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MULTIPLICITY RESULTS FOR THE NONLINEAR SUSPENSION BRIDGE EQUATION

Q-Heung Choi[1] and Tacksun Jung [2]

[1] Department of Mathematics
Inha University, Incheon 402-751,Korea
[2] Department of Mathematics
Kunsan National University, Kunsan 573-701, KOREA

Abstract. We investigate the number of solutions of the nonlinear suspension bridge equation with Dirichlet boundary condition when the nonlinearity crosses k eigenvalues. We show by critical point theory that the equation has at least k solutions.
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1 INTRODUCTION

In this paper we investigate the number of solutions of the nonlinear suspension bridge equation with Dirichlet boundary condition

$$u_{tt} + u_{xxxx} + bu^+ = 1 + \epsilon h(x,t) \qquad \text{in } [-\frac{\pi}{2}, \frac{\pi}{2}] \times R, \tag{1.1}$$

$$u(\pm\frac{\pi}{2}, t) = u_{xx}(\pm\frac{\pi}{2}, t) = 0 \tag{1.2}$$

$$u \text{ is } \pi-\text{periodic in } t \qquad \text{and} \qquad \text{even in } x, \tag{1.3}$$

where $u^+ = \max\{0, u\}$ and the nonlinearity bu^+ crosses k eigenvalues.

McKenna and Walter [9] proved that if $3 < b < 15$, then (1.1) with (1.2) has at least two solutions by the degree theory, with replacing the condition (1.3) by

$$u \text{ is } \pi-\text{periodic in } \; t \qquad \text{and} \qquad \text{even in } \; x.$$

Choi and Jung [5] also proved that if $3 < b < 15$, then (1.1) with (1.2) and (1.3) has at least three solutions by the variational reduction method. Lazer and McKenna [6] proved that if $-\mu_1 < b < -\mu_2$, μ_i is the sequence of the negative eigenvalues, then there exist at least two nontrivial solutions of (1.1) with free and boundary condition. Micheletti and Pistoia [11] also proved that if $-\mu_1 < b$, then there exist at least two nontrivial solution of (1.1) with free and boundary condition. Our aim is to prove the multiplicity rsult for