Recent Achievements in Dynamical Systems

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SOME EXAMPLES OF LOTKA-VOLTERRA TYPE MODELS

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Abstract

In this paper we study nonlinear Lotka-Volterra (in short LV) type models. LV type models can exhibit any asymptotical behavior such as equilibrium states, periodic cycles, and Attractors.

Keywords: LV type model; equilibrium state; periodic cycle

Look at the Background

Predator-prey models have been studied for a long time. Many biologists believe that if the unique positive equilibrium point of a predator-prey system is local asymptotically stable, then it is global asymptotically stable. However, this is not always true. It is found that a unique positive local asymptotically stable equilibrium point has at least one limit cycle surrounding the equilibrium point under suitable condition. Therefore, many mathematicians try to use some well-known methods to find conditions for global stability for the equilibrium point of predator-prey systems.

The Lotka-Volterra (in short LV) model is the simplest model of predator-prey interactions. It is based on linear per capita growth rates and written as follows

\[
\begin{align*}
\dot{x} &= x(b - py) \\
\dot{y} &= y(-d + rx) 
\end{align*}
\]

(1)

where

(i) \(y\) is the number of some predators (for example, wolves);
(ii) \(x\) is the number of its preys (for example, rabbits);
(iii) \(\dot{y}\) and \(\dot{x}\) represent the growth of the two populations against the time;
(iv) \(t\) represents the time;

\(b, p, d, r \geq 0\) are parameters representing the interaction of the two species

The equation (1) has periodic solutions which do not have a simple expression in terms of the usual trigonometric functions. At any given time in the phase plane, the system is in a limit cycle and lies somewhere on the inside of these elliptical solutions

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