

ADVANCED COURSE

Multi-Omics approaches for Improvement of Industrial Microbes

2 - 6 June 2025

Aljoscha Wahl
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AIM OF THE COURSE

This course offers a coherent overview of current state of the art omics technologies, bridging the different cellular levels, i.e. metabolomics, fluxomics, transcriptomics and proteomics. It will be shown how integrated application of these technologies provides holistic, quantitative insights in cellular physiology. Finally, it will be demonstrated how targets for (further) improvement of industrial microbes can be identified through integration of omics data with modelling approaches.

The courses of the Department of Biotechnology at the Delft University of Technology has been known for more than 35 years. Teachers from universities and experts from industries will share their new insights in the field and give you insights they acquired during their career. Throughout the course you will practise with the newly gained knowledge by yourself, to optimize your learning.

The first two days of the course are mainly dedicated to experimental techniques and data acquiring. From experimental design to mass spectrometry to transcript assembly.

The next two days focus on theoretical and modeling aspects of Systems Biology. Approaches from network reconstruction, stoichiometric and thermodynamic network analysis and in-vivo kinetic modeling will be covered. ^{13}C tracer methods will be discussed to increase the information content of stationary state as well as dynamic experiments.

Day five will be dedicated to future perspectives for systems biology and industrial application of multi-omics approaches.

COURSE DESCRIPTION

This one-week course is taught in English and has intensive and long days. To ensure active participation by those attending, a combination of theoretical (lectures) and practical work (exercises and computer simulations) is offered. Some online preparatory materials will be offered to facilitate all participants having the same start knowledge.

LECTURES

In the lectures, attention will be paid to the following themes:

- Genome sequencing and analysis
- Transcriptomics (incl. RNA sequencing)
- Microbial proteomics
- Bioinformatics
- Novel molecular tools and automated strain construction
- Rapid sampling and quenching
- Metabolite quantification and validation using Isotope Dilution Mass Spectrometry (IDMS)
- Estimation of extra- and intracellular rates from experimental data
- Kinetic modeling and approaches to handle parameter identification problems
- Genomics in strain improvement (incl. metabolic and evolutionary engineering)

EXERCISES AND COMPUTER SIMULATIONS

The participants will apply the theory from lectures in case study exercises, especially for concepts from bioinformatics, quantitative metabolomics and metabolic modeling. The participants will focus on analysis of next-generation sequence data, massive data handling, statistics, interpretation and visualisation of multi-omics data.

WHO SHOULD ATTEND?

This Advanced Course is aimed at participants from industry, universities and research institutions who want to update and extend their theoretical knowledge and practical insight in multi-omics and modeling. The course is intended for postgraduates (MSc, EngD, PhD), with a sound background in microbiology, microbial physiology, biotechnology, biochemistry or biochemical engineering, with a basic knowledge in some of the other disciplines and an affinity to applied mathematics.

COURSE BOARD

Aljoscha Wahl
Friedrich Alexander Universität Erlangen
Nürnberg, Germany

Djordje Bajić
Industrial Microbiology
Delft University of Technology
Delft, the Netherlands

Martin Pabst
Environmental Biotechnology, High-resolution
Mass Spectrometry
Delft University of Technology, the Netherlands

COURSE COORDINATION

Yvonne van Gameren
Jenifer Baptiste
BioTech Delft
Delft University of Technology
Delft, the Netherlands

LECTURERS

Marcel van den Broek
Industrial Biotechnology
Delft University of Technology
Delft, the Netherlands

Frank Bruggeman
Systems Biology Lab
Vrije Universiteit Amsterdam
Amsterdam, the Netherlands

Jeroen Demmers
Erasmus MC
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Eduard Kerkhoven
Systems and Synthetic Biology
Chalmers University of Technology
Gothenburg, Sweden

Douwe Molenaar
Biochemistry and Molecular Biology
Vrije Universiteit Amsterdam
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Hector Garcia Martin
Lawrence Berkeley National Laboratory
Berkeley, USA

Joanna Kirkpatrick
Thermo Fisher Scientific
Hemel Hempstead, United Kingdom

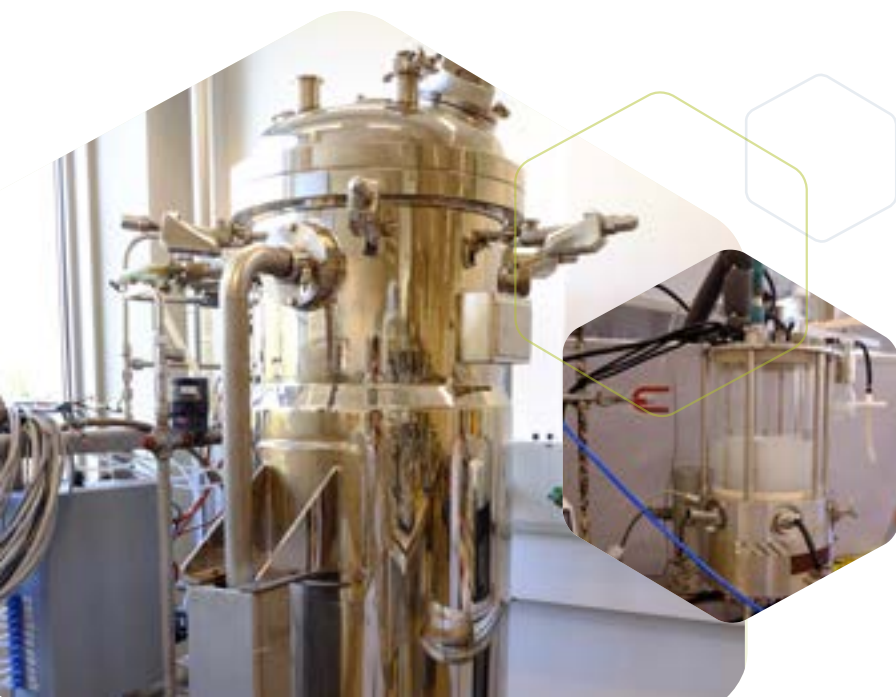
Joan Gallego Murillo
Meatable
Leiden, The Netherlands

Barbara Kozak
IFF Health & Biosciences
Oegstgeest, the Netherlands

Bas Teusink
Systems Bioinformatics group (AIMMS)
Vrije Universiteit Amsterdam
Amsterdam, the Netherlands

Alexander Wittenberg
KeyGene
Wageningen, the Netherlands

Koen Verhagen
dsm-firmenich
Delft, The Netherlands



PROGRAM

MONDAY 2 JUNE 2025

Theme: Omics technologies: Overview and state of the art

- 08:45 Registration
- 09:00 Introduction, including motivation for multi-omics analysis
Djordje Bajić
- 09:15 Reveal and understand natural variation using long-read sequencing technologies
Alexander Wittenberg
- 10:30 Introduction to genome analyses
Djordje Bajić
- 11:30 Genome analyses I
Marcel van den Broek & Djordje Bajić
- 12:30 Lunch & picture
- 13:30 Genome analyses II
Marcel van den Broek & Djordje Bajić
- 17:00 RNA sequencing and transcriptomics
Eduard Kerkhoven
- 19:00 Social drink and buffet

TUESDAY 3 JUNE 2025

Theme: Mass spectrometry based proteomics & metabolomics techniques

- 09:00 Genome analyses III
Marcel van den Broek & Djordje Bajić
- 11:15 Cellular proteomics, introduction and theory
Martin Pabst
- 12:30 Lunch
- 13:30 Proteomics data analysis exercise
Martin Pabst
- 15:45 Targeted proteomics
Jeroen Demmers
- 17:00 Optional lab tour genomics proteomics

WEDNESDAY 4 JUNE 2025

Theme: Fluxomics & Modelling approaches

- 09:00 Metabolomics and metabolic networks (theory and links)
Aljoscha Wahl
- 10:15 Genome-scale modelling for *in-silico* analysis of metabolism
Bas Teusink
- 11:30 Introduction to Cobra
Aljoscha Wahl
- 12:00 Lunch
- 13:00 Exercise with open source tools (Cobra)
Aljoscha Wahl
- 14:30 Industrial applications (including ¹³C MFA)
Aljoscha Wahl
- 15:15 Resource allocation and microbial life cycle strategies
Douwe Molenaar
- 16:30 Resource allocation modelling (*S. cerevisiae*, *E. coli*)
Eduard Kerkhoven

THURSDAY 5 JUNE 2025

Theme: Integration of omics data & Modelling approaches

- 09:00 Regulatory functions of the metabolomic network
Frank Bruggeman
- 10:15 Introduction to Copasi and exercises
Aljoscha Wahl
- 12:15 Lunch
- 13:30 Continuation: Copasi
- 15:00 Multi omics in industrial environment (with examples)
Koen Verhagen
- 16:15 Taming *Trichoderma reesei* for industrial needs
Barbara Kozak
- 18:15 Course Dinner

FRIDAY 6 JUNE 2025

Theme: Future perspectives

- 09:30 Machine learning for industrial biotechnology
Hector Garcia Martin
- 11:40 Ex vivo expansion of erythoblasts: Optimization of culture conditions by untargeted metabolomics
Joan Gallego Murillo
- 12:30 Lunch
- 13:30 Theme group discussions & questions
Course board
- 14:30 Single cell omics
Joanna Kirkpatrick
- 15:30 Evaluation and Farewell Drink



LOCATION

The course will be held at the Delft University of Technology Department of Biotechnology Van der Maasweg 9 2629 HZ Delft, The Netherlands <http://bt.tudelft.nl>

COURSE REGISTRATION

Please register via the website to attend the course. Applicants will be handled in order of the date of receipt.

COURSE FEE

The course fee can be found on the [website](#). The fee includes course materials, lunches, the buffet on Monday and the course dinner on Thursday. The fee does not cover other meals and lodging.

When the number of participants is too low to have a fruitful course, BioTech Delft will cancel the event no later than six weeks before the start of the course. The course fee will be reimbursed within three weeks after cancellation.

In case a speaker will not be able to present his/her lecture due to unforeseen circumstances, BioTech Delft will arrange an equivalent replacement.

Preparatory texts will be sent a month before the start of the course. The complete digital course book will be supplied at the start of the course.



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BioTech Delft organises courses in biotechnology at postgraduate level. BioTech Delft closely cooperates with the department of Biotechnology of Delft University of Technology. Since its foundation, in 1987, BioTech Delft has very successfully organised various types of postdoctoral education.

Currently BioTech Delft offers various Advanced Courses given each year covering the multidisciplinary spectrum of biotechnology. The courses have a long track-record dating back to 1988.

- *Microbial Physiology and Fermentation Technology (1988)*
- *Downstream Processing (1989)*
- *Biocatalysis and Protein Engineering (1999)*
- *Bioprocess Design* (2014)*
- *Modelling for Computation for Microorganisms in Bioprocesses (2018)*
- *Integrated Multi-Omics Approaches for Improvement of Industrial Microbes (2021)*
- *Cellular Agriculture: Precision fermentation and cultured meat (2024)*
- *EPS for resource recovery (2025)*
- *Biopharmaceutical Bioprocessing (2025)*

* in partnership with Wageningen University & Research

FURTHER INFORMATION

Jenifer Baptiste, BA

Course coordination

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