An adaptive optimized Runge-Kutta-Nyström method for second-order IVPs

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Abstract

This research paper is concerned with developing, analyzing, and implementing an adaptive optimized one-step block Nyström method for solving second-order initial value problems of ODEs and time-dependent partial differential equations. The new technique is developed through a collocation method with a new approach for selecting the collocation points. An embedding-like procedure is used to estimate the error of the proposed optimized method. The current approach has produced approximate solutions to real-world oscillatory, periodic and stiff application problems. The numerical experiments demonstrate that the introduced error estimation and stepsize control strategy presented in this manuscript has produced a good performance compared with some of the other existing numerical methods.

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