INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

DPT BIOSCIENCES
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Mathematics and Modeling

Modeling of biological networks

IDENTIFICATION

CODE : BS-5-S1-EC-BMRESEA
ECTS : 2.0

HOURS

Lectures :	18.0 h
Seminars :	14.0 h
Laboratory :	0.0 h
Project :	0.0 h
Teacher-student contact :	32.0 h
Personal work :	18.0 h
Total :	50.0 h

ASSESSMENT METHOD

Report and presentation of mini-projects

TEACHING AIDS

Slides, articles

TEACHING LANGUAGE

English

CONTACT

M. DE JONG Hidde
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AIMS

At the end of this module the student will be able to construct a model of a biological network (genetic or metabolic) and to analyze it by means of various mathematical and computational tools.
The educational objective is to master kinetic modelling as applied to gene and metabolic networks. This will concern both the theoretical foundations and concrete applications to diverse systems of biological regulation. Applications will rely on the practical use of computer tools for the modelling, analysis and simulation of biological networks.

CONTENT

Courses:
- Introduction : systems biology and biological networks
- Modeling of metabolic networks: flux balance analysis, kinetic modeling, metabolic control analysis
- Modeling of gene regulatory networks: kinetic modeling, qualitative modeling, stochastic modeling
- Calibration and validation of models, model-based integration of multi-omics data

Practical exercises:
- Flux balance analysis (COBRA)
- Integrated modeling of metabolism, gene expression and growth using ODE models (Matlab)

Mini-projects:
- Mini-projects on a topic of choice or on a proposed topic (literature study, report and/or presentation)

BIBLIOGRAPHY

A. Cornish-Bowden, Fundamentals of Enzyme Kinetics, Portland Press, London, 1995
Z. Szallasi, V. Periwal, J. Stelling (eds), System Modeling in Cellular Biology: From Concepts to Nuts and Bolts, MIT Press, Cambridge, MA, 2006
D. Fell, Understanding the Control of Metabolism, Portland Press, London, 1997
U. Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall, New York, 2006
R. Heinrich & S. Schuster, The Regulation of Cellular Systems, Chapman & Hall, New York, 1996
S.H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, Perseus Books, Reading, MA, 1994
H. Bolouri, Computational Modeling of Gene Regulatory Networks, Imperial College Press, London, 2008

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PRE-REQUISITE

Basic knowledge in molecular biology and biochemistry
Basic knowledge in linear algebra, ordinary differential equations, and dynamical systems