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APPLICATION OF MACHINE LEARNING ON SEARCHING FOR Be STAR CANDIDATES WITHIN THE OGLE-IV GAIA SOUTH ECLIPTIC POLE FIELD

A. García-Varela,[1] M. F. Pérez-Ortiz,[1] B. E. Sabogal,[1] and A. J. Quiroz[2]

By using a random forest classifier and color criteria, we find 50 new Be star candidates in the direction of the Gaia south ecliptic pole field.

Long time surveys yield a large number of high quality light curves among their subproducts, useful to identify new variable stars. Since the number of observed objects is too large, machine learning techniques ought to be used to obtain results in reasonable periods of time. Typically, quantities related to the light curves and their Fourier coefficients have been chosen to perform an automatic classification. However, their calculations are computationally expensive and the accuracy of the classifiers depends heavily on the quality of the light curves used to train them. We propose a new set of six features based on robust descriptive statistics of the light curves that does not need to be manually checked. In order to avoid quantities sensitive to outliers, we choose the following robust estimators: median (as a measurement of location), median absolute deviation (as a measurement of scale), octile skewness (as a measurement of skewness), left/right octile weight (as a measurement of tail weight) and a modified version of the Abbe Value (as a measurement of smoothness). We calculate this set of features for OGLE-III variable stars belonging to the Milky Way and the Magellanic Clouds, classified as Cepheids, δ Scuti, Eclipsing Binaries, Long Period Variables, RR Lyræ, Type 2 Cepheids and a set of Be Star Candidates reported in the literature. Its performance was evaluated over the following classifiers: K-nearest neighbors, classification trees, random forests, support vector machines, and gradient boosted trees. We find that random forests supervised classification technique is the most successful to select these variable stars. As the result of its application on the sample of 1473 "other" variable stars reported by Soszyński et al. (2012), and a subsequent selection by colors, we find 50 new Be star[3] candidates in the direction of the Gaia south ecliptic pole field (Pérez-Ortíz et al. 2017). Although these stars need to be spectroscopically studied to confirm their Be nature, their colors and light curves correspond to the expected for Be stars, showing stochastic variability, outbursts and jumps of brightness, as it can be seen in Figure 1. It is also worth to note the presence in our catalog of objects showing a sudden brightness discontinuity of magnitude. Since these objects are observed in the direction of the ecliptic pole, it is more probable that they are members of the LMC than of the Galaxy, where this type of variability has never been detected.

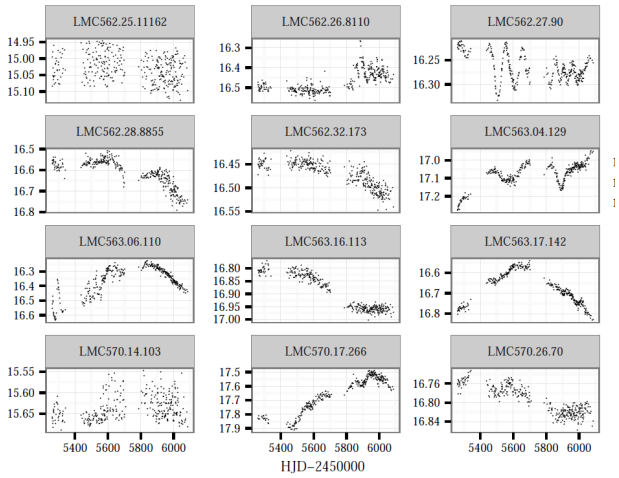

Fig. 1. Representative I-band light curves of Be star candidates.

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[1]Universidad de los Andes, Departamento de Física, Cra. 1 No. 18A–10, Bloque Ip, A.A. 4976, Bogotá, Colombia (josegarc,mf.perez648,bsabogal@uniandes.edu.co).
[2]Universidad de los Andes, Departamento de Matemáticas, Cra. 1 No. 18A–10, Edificio H, Bogotá, Colombia (aj.quiroz1079@uniandes.edu.co).

[3]Be stars are non-supergiant very rapid rotators, with spectral types between late O and early A, whose spectra show or have shown at some time one or more Balmer lines in emission (Collins 1987). These emission lines are generated in a circumstellar decretion disk that emerges from the ejection of stellar mass whose causes are yet under study.