Computations of the cosmic distance equation

M.A. Sharaf

Department of Astronomy, Faculty of Science,
King Abdul-Aziz University, 80203 Jeddah, Saudi Arabia

Abstract

In this paper, an iterative method of second order of convergence for solving the distance equation is developed using homotopy continuation technique. The method does not need any priori knowledge of the initial guess, a property which avoids the critical situations between divergent to very slow convergent solutions, that may exist in the application of other numerical methods depending on initial guess. Moreover, this method uses the most efficient technique of the continued fraction expansions for the evaluation of the basic functions involved. The accuracy of the method is at least of $O(10^{-8})$, a sufficient accuracy that secures very accurate distance determination.
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1. Introduction

One of the most crucial pieces of information needed in astronomy is the distance to stars or cosmic groups. For example [1], 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 s),

E-mail address: sharaf_adel@hotmail.com