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Computational Developments for Distance Determination of Stellar Groups

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Abstract. In this paper, we consider a statistical method for distance determination of stellar groups. The method depends on the assumption that the members of the group scatter around a mean absolute magnitude in Gaussian distribution. The mean apparent magnitude of the members is then expressed by frequency function, so as to correct for observational incompleteness at the faint end. The problem reduces to the solution of a highly transcendental equation for a given magnitude parameter α. For the computational developments of the problem, continued fraction by the Top–Down algorithm was developed and applied for the evaluation of the error function erf(z). The distance equation $\Lambda(y) = 0$ was solved by an iterative method of second order of convergence using homotopy continuation technique. This technique does not need any prior knowledge of the initial guess, a property which avoids the critical situations between divergent and very slow convergent solutions, that may exist in the applications of other iterative methods depending on initial guess.

Finally, we apply the method for the nearby main sequence late type stars assuming that the stars of each group of the same spectral type scatter around a mean absolute magnitude in a Gaussian distribution. The accuracies of the numerical results are satisfactory, in that, the percentage errors between r and the mean values are respectively: (2.4%, 1.6%, 0.72%, 0.66%, 3.5%, 2.4%, 2%, 2.5%, 0.9%) for the stars of spectral types: (F5V, F6V, F7V, F8V, F9V, G0V, G2V, G5V, G8V).

Key words. Distance determination—spectral type—frequency function.

1. Introduction

One of the most crucial pieces of information needed in astronomy is the distance to stars. For example (Robinson 1985), if the distance d (in parsec) of a star is known as well as its proper motion μ (in second of arc per year) then one can calculate its tangential velocity V_t to the line of sight (in km per second), which is one of the most useful quantities that could be used for the membership problem for Hyades cluster. Also, having measured the distances to the globular cluster, we can study their distribution in the galaxy (Cassisi *et al.* 2001; Duncan *et al.* 2001). If moving stellar vertex