ASHBi SEMINAR

Structural sources of instability in biochemical networks

Lecturer: Dr. Nicola Vassena

Scientist & Project leader
Interdisciplinary Centre for Bioinformatics at Leipzig University

Date Monday, 19 August 2024

Time 15:00 – 16:00 [JST]

Venue Conference Room / Zoom
B1F, Faculty of Medicine Bldg. B

*Register via the right QR code

Abstract

Biochemical reaction networks, e.g. of metabolic type, may comprise hundreds of species and reactions. In this talk, I will present a comprehensive framework for predicting the dynamic range of such large networks. To this end, I will introduce the class of 'parameter-rich kinetics', which includes suited nonlinearities such as Michaelis-Menten, Hill, and Generalized Mass Action. I will further apply multiscale methods and bifurcation theory using the network structure as the sole ingredient.

At a fixed equilibrium, a proper rescale of the partial derivatives in the Jacobian matrix highlights changes in stability and bifurcations. This approach identifies fast 'leading' subnetworks that drive the system into unstable regions. As a first case study, I will focus on the existence of unstable equilibria based on the network structure, introducing the concept of unstable cores: minimal sources of instability in the network. Unstable cores can be classified into autocatalytic and nonautocatalytic types, with the presence of at least one autocatalytic core indicating autocatalysis within the network. Unstable cores are crucial for predicting whether a network can exhibit multiple equilibria or periodic oscillations, thus providing insights into the network's dynamic range.

Organizer : Graduate School of Medicine
Institute for the Advanced Study of Human Biology (WPI-ASHBi)

Contact: Prof. Yasuaki Hiraoka
[E-mail] hiraoka.yasuaki.6z@kyoto-u.ac.jp