Nonlinear Dynamics and Systems Theory, **14** (4) (2014) 383–394

Pullback Attractors of Nonautonomous Boundary Cauchy Problems

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Received: April 15, 2014; Revised: October 14, 2014

Abstract: In this work, we establish the existence of pullback attractors for nonautonomous nonlinear boundary Cauchy problems. We apply our result to a reaction-diffusion equation.

Keywords: *nonautonomous boundary Cauchy problem; pullback attractors; reaction-diffusion equation.*

Mathematics Subject Classification (2010): 47J35, 45Exx, 34D45, 35K57.

1 Introduction

Consider the nonlinear boundary Cauchy problem for arbitrary $s \in \mathbb{R}$

$$\begin{cases} \frac{d}{dt}u(t) = A_{\max}(t)u(t), \quad t \in [s, \infty), \\ L(t)u(t) = f(t, u(t)), \quad t \in [s, \infty), \\ u(s) = x, \end{cases} \tag{1}$$

where $A_{\max}(t)$ is a closed operator on a Banach space X endowed with a maximal domain $D(A_{\max}(t))$, and $L(t) : D(A_{\max}(t)) \to \partial X$, with a 'boundary space' ∂X and a function $f : \mathbb{R} \times X \to \partial X$, the solution $u : [s, \infty) \to X$ takes the initial value $x \in X$ at time s. Moreover, the restriction $A(t) := A_{\max}(t)|_{ker(L(t))}$ is assumed to generate an evolution family $(U(t, s))_{t \geq s}$, on the state space X. That is $U(t, s)x$ is a solution of the corresponding linear boundary Cauchy problem of (1) given by

$$\begin{cases} \frac{d}{dt}u(t) = A_{\max}(t)u(t), \quad t \in [s, \infty), \\ L(t)u(t) = 0, \quad t \in [s, \infty), \\ u(s) = x. \end{cases} \tag{2}$$

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