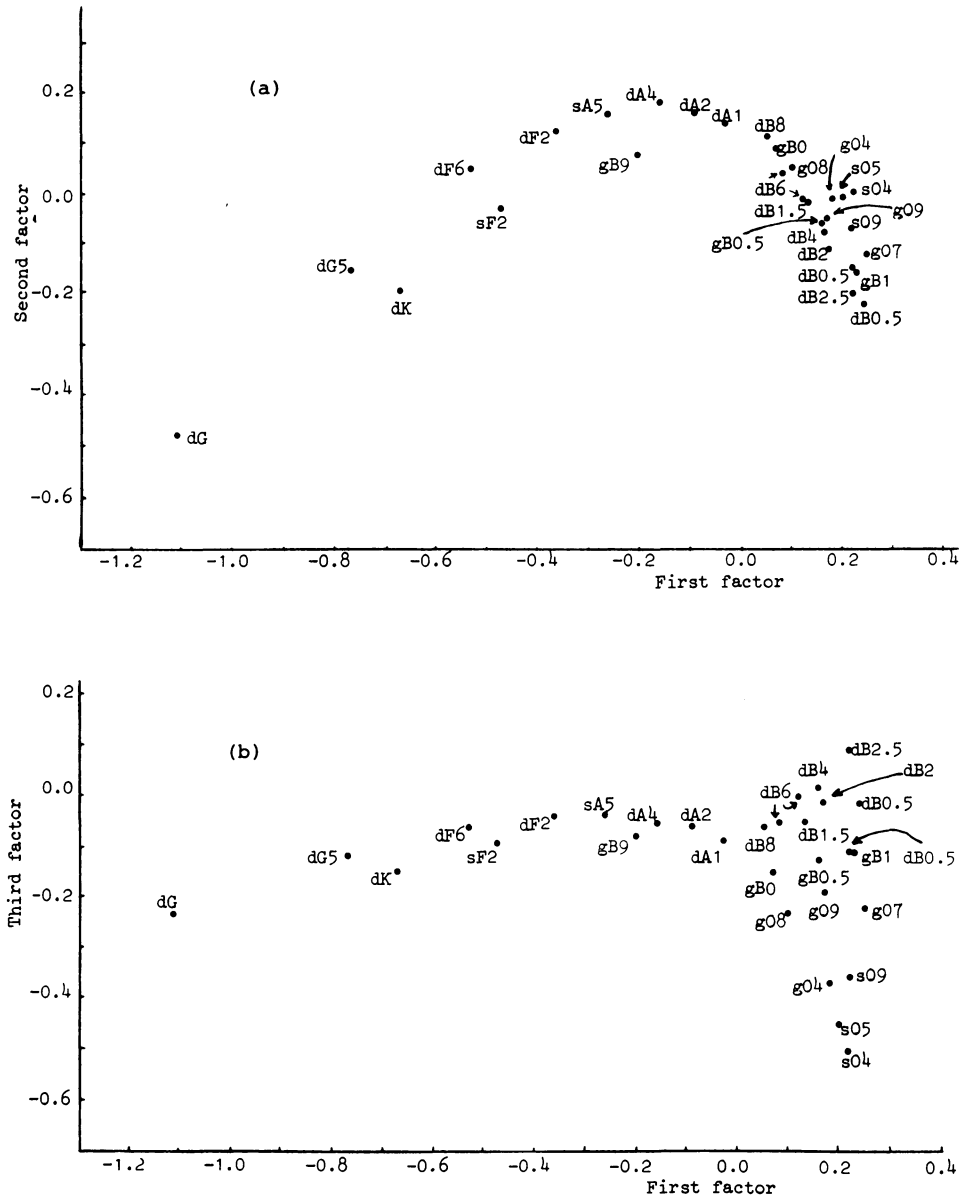

Fig. 1. Distribution of the group barycenters in the planes of the first two PCA factors (a) and of the first and third PCA factors (b).

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4. CONCLUSION AND FINAL REMARKS

We have shown that it is quite feasible to use purely statistical approaches to establish an objective UV classification frame in full agreement with that resulting from a classical morphological approach. Standard stars for the groups constructed in the multivariate space can be selected by examining the distances to each barycenter.

Refinements at the level of the VPB approach have still to be implemented, which should improve the overall performance of the method and the quality of its results. An increase of the size of the original sample should also have a positive influence on the final discriminating power.

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