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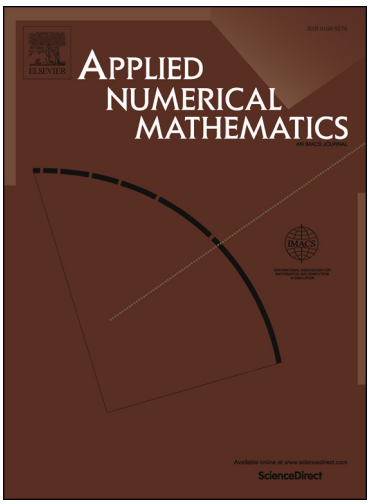

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Error propagation for implicit-explicit general linear methods

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Abstract

We consider the class of implicit-explicit general linear methods (IMEX). Such schemes are designed for ordinary differential equation systems with right hand side function splitted into stiff and non-stiff parts. We investigate error propagation of IMEX methods up to the terms of order $p + 2$. In addition, we construct IMEX schemes of order p and stage order $q = p$, $p \leq 4$ and we verify the performance of methods in several numerical experiments.

Keywords: General linear methods; Implicit-explicit methods; Stage order and order conditions; Local discretization errors; Error propagation; Stability analysis

1. Introduction

Many practical problems in science and engineering are modeled by large systems of ordinary differential equations (ODEs) which arise from discretization in space of partial differential equations (PDEs) by finite difference methods, finite elements or finite volume methods, or pseudospectral methods. For such systems there are often natural splittings of the right hand sides of the differential systems into two parts, one of which is non-stiff or mildly stiff, and suitable for explicit time integration, and the other part is stiff, and suitable for implicit time integration. Such systems can be written in the form

$$\begin{cases} y'(t) = f\big(y(t)\big) + g\big(y(t)\big), \quad t \in [t_0, T], \\ y(t_0) = y_0 \in \mathbb{R}^m, \end{cases} \tag{1.1}$$

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