Periodic and Connecting Orbits for Delay Differential Equations

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We consider a class of nonlinear differential equations with delayed feedback. It is well known that these can generate complex or even chaotic dynamics. One such equation is the *Mackey-Glass equation*. An article by Mackey and Glass in 1977 ([3]) studies physiological processes in which time lag plays a significant role. The model they prescribe is based on the fact that it takes a significant amount of time from the formation of blood cells to their entry into the bloodstream. The parameters occurring in the model result in varied, often chaotic behaviour of the system, so understanding dynamics is an area still researched today.

In [1] we considered a more general form of the Mackey-Glass equation, which is suitable for modeling a significant Allee effect in population dynamics. Our results relate to the existence of orbitally asymptotically stable periodic and certain heteroclinic orbits to which we apply the general theory of infinite dimensional dynamics systems developed in [2]. The method of the [1] article can be extended to more general nonlinearities that also allows the Allee effect. In the case of the Allee effect, a new unstable equilibrium occurs that is not present in the Mackey-Glass equation.

In the talk we summarize the previous results and describe those conditions that define such a nonlinear feedback function class for which our results still hold. Additionally we delineate our present research goals about understanding the dynamics of the general case.

This is a joint work with **Tibor Krisztin**, University of Szeged, Bolyai Institute.

[1] Gábor Benedek, Periodic and connecting orbits for Mackey-Glass type differential-delay equations, *in preparation.*

[2] Tibor Krisztin, Hans-Otto Walther, Jianhong Wu, Shape, Smoothness and Invariant Stratification of an Attracting Set for Delayed Monotone Positive Feedback, *Fields Institute Monographs, Vol. 11, Amer. Math. Soc., Providence, RI,* (1999).

[3] M. Mackey and L. Glass, Oscillation and chaos in physiological control systems, *Science, New Series*, **197** (1977), 286-289.