The Relationship between Pullback, Forward and Global Attractors of Nonautonomous Dynamical Systems

D.N. Cheban¹, P.E. Kloeden² and B. Schmalfuß³

¹Departement of Mathematics and Informatics, State University of Moldova, A. Mateevich Street 60, MD–2009 Chișinău, Moldova
²Fachbereich Mathematik, Johann Wolfgang Goethe Universität, D–60054 Frankfurt am Main, Germany
³Department of Sciences, University of Applied Sciences, D–06217 Merseburg, Germany

Received: July 18, 2001; Revised: June 12, 2002

Abstract: Various types of attractors are considered and compared for non-autonomous dynamical systems involving a cocycle state space mapping that is driven by an autonomous dynamical system on a compact metric space. In particular, conditions are given for a uniform pullback attractor of the cocycle mapping to form a global attractor of the associated autonomous skew-product semi-dynamical system. The results are illustrated by several examples that are generated by differential equations on a Banach space with a uniformly dissipative structure induced by a monotone operator.

Keywords: Nonautonomous dynamical system; skew-product flow; pullback attractor; global attractor; asymptotical stability; nonautonomous Navier-Stokes equation.


1 Introduction

Nonautonomous dynamical systems can often be formulated in terms of a cocycle mapping for the dynamics in the state space that is driven by an autonomous dynamical system in what is called a parameter or base space. Traditionally the driving system

¹This work was partially supported by the DFG Forschungsschwerpunktsprogramm “Ergodentheorie, Analysis und effiziente Simulation dynamischer Systeme” and “Interagierende stochastische Systeme von hoher Komplexität”.

© 2002 Informath Publishing Group. All rights reserved.