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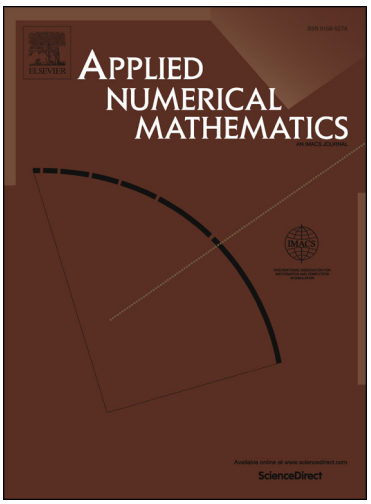

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Finite element schemes for a class of nonlocal parabolic systems with moving boundaries

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Abstract

The aim of this paper is to study the convergence, properties and error bounds of the discrete solutions of a class of nonlinear systems of reaction-diffusion nonlocal type with moving boundaries, using the finite element method with polynomial approximations of any degree and some classical time integrators. A coordinate transformation which fixes the boundaries is used. Some numerical tests to compare our Matlab code with a moving finite element method are investigated.

Keywords: nonlinear parabolic system, nonlocal diffusion term, reaction-diffusion, convergence, numerical simulation, Euler, Crank-Nicolson, finite element method.

1. Introduction

In this work, we study nonlinear nonlocal parabolic systems of the following type:

$$\begin{cases} \dfrac{\partial u_i}{\partial t} - a_i\left(\displaystyle\int_{\Omega_t} u_1(x,t)dx, \ldots, \int_{\Omega_t} u_{n_e}(x,t)dx\right)\dfrac{\partial^2 u_i}{\partial x^2} = f_i\left(x,t\right), \quad (x,t)\in Q_t \\ u_i\left(\alpha(t),t\right) = u_i\left(\beta(t),t\right) = 0\,, \quad t>0 \\ u_i(x,0) = u_{i0}(x)\,, \quad x\in\Omega_0 =]\alpha(0),\beta(0)[, \quad i=1,\ldots,n_e \end{cases} \tag{1}$$

where Q_t is a bounded non-cylindrical domain defined by

$$Q_t = \left\{(x,t)\in\mathbb{R}^2 :\ \alpha(t)<x<\beta(t),\ 0<t<T\right\} \tag{2}$$

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