

Varieties of Modeling in Technoscience: The Case of Synthetic Biology

Interdisciplinary Workshop and Winter School
 Darmstadt, March 5- 10, 2017

The aim of this winter school is to exchange ideas and engage with a wide spectrum of modeling approaches - and how they come together in an exemplary research project.

Data-intensive research relies on models to generate predictions, control phenomena, or technologically stabilize performances. In order to successfully manage the large volume of data, these models have to meet the pragmatic constraints imposed by data processing technologies. In order to be intelligible, these models have to also meet the intellectual constraints imposed by the human mind. Seeking to analyse as well as design complex systems, researchers and research consortia need to negotiate the tensions between these various constraints.

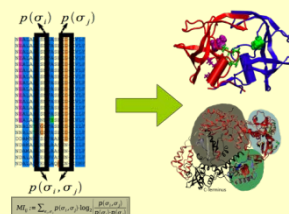


The philosophers:

Julia Bursten, University of Kentucky
 Annamaria Carusi, University of Sheffield
 Gabriele Gramelsberger, Universität Witten/Herdecke
 Andrea Loettgers, Universität Bern
 Andreas Kaminski, HLRS Stuttgart
 Tarja Knuutila, USC/Columbia and University of Helsinki
 Thorsten Kohl, TU Darmstadt
 Johannes Lenhard, Universität Bielefeld
 Alfred Nordmann, TU Darmstadt and USC/Columbia

The CompuGene modeling teams:

Barbara Drossel, Physics, TU Darmstadt
 Kay Hamacher, Computational Biology, TU Darmstadt
 Reiner Hähnle, Software Engineering, TU Darmstadt
 Steffen Hardt, Nano- and Microfluidics, TU Darmstadt
 Heinz Koepl, Electrical Engineering, TU Darmstadt



This is especially evident in Synthetic Biology such as the TU Darmstadt's CompuGene project. [CompuGene](#) seeks to genetically implement electronic circuitry: *The computer learns to simulate biological processes and teaches biological structures to simulate a computer.* Computing appears in its classical data processing role (descriptive and predictive) but also as a design tool (constructive as in architectural models). Aside from computer modeling, when cells are physically rendered as droplets, these are models for measurement and computational purposes.

The workshop and Winter School is organized by Tarja Knuutila and Alfred Nordmann. It brings together i) philosophers of science with an interest in the history, theory, and practice of modeling, ii) the modeling teams of the CompuGene project, and iii) graduate students and post-docs from philosophy, STS, biology, the engineering sciences. If you are interested to participate (a few slots for graduate students and post-docs are still available), please contact Michael Marquardt.

Venue (except Wednesday afternoon):

Tee Kontor Friesische Freiheit, [Kirchstraße 5](#), 64287 Darmstadt

Short Biographies of the Contributors

Julia Bursten is an assistant professor in the department of philosophy at the University of Kentucky, specialised in the philosophy of nanoscience. Her interests range from the relationships between science and society, philosophy of science and logic to health care ethics and gender studies. She recently conducted a workshop on “unnatural kinds” and the classification of objects in the synthetic sciences. Among her publications is a paper on multiscale modeling in nanoscience.

Annamaria Carusi is reader in medical humanities at the University of Sheffield. With a background in philosophy, critical and literary theory, her research is deeply influenced by the phenomenology of Merleau-Ponty. She is especially interested in images, models, simulations and visualisations in the biosciences. Among her publications is a paper on bridging experiments, models, and simulations.

Gabriele Gramelsberger holds a chair in philosophy of digital media at University Witten/Herdecke. She studied simulation modeling as a core element of the 'Culture of Prediction' and explored the synthesis of computer science and biology within 'living' algorithms. Further interests are applied mathematics, philosophy and history of science with a focus on climate research, biology and physics. Among her publications is a paper on the simulation approach in synthetic biology.

Reiner Hähnle is professor for Software Engineering at TU Darmstadt. His research covers automated theorem proving, formal verification, also he is one of the designers of the modeling language ABS. At CompuGene he is responsible for the formal modeling and analysis of complex genetic circuits.

Kay Hamacher, professor of computational biology and simulation from TU Darmstadt studies the simulation of biomolecular dynamics, coarse-grain modeling and the analysis of evolutionary signatures in sequences.

Steffen Hardt also comes from TU Darmstadt. With a background in theoretical physics, he is professor for nano and micro fluidics. With his team he explores transport phenomena on small scales, for example separation processes in biomolecules.

Andreas Kaminski is head of the Philosophy of Science & Technology of Computer Simulation group at the High Performance Computing Center Stuttgart (HLRS). He examines the role of sociality and technology in computer simulations. He is a postdoc from Darmstadt with interests in the philosophy of information technology, social and technical epistemology, the structure of trust and the history of psychometry. He recently co-authored a paper on simulation as cunning or ruse.

Tarja Knuuttila is associate professor at the University of South Carolina. In the philosophy of science, her field is scientific representation and the combination of philosophical analysis with historical and empirical case studies. Besides synthetic biology her interests include economics and the engineering sciences. She also served as Editor-in-Chief of *Science & Technology Studies*. In her publications she has pursued an artefactual approach to modeling and representing.

Thorsten Kohl is a postdoctoral researcher at the TU Darmstadt and at the University of Lübeck. He studied physics, history and philosophy. His interests are historical and philosophical issues regarding biophysics, systems and synthetic biology, cybernetics and medical technology.

Johannes Lenhard is a philosopher at the University of Bielefeld and associate at the "Institute for Interdisciplinary Studies of Science". With a background in mathematics and biology, his work in the philosophy of science is especially concerned with applied mathematics, focusing on mathematics as a tool and on the epistemological characterisation of computer simulations. He is co-editor of a forthcoming book on mathematics as a tool.

Andrea Loettgers is a philosopher and historian of science at the University of Bern, Switzerland. She examined models of gene regulatory networks, published on synthetic biology and the dual meaning of noise, with a paper also on getting abstract mathematical models in touch with nature.

Alfred Nordmann is professor of philosophy and history of science and of technoscience at Darmstadt Technical University. He is interested in the production of technoscientific knowledge with papers on synthetic biology at the limits of science and the collapse of distance in modeling.

(Preliminary) Schedule:

Sunday, March 5

6pm to 9pm:

Dinner and opening discussion at the Bockshaut restaurant and hotel (late arrivals can join over the course of the evening)

Monday, March 6

9:30 am to 12:30pm:

Discussion with one of the PIs of the CompuGene project Heinz Koepl (and collaborators) - with particular emphasis on models as mathematical tools for reverse engineering biological systems

2 pm to 5:30 pm:

Presentations and discussion by and among winter school participants

6pm: dinner

Tuesday, March 7

9:30 to 12:30pm:

Discussion with Steffen Hardt (and collaborators) - nano- and microfluidic physical modeling of cells

2pm to 5:30pm:

Presentations of work in progress and discussion by and among winter school participants*

6pm: dinner

Wednesday, March 8

9:30am to 11:45am:

Presentations of work in progress and discussion by and among winter school participants

1:00 to 3:30pm biology campus at Botanischer Garten:

Discussion with Kay Hamacher (and collaborators) on computational biology simulation models

4pm to 5pm biology campus at Botanischer Garten:

CompuGene lecture by Andrea Loettgers, developed from her

"Model Organisms and Mathematical and Synthetic Models to Explore Gene Regulation Mechanisms"

5pm to 6pm biology campus at Botanischer Garten:

CompuGene workshop/lecture by Andreas Kaminski and Colin Glass:

"The End of Models? Epistemic Opacity in Computer Simulation and Machine Learning"

6:30pm: dinner with CompuGene colleagues

Thursday, March 9

9:30am to 12:30pm:

Discussion with Reiner Hähnle and Radu Muschevici - software engineering and design models as blueprints for genetic circuitry

2pm to 5:00pm:

Presentations of work in progress and discussion by and among winter school participants

7:30pm: George Bizet - *Carmen* at [Staatstheater Darmstadt](http://www.staatstheater-darmstadt.de)

Friday, March 10

9:30 to 11:30am:

Discussion with Barbara Drossel (and collaborators) on theoretical models for the limits of complexity

12 to 1pm:

Concluding discussion

* Graduate and post-doc participants from biology, philosophy, STS or engineering are invited to present work-in-progress or to raise issues for discussion – as are the winter school faculty members. The final schedule will be made after collecting all expressions of interests. A reader of pertinent texts will be made available by March 3.