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ACCEPTED MANUSCRIPT

Positive Solutions for the Kirchhoff-Type Problem Involving General Critical Growth – Part II: 3D Numerical Solutions

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Abstract

In this paper, we continue the study of the following Kirchhoff-type problem

$$\begin{cases} \left(a + \lambda \int_{\mathbb{R}^3} |\nabla u|^2 dx + \lambda b \int_{\mathbb{R}^3} |u|^2 dx\right) (-\Delta u + bu) = f(u), \text{ in } \mathbb{R}^3, \\ u \in H^1(\mathbb{R}^3), \ u > 0, \text{ in } \mathbb{R}^3, \end{cases}$$

where $\lambda \geq 0$ is a parameter, a, b are positive constants and f reaches the critical growth. We use a scaling iterative algorithm to find numerical solutions to the problem on a large enough bounded domain with several particular nonlinearities f, including those with critical growth. We also study the behavior of the solutions as λ decreases to 0 in consonance with the theoretical study in Part I.

Keywords: Kirchhoff-type problem, positive solutions, critical nonlinearity, numerical solutions

1 Introduction

Part I of the paper deals with the existence of positive solutions for the following nonlinear Kirchhoff-type problem

$$\begin{cases} \left(a + \lambda \int_{\mathbb{R}^3} |\nabla u|^2 dx + \lambda b \int_{\mathbb{R}^3} |u|^2 dx\right) (-\Delta u + bu) = f(u), \text{ in } \mathbb{R}^3, \\ u \in H^1(\mathbb{R}^3), \ u > 0, \text{ in } \mathbb{R}^3, \end{cases}$$
(1.1)

where $\lambda \ge 0$, a, b are positive constants and the general nonlinearity f reaches critical growth. The main results in Part I is outlined in the following. Assume the conditions

(H₁)
$$f \in C(\mathbb{R}_+, \mathbb{R}_+), \mathbb{R}_+ = [0, \infty) \text{ and } \lim_{s \to 0^+} \frac{f(s)}{s} = 0;$$

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