

Accepted Manuscript

Conditional full stability of positivity-preserving finite difference scheme for diffusion-advection-reaction models

Rafael Company, Vera N. Egorova, Lucas Jódar

PII: S0377-0427(18)30110-9
DOI: <https://doi.org/10.1016/j.cam.2018.02.031>
Reference: CAM 11537

To appear in: *Journal of Computational and Applied Mathematics*

Received date: 15 September 2017
Revised date: 22 January 2018

Please cite this article as: R. Company, V.N. Egorova, L. Jódar, Conditional full stability of positivity-preserving finite difference scheme for diffusion-advection-reaction models, *Journal of Computational and Applied Mathematics* (2018), <https://doi.org/10.1016/j.cam.2018.02.031>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Conditional full stability of positivity-preserving finite difference scheme for diffusion-advection-reaction models

Rafael Company¹, Vera N. Egorova², Lucas Jódar¹

¹ *Universitat Politècnica de València, camino de Vera s/n, 46022, Valencia, Spain*

² *BCAM - Basque Center for Applied Mathematics, Al. de Mazarredo 14, 48009 Bilbao, Basque Country, Spain*

Abstract

The matter of the stability for multidimensional diffusion-advection-reaction problems treated with the semi-discretization method is remaining challenge because when all the stepsizes tend simultaneously to zero the involved size of the problem grows without bounds. Solution of such problems is constructed by starting with a semi-discretization approach followed by a full discretization using exponential time differencing and matrix quadrature rules. Analysis of the time variation of the numerical solution with respect to previous time level together with the use of logarithmic norm of matrices are the basis of the stability result. Sufficient stability conditions on stepsizes, that also guarantee positivity and boundedness of the solution, are found. Numerical examples in different fields prove its competitiveness with other relevant methods.

Keywords: Diffusion-advection-reaction, semi-discretization, exponential time differencing, finite difference, numerical analysis.

2010 MSC: 65M06, 65M12, 65M20

1. Introduction

Time-dependent diffusion-advection-reaction (DAR) models have application in a wide class of problems [1] appearing in many fields as fluid dynamics [1], biology [2], population dynamics [3], and financial mathematics [4], etc. Such time evolution problems are modeled by involving three factors: diffusion, advection and reaction. Diffusion deals with the dispersion given in the species involved in the process throughout the domain of the problem. Advection is

Download English Version:

<https://daneshyari.com/en/article/8901937>

Download Persian Version:

<https://daneshyari.com/article/8901937>

[Daneshyari.com](https://daneshyari.com)