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Periodic and connecting orbits for delay differential equations

Gábor Benedek

Bolyai Institute, University of Szeged, Hungary
benedek.gabor.istvan@gmail.com

We consider a class of nonlinear differential equations with delayed feedback. Numerical results suggest that these can generate complex dynamics. An example is the famous *Mackey–Glass equation* modeling physiological processes in which time lag plays a significant role. The nonlinearity in the equation allows to model the so-called Allee effect in population dynamics.

First, a limiting version of the equation is introduced with discontinuous nonlinearity. A combination of analytical and verified numerical tools gives the existence of an orbitally asymptotically stable periodic orbit. Then it is shown that near this periodic orbit the original equation has a periodic orbit, as well.

For nonlinearities, allowing to model the Allee effect, an additional unstable equilibrium occurs. From this equilibrium point, and from small amplitude periodic orbits close to this equilibrium there exist connecting orbits to the stable periodic orbit obtained in the first step.

This is a joint work with Tibor Krisztin and Robert Szczelina.