

## Accepted Manuscript

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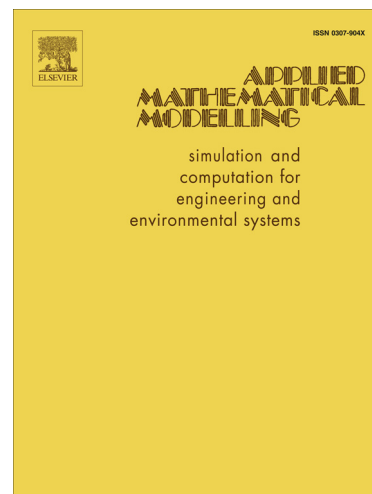
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PII: S0307-904X(14)00385-0

DOI: <http://dx.doi.org/10.1016/j.apm.2014.07.029>

Reference: APM 10100

To appear in: *Appl. Math. Modelling*



Please cite this article as: Y. Jiang, A new analysis of stability and convergence for finite difference schemes solving the time fractional Fokker-Planck equation, *Appl. Math. Modelling* (2014), doi: <http://dx.doi.org/10.1016/j.apm.2014.07.029>

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# A new analysis of stability and convergence for finite difference schemes solving the time fractional Fokker-Planck equation \*

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July 30, 2014

## Abstract

This paper presents a new analysis of stability and convergence for finite difference methods used to solve the time fractional Fokker-Planck equation. We show the monotone properties of the numerical solutions with respect to initial values and truncation errors, based on which we prove the stability and convergence under discrete  $L_1$  norm.

**2000 Mathematics subject classification:** 65M12, 65M06, 35S10

**Keywords:** time fractional Fokker-Planck equations, finite difference methods

## 1 Introduction

This paper presents a new analysis of the stability and convergence for several finite difference methods used to solve the time fractional Fokker-Planck equation (FFPE)

$$\frac{\partial w}{\partial t} = {}_0D_t^{1-\alpha} \left[ \frac{\partial}{\partial x} f(x) + K_\alpha \frac{\partial^2}{\partial x^2} \right] w(x, t), \quad a \leq x \leq b, 0 < t \leq T \quad (1)$$

subject to the initial condition

$$w(x, 0) = \varphi(x), \quad a \leq x \leq b$$

and boundary conditions

$$w(a, t) = g_1(t), \quad w(b, t) = g_2(t), \quad 0 < t \leq T,$$

where the Riemann-Liouville fractional derivative of order  $1 - \alpha$  is

$${}_0D_t^{1-\alpha} w(x, t) = \frac{1}{\Gamma(\alpha)} \frac{\partial}{\partial t} \int_0^t \frac{w(x, s)}{(t-s)^{1-\alpha}} ds$$

\*The work was supported by National Natural Science Foundation of China (Grant No. 10901027).

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