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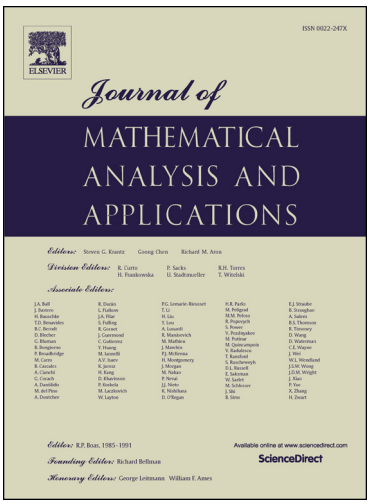

Stability Results for a Reaction-Diffusion Problem with Mixed Boundary Conditions and Applications to some Symmetric Cases

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Stability Results for a Reaction-Diffusion Problem with Mixed Boundary Conditions and Applications to some Symmetric Cases

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Abstract

In this paper we consider a one-dimensional reaction-diffusion problem with mixed boundary conditions. We provide conditions for existence or nonexistence of stable nonconstant solutions whose derivative vanishes at some point. As an application, we obtain similar results for problems supplied with Dirichlet boundary conditions posed in some symmetric domains: an n-dimensional ball, surfaces of revolution and model manifolds.

Keywords: stability, symmetric solutions, mixed boundary conditions, Dirichlet boundary conditions.
2010 MSC: Primary: 35K57. Secondary: 35B07, 35B35, 35B36, 58J32.

1. Introduction

Consider the following reaction-diffusion problem with mixed boundary conditions

$$\begin{cases} (a^2(x)u')' + f(u) = 0, & x \in (0,1) \\ u'(0) = 0, \quad u(1) = u_1, \end{cases} \tag{1.1}$$

where $u_1 \in \mathbb{R}$, $a(x) > 0$ in $[0,1]$ is of class C^2 and $f \in C^1(\mathbb{R})$. We are concerned with existence or nonexistence of stable nonconstant solutions of (1.1) whose derivative vanishes at some point in $(0,1)$. Roughly speaking, U is a stable solution if the solutions of the corresponding parabolic problem

$$\begin{cases} (a^2(x)u_x)_x + f(u) = u_t, & (x,t) \in (0,1) \times \mathbb{R}^+ \\ u_x(0,t) = 0, \quad u(1,t) = u_1, & t \in \mathbb{R}^+ \end{cases}$$

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