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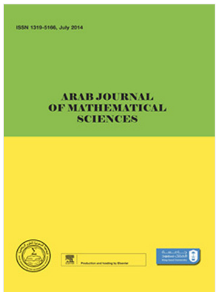

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Asymptotic behaviour of a suspension bridge problem

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Abstract: In this paper, we consider a fourth-order viscoelastic plate equation with infinite memory, and with partially hinged boundary conditions. We investigate the asymptotic behaviour of solutions. This present paper improves earlier results in the literature and allow an extended range of relaxation functions.

Keywords: Asymptotic behaviour; Fourth-Order; Infinite Memory; Viscoelastic; Plate.
AMS Classification: 35B35, 35B40, 35L25, 35G16

1 Introduction

In this paper, we investigate the asymptotic behaviour of solutions for the following fourth-order viscoelastic plate problem

$$\begin{cases} u_{tt} + \Delta^2 u(x,y,t) - \displaystyle\int_0^\infty g(s)\Delta^2 u(x,y,t-s)ds = 0, & \text{in } \Omega \times \mathbb{R}^+, \\ u(0,y,t) = u_{xx}(0,y,t) = 0, & \text{for } (y,t) \in (-\ell,\ell) \times \mathbb{R}^+, \\ u(\pi,y,t) = u_{xx}(\pi,y,t) = 0, & \text{for } (y,t) \in (-\ell,\ell) \times \mathbb{R}^+, \\ u_{yy}(x,\pm\ell,t) + \sigma u_{xx}(x,\pm\ell,t) = 0, & \text{for } (x,t) \in (0,\pi) \times \mathbb{R}^+, \\ u_{yyy}(x,\pm\ell,t) + (2-\sigma)u_{xxy}(x,\pm\ell,t) = 0, & \text{for } (x,t) \in (0,\pi) \times \mathbb{R}^+, \\ u(x,y,0) = u_0(x,y), \quad u_t(x,y,0) = u_1(x,y), & \text{in } \Omega, \end{cases} \tag{1.1}$$

where $\Omega = (0,\pi) \times (-\ell,\ell) \subset \mathbb{R}^2$, $0 < \sigma < \frac{1}{2}$, g is a positive and nonincreasing function and $(u_0, u_1,)$ are given data. The plate problem (1.1) describes the torsional oscillations in suspension bridges in the present of infinite viscoelastic damping. Recently, plate equations with infinite viscoelastic damping have become an active research area; see for instance the results in [5, 10] and reference therein. The recent ground work of Ferrero and Gazzola [7], suggested a rectangular plate model describing the displacement of a suspension bridge in the downward direction. The plate $\Omega = (0,\pi) \times (-\ell,\ell)$ is assumed to be partially hinged on the vertical edges

$$u(0,y) = u_{xx}(0,y) = u(\pi,y) = u_{xx}(\pi,y) = 0, \quad \forall\, y \in (-\ell,\ell)$$

and free on the horizontal edges

$$u_{yy}(x,\pm\ell) + \sigma u_{xx}(x,\pm\ell) = u_{yyy}(x,\pm\ell) + (2-\sigma)u_{xxy}(x,\pm\ell) = 0, \quad \forall\, x \in (0,\pi).$$

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