Dynamics of a logistic equation with unbounded time depend coefficients

Felipe Rivero[1] and Juan Carlos Jara[2]

[1] Dpto. Matemáticas y Mecánica

Instituto de Investigaciones en Matemática Aplicada y Sistemas

Universidad Nacional Autónoma de México

[2] Dpto. Ecuaciones Diferenciales y Análisis Numérico

Universidad de Sevilla

Spain

Abstract

The aim of this talk is the study of the following non-autonomous logistic ODE

$$\begin{cases} x'(t) = \rho(t)x(t) - \eta(t)x^2(t), & t \in \mathbb{R} \\ x(s) = x_s, & x_s \in \mathbb{R}, \end{cases}$$

where both functions $\rho, \eta : \mathbb{R} \to \mathbb{R}$ are not necessary bounded, $\eta(t) > 0$ and $\rho(t)$ can be negative in a bounded subset. The main idea in this case is to use the well known techniques in the autonomous case to obtain a function that gives us information about the dynamic of the system in a very simple way. Then we will apply that to a non-autonomous prey-predator system to obtain the permanence of solutions.

References

[1] S. Ahmad, Convergence and ultimate bounds of solutions of the nonautonomous Volterra-Lotka competition equations, *J. Math. Anal. Appl.*, **127** (1987) 377–387.

[2] J. Balbus, J. Mierczyński, Time-averaging and permanence in nonautonomous competitive systems of PDE's via Vance-Coddington estiamtes, *Discrete Contin. Dyn. Syst. Ser. B*, **17** (2012) 1407–1425.

[3] T.A. Burton, V. Hutson, Permanence for nonautonomous predator-prey systems, *Differential Integral Equations*, **4** (1991) 126–1280.

[4] T. Caraballo, A.N. Carvalho, J.A. Langa, F. Rivero, Existence of pullback attractors for pullback asymptotically compact processes, *Nonlinear Analysis*, **72** (2010) 1967–1976.

[5] J.A. Langa, J.C. Robinson, A. Rodríguez-Bernal, A. Suárez, Permanence and asymptotically stable complete trajectories for nonautonomous Lotka-Volterra models with diffusion, *SIAM J. Math. Anal.*, **40** (2009) 2179–2216.

[6] J.A. Langa, J.C. Robinson, A. Suárez, Forwards and pullback behaviour of a nonautonomous Lotka-Volterra system, *Nonlinearity*, **16** (2003) 1277–1293.

[7] J.A. Langa, A. Rodríguez-Bernal, S. Suárez, On the long time behavior of nonautonomous Lotka-Volterra models with diffusion via the sub-supertrajectory method, *J. Differential Equations*, **249** (2010) 414–445.

[8] M.N. Nkashama, Dynamics of logistic equations with non-autonomous bounded coefficients, *Electron. J. Differential Equations* **2000**, (2000) 8 pp. (electronic).

[9] J. Sugie, Y. Saito, M. Fan, Global asymptotic stability for predator-prey systems whose prey receives time-variation of the environment, *Proc. Amer. Math. Soc.*, *139* (2011) 3475–3483.