Almost Automorphic and Almost Periodic Dynamics in Skew-Product Semiflows, Part II. Skew-product Semiflows, Part III. Applications to Differential Equations

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Abstract

The current series of papers, which consists of three parts, are devoted to the study of almost automorphic dynamics in differential equations. By making use of techniques from abstract topological dynamics, we show that almost automorphy, a notion which was introduced by S. Bochner in 1955, is essential and fundamental in qualitative studies of almost periodic differential equations.

Fundamental notions from topological dynamics are introduced in the first part. Harmonic properties of almost automorphic functions such as Fourier series and frequency module are also studied. A module containment result is provided.

In the second part, we study lifting dynamics of ω-limit sets and minimal sets of a skew-product semiflow from an almost periodic minimal base flow. Skew-product semiflows with (strongly) order preserving or monotone natures on fibers are given a particular attention. It is proved that a linearly stable minimal set must be almost automorphic and become almost periodic if it is also uniformly stable. Other issues such as flow extensions and globally attracting almost periodic motions, etc. are also studied.

The third part of the series deals with dynamics of almost periodic differential equations. In this part, we apply general theories developed in the previous two parts to study almost automorphic or almost periodic dynamics which are lifted from certain coefficient structures (e.g. almost automorphic or almost periodic) of differential equations. It is shown that

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(harmonic or subharmonic) almost automorphic solutions exist for a large class of almost periodic ordinary, parabolic and delay differential equations.