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A global attractor for the plate equation with displacement-dependent damping

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ABSTRACT

We study the long-time behaviour of solutions of the plate equation with nonlinear damping coefficient. We prove under suitable conditions that this equation possesses a global attractor.

1. Introduction

In this paper, we are interested in the long-time behaviour (in terms of attractors) of the solutions of the following plate equation in R^3:

$$u_{tt}+\sigma(u)u_t+\Delta^2u+\lambda u+f(u)=g(x). \tag{1.1}$$

The attractors for the wave equation in the form

$$u_{tt}+\sigma(u)u_t-\Delta u+f(u)=g(x), \quad (t,x)\in(0,\infty)\times\Omega \tag{1.2}$$

were studied in [1–5]. In the case when $\Omega=(0,\pi)$ the existence of global and exponential attractors for (1.2) with the homogeneous Dirichlet boundary condition was proved in [1], assuming conditions

$$f\in C^1(R), \quad \liminf_{|u|\to\infty}\frac{f(u)}{u}>-1,$$

and

$$\sigma\in C^1(R), \quad \sigma(u)>0, \ \forall\, u\in R.$$

For the two-dimensional case, the attractors for (1.2) were investigated in [2], under the conditions

$$\begin{aligned}
&f\in C^1(R), \quad \liminf_{|u|\to\infty}\frac{f(u)}{u}>-\lambda_1, \quad \text{where } \lambda_1=\inf_{\varphi\in H_0^1(\Omega),\varphi\neq0}\frac{\|\nabla\varphi\|^2_{L^2(\Omega)}}{\|\varphi\|^2_{L^2(\Omega)}},\\
&\left|f'(u)\right|\le c\left(1+|u|^p\right), \quad \forall\, u\in R,\ 0\le p<\infty,\\
&f'(u)\ge -l, \quad \forall\, u\in R\\
&\sigma\in C^1(R), \quad 0<\sigma_0\le\sigma(u)\le c\left(1+|u|^q\right), \quad \forall\, u\in R,\ 0\le q<\infty,
\end{aligned} \tag{1.3}$$

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