A numerical scheme based on the collocation and optimization methods for accurate solution of sensitive boundary value problems

MOHAMMAD ALI MEHRPOUYA[1] and REZVAN SALEHI[2]

[1]Tafresh University
[2]Tarbiat Modares University

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Abstract

Despite the significant advances in the numerical solution of nonlinear boundary value problems, most of the existing methods still encounter with a high sensitivity to the initial guess. The aim of this paper is to propose a less sensitive robust numerical scheme for accurate solution of sensitive boundary value problems. For this purpose, an orthogonal collocation approach for discretization of the problem is utilized. Thereby, the problem is converted to the solution of nonlinear algebraic equations. However, due to the difficulties of solving the obtained system of nonlinear equations, particularly in providing the proper initial guess, the obtained system of equations is transferred to an optimization problem in which the values of the solution at collocation points are considered as decision parameters. The method finds good results even using not good initial guess for decision parameters and even using a small number of discretization points. Numerical results of two benchmark examples are presented and the efficiency of the method is reported.

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