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LONG-TIME DYNAMICS OF A VON KARMAN EQUATION WITH TIME DELAY

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ABSTRACT. In this paper we consider a von Karman equation with time delay. Many researchers have studied well-posedness, decay rates of energy, and existence of attractors for von Karman equations without delay effects. But there are few works on von Karman equations with time delay. Moreover there are not many studies on attractors for other delayed systems. Thus, we discuss the existence of global attractors for the von Karman equation with time delay by establishing energy functionals which are related to the norm of the phase space to our problem.

1. Introduction

We consider the following von Karman system with time delay

$$u_{tt} + \Delta^2 u + a_0 u_t(x,t) + a_1 u_t(x,t-\tau) = [u, F(u)] + g \text{ in } \Omega \times \mathbb{R}^+, \tag{1.1}$$

$$\Delta^2 F(u) = -[u,u] \text{ in } \Omega \times \mathbb{R}^+, \tag{1.2}$$

$$u = \frac{\partial u}{\partial \nu} = 0, \;\; F(u) = \frac{\partial F(u)}{\partial \nu} = 0 \text{ on } \partial\Omega \times \mathbb{R}^+, \tag{1.3}$$

$$u(0) = u_0, \;\; u_t(0) = u_1 \text{ on } \Omega, \tag{1.4}$$

$$u_t(x,t) = f_0(x,t) \quad \text{for } (x,t) \in \Omega \times (-\tau, 0), \tag{1.5}$$

where $\Omega \subset \mathbb{R}^2$ is a bounded domain with sufficiently smooth boundary $\partial\Omega$, ν an outward unit normal vector to $\partial\Omega$, $x = (x_1, x_2) \in \overline{\Omega}$, a_0 and a_1 are real numbers, $\tau > 0$ is time delay, $F(u)$ is a stress function, $g \in L^2(\Omega)$, and $f_0 \in L^2(\Omega \times (-\tau, 0))$. The bilinear operator $[\cdot,\cdot]$ is defined by $[u,\phi] \equiv u_{x_1x_1}\phi_{x_2x_2} + u_{x_2x_2}\phi_{x_1x_1} - 2u_{x_1x_2}\phi_{x_1x_2}$.

Problem (1.1)-(1.2) with $a_1 = 0$ was intensively studied about existence, energy decay, and attractors by many authors (see e.g. [4, 6, 8, 9, 13]). Favini et al. [4] considered (1.1) with $a_0 = a_1 = g = 0$ and nonlinear boundary dissipation. They proved global existence, uniqueness and regularity of solutions for the equation. Moreover they showed the uniqueness of weak solutions by proving sharp regularity results of the Airy stress function. Since

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