SJÄLVSTÄNDIGT ARBETE I MATEMATIK

Onsdagen den11 januari kl. 10–11 presenterar Muhammad Adnan sitt arbete "On Some Mathematical Topics in Modeling and Analysis of Biological Systems" (30 högskolepoäng, avancerad nivå).

Handledare: Yishao Zhou

Plats: Sal 21, hus 5, Kräftriket

Abstract: The central topic of this report is mathematical analysis of dynamical systems aris- ing from systems biology, in particular three lower dimensional models on circadian rhythms in drosophila. Such systems have the common feature that they are large and nonlinear and many parameters and variables are nonnegative. The main issues are stability of steady state solutions, bifurcation of type Saddle node and Hopf, limit cycles and global bifurcation diagram in terms of biological parameters. The local stability of steady state and the Hopf bifurcation are carried out by the linearization together with a careful analysis using Routh-Hurwitz criterion in terms of parameters. It is found that the conclusions drawn from computer simulations in many research papers on these models are too rough to be qualified as Hopf bifurcation so a better value for the Hopf bifurcation is provided here, based on more rigorous mathematical analysis based on theory of zero locations and an extensive numerical simulation using Matlab and Mathematica. To prove the stability of the Hopf bifurcation, center manifold theorem is studied in order to compute the first Lyapunov coefficient of a dynamical system although the goal for the five dimensional model has not been achieved. In the end, descriptions on parameters resulting in saddle node bifurcation and the Hopf bifurcation are given. To make the ideas apparent for non-mathematicians the details on "bacterial growth in chemostat" are worked in most of the mathematical topics studied in this report. Some model reduction techniques are also discussed. To the best of our knowledge the theoretical results found for the five dimensional model are new.

Alla intresserade är välkomna!