Positive almost periodic solutions of nonautonomous evolution equations and application to Lotka–Volterra systems

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Abstract

Consider the nonautonomous semilinear evolution equation of type: $(\star) \; u'(t)=A(t)u(t)+f(t,u(t)), \; t \in \mathbb{R},$ where $ A(t), \ t\in \mathbb{R} $ is a family of closed linear operators on a Banach space X, the nonlinear term f, acting on some real interpolation spaces, is assumed to be almost periodic only in a weak sense (i.e. in Stepanov sense) with respect to t and Lipschitzian in bounded sets with respect to the second variable. We prove the existence and uniqueness of positive almost periodic solutions in the strong sense (Bohr sense) for equation $ (\star) $ using the exponential dichotomy approach. Then, we establish a new composition result of Stepanov almost periodic functions by assuming only the continuity of f in the second variable. Moreover, we provide an application to a nonautonomous system of reaction–diffusion equations describing a Lotka–Volterra predator–prey model with diffusion and time–dependent parameters in a generalized almost periodic environment.

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