

On Observability of Limit Cycles in the Chemostat

Torsten Lindström

Linnæus University Växjö, Sweden
TORSTEN.LINDSTROM@LNU.SE

Abstract

Ever since May (Science, 1974) pointed out that the dynamics of equations describing commonly appearing equations in ecology contains the seeds of chaos and nonlinear dynamics, it has been a debate whether nonlinear dynamics and chaos actually can be observed in ecological systems. The chemostat is a very basic experimental setting describing of an ecosystem with an explicitly modelled resource flow. Presence of autonomous limit cycles is the simplest nonlinear dynamical phenomenon that can be studied and the Rosenzweig and MacArthur (Am. Nat. 1963) criterion divides the parameter space of the deterministic two-species chemostat into a one regime describing global stability and one with autonomous limit cycles. Deterministic systems of differential equations can, however, only be viewed only as approximations of the Markov processes describing the ecological phenomena (Renshaw, Stochastic Population Processes, 2011). It is likely that deterministic stable equilibria describing sufficiently large populations are described by approximately normal distributions and this can indeed, be proved in the univariate case. The objective of this talk is to study in what sense limit cycles approximate the quasi-stationary distributions arising in the Markov process describing the two-species chemostat.