An L-stable Trapezoidal-Like Integrator for the Numerical Solution of One-dimensional Time Dependent Partial Differential Equations

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Abstract

In this paper, an L-stable Trapezoidal Integrator for obtaining numerical solutions of one-dimensional time dependent partial differential equations is presented. The method proposed here preserve the A-stability property of the trapezoidal scheme and also L-stable. Two theorems and one lemma are proposed and proved which establish the A-stability and L-stability properties of the derived method. The local truncation error and the global error of the methods are estimated. Applying the scheme developed on One-dimensional heat equation with Dirichlet boundary conditions, the relative error of O (10^{-7}) was obtained. Relative error of O (10^{-6}) was obtained when the schemes were applied to the Burger's equation. Applying the method to time dependent one-dimensional Schrodinger's equation, a relative error of O (10^{-4}) was obtained. On application of the schemes to solve the Korteweg-de Vries (KdV) equation in an IMEX context, absolute error of O (10^{-7}) was obtained. The performance of the method as compared to other existing scheme is considered favorable.

Key words: A-stable method, L-stable method, partial differential equations, Method of Lines (MOL), stiff ODEs, trapezoidal-like integrator.