

Synthetic biology: Design, simulation and control of genetic circuits in microbial cell factories

Overview

The course is divided to two parts: The first week is theoretical, learning the basics of modeling and control theory, analysis and simulations. In the second week, control of cell factories will be taught, with overview of design of genetic circuits with synthetic biology tools, optimal control of fermentation processes, measurement systems and advance feedback control. We will learn the existing control application, and recent trends and discoveries with great potential to increase the productivity of fermentation. Some of the important topics that will be covered:

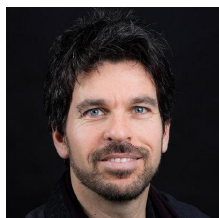
1. Basic elements of modelling of reactions and enzymes kinetics, Hill equation, phosphorylation, inhibition, time delays and the dynamics they create.
2. Designing genetic circuits – network motifs, feedback, feedforward (coherent and incoherent) to obtain properties such as robustness and noise reduction.
3. Simulations – Using MATLAB to develop simple ODE solver with fixed step size (Euler), variable step size (Runge-Kutta, ode15), simulations of set of differential equations, implementation of feedback, sensitivity analysis with matlab. Simulate genetic circuits and cascade systems.

The course will have a MATLAB project for students, in which they will implement their knowledge in a computer laboratory

Modules	A: Modelling and control theory : Dec 3 - Dec 7 B: Synthetic biology : Dec 10 – Dec 14 Number of participants for the course will be limited to thirty. Those interested in attending a single module are requested to contact the course co-ordinator.
Audience	<ul style="list-style-type: none">▪ Senior undergraduate/master's and doctoral students working in chemical/bioprocess engineering/life sciences▪ Personnel working in biotechnology/pharmaceutical industries
Number of credits	<ul style="list-style-type: none">▪ 2 (as per old IIT Madras system)
Fees	The participation fees for taking the course is as follows: Participants from abroad : Student participants: Rs. 2000 Faculty participants: Rs. 5000 Industry: Rs. 15,000 Research Organizations: Rs. 10,000 Modes of payment: <u>Online transfer:</u> Account Name: CCE IIT Madras Acc. No: 3640111110 Branch: SBI, IIT Madras Branch, Chennai IFSC Code: SBIN0001055 Swift Code: SBININBB453 Note: The participants should be mentioned the purpose of GIAN while the transaction and have to send the transaction details to cceoffie@iitm.ac.in OR Demand draft in favour of "CCE IIT Madras" payable at Chennai . The demand draft is to be sent to the course coordinator at the address given below.

Co-ordinator	<p><u>Sridharakumar Narasimhan</u> <u>Dept. of Chemical Engineering, IIT Madras, Chennai. 600036</u> <u>Email: sridharkrn@iitm.ac.in</u></p>
Registration	<p>http://www.gian.iitkgp.ac.in/GREGN/index</p>

The Faculty



Prof. Nadav Bar is professor of chemical engineering at Norwegian Univeristy of Science and Tehcnology, Trondheim, Norway. Bar's group mainly explores modeling and control of cell factories to increase productivity and efficiency of microbial biocatalysis, targeting membrane repair proteins and genetic pathways of food pathogens (L.Monocytogenes). He also works on sensor-motor control of flying mammals, guidance control and gene regulatory networks and mechanisms.

URL: <https://www.ntnu.edu/employees/nadi.bar>



Prof. Sridharakumar Narasimhan is professor of chemical engineering at IIT M Madras, Chennai. His interests are broadly in optimal experiment and measurement system design, water distribution networks and continuous manufacturing.

URL: www.che.iitm.ac.in/~sridharkrn



Prof. Guhan Jayaraman is professor in the department of biotechnology at IIT Madras. The long term focus of his research is to develop Synthetic biology platforms and metabolic engineering strategies for biotechnology.

URL: <https://biotech.iitm.ac.in/Faculty/guhan/index.html>