

Living Techno-Natures: Biohybrid Objects, Life, and Technology

Goethe University Frankfurt am Main | Casino 1.811
10 am – 7 pm | 7 March 2024

KEYNOTE LECTURE:
NATURE-CULTURE DUALISM IN BIOMIMICRY
HENRY DICKS

**Steven
GONZALEZ
MONSERRATE**

**Julia
RIJSSENBECK**

**Gabriele
GRAMELSBERGER**

**Dominika
LISY**

**2024
MARCH 7**

**Marco
TAMBORINI**

**Louisa
ESTADIEU**

**Hannah
LINK**

**Josef
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**Fiorella
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Organisers: Josef Barla, Goethe University Frankfurt | Marco Tamborini, TU Darmstadt



Living Techno-Natures: Biohybrid Objects, Life, and Technology

Evolutionary algorithms that imitate nature in order to solve technical problems, synthetic DNA that turns plants into living data archives, and the use of autonomous machines inside living bodies are just a few examples suggesting that the boundaries between life and technology have become fundamentally blurred in the early 21st century. While the technologisation of organisms has a longer history, an increasing biologisation of technology can be observed in bioinformatics, molecular biology, and other fields today. This development is characterised by the crossing of disciplinary and methodological boundaries. It is becoming increasingly difficult to say where the boundaries between biology and technology, science and economics, representation and intervention lie. In fact, organisms and technologies can no longer be thought of as ontologically distinctive entities. Rather, it seems that biological and technical systems are becoming increasingly interwoven and exchanging properties in the process. Against this backdrop, nature itself becomes more and more a construction kit and a resource for technological design and economic investment.

Proposing the notion of “biohybrid objects” for complex systems consisting of natural and artificial components that not only imitate living beings but also share their basic principles, this symposium explores the remarkable circulation of morphological knowledge between biology and technology. Bringing together innovative interdisciplinary contributions, the symposium aims at bringing together insights on the emergence and nature of biohybrid objects from philosophy, epistemology, and science and technology studies. After a series of breakthroughs in synthetic biology and artificial intelligence, how can we still distinguish philosophically, scientifically, and epistemologically between living beings and technologies? In what ways do biohybrid objects both inform and challenge established understandings of life and technology? What does it mean to shift our understanding from organisms as objects of knowledge to biohybrid objects, i.e., to natural-technological assemblages that do not exist in isolation from interventions in science and engineering and economic practices? What epistemological adjustments are necessitated by the shift in biology from organisms as objects of knowledge to organisms as problems of genetic coding and access to information, but also by recent reworking of organisms to technologies themselves? How are biohybrid objects not only technoscientifically produced but themselves reconfiguring science, engineering, and the bioeconomy? Engaging with these and other crucial questions that emerge from the dissolution of the boundaries between life and technology, the symposium will contribute to current debates in philosophy, epistemology, and science and technology studies that explore the relationship between life and technology against the backdrop of fundamental shifts brought about by synthetic biology and artificial intelligence.

Programme

- 10:00-10:15 **Welcome and opening** (Josef Barla and Marco Tamborini)
- 10:15-12:30 **Panel 1 | Machinic Life:
Philosophical Perspectives on Bioinspiration**
1. *New Encounters Between Life and Technology: Simondon and the Case of Synthetic Biology* | **Julia Rijssenbeek** | Wageningen University and Research
 2. *A Mouse Out of "Grey Rags and Dust": Bioinspiration and Technology Games* | **Marco Tamborini** | TU Darmstadt
 3. *Death Work and the Emergence of Necrovalue in Synthetic Biology* | **Barla Josef** | Goethe University Frankfurt
 4. *Sympoietic Machines: Fragments of a Posthumanist Philosophy of Technology* | **Christoph Hubatschke** | University of Vienna
- Discussion
- Moderation: Vicky Kluzik
- 12:30-13:30 Lunch break
- 13:30-15:15 **Panel 2 | Re/Generating Life:
Biohybrid Approaches and Technological Promises**
1. *Life From Scratch – Biohybrid Regimes of Generating Life* | **Gabriele Gramelsberger** | RWTH Aachen University
 2. *Normativity and Presuppositions of the "Biomimetic Promise"* | **Louisa Estadieu** | University of Freiburg
 3. *What is the Role of Simulations and Models at the Interface of Biology and Technology* | **Fiorella Battaglia**, Università del Salento
- Discussion
- Moderation: Marco Tamborini
- 15:15 -15:30 Coffee break
- 15:30-17:15 **Panel 3: Simulating Life:
Ethics, Practices, and Boundaries of Artificiality**

1. *Life as Archive: Synthetic DNA & The Molecularization of Data Storage* | **Steven Gonzalez Monserrate** | Goethe University Frankfurt
2. *A Relatable Subject Through Skin and Touch: Body Boundaries and Sensorial Hierarchies* | **Dominika Lisy** | Linköping University
3. *Designing Humanoid Robots. Knowledge Practices in Robotics* | **Hannah Link** | Johannes Gutenberg University

Discussion

Moderation: Josef Barla

17:15-17:30

Coffee break

17:30-19:00

Keynote lecture

Nature-Culture Dualism in Biomimicry,
Henry Dicks | University Jean Moulin Lyon 3

Moderation: Marco Tamborini

Keynote lecture

Nature-Culture Dualism in Biomimicry

Henry Dicks | Institut de Recherches Philosophiques, Université Jean Moulin Lyon 3, Lyon

Biomimicry is sometimes criticized for pre-supposing nature-culture dualism (Barad, 2007; Fisch 2017). In this talk, I will argue that, while it is true that biomimicry presupposes a certain nature-culture dualism, this dualism functions as a starting point for two key ways in which the boundaries between nature and culture may be crossed: i) integrating nature into culture; and ii) integrating culture into nature. Further, I will argue that what underlies these two ways of crossing the nature-culture boundary is the basic ethical goal of aligning human agency with non-human agency by recognizing and adopting life's basic principle: life creates conditions conducive to life. Biomimicry may not dissolve the boundaries between nature and culture, but it does allow these boundaries to be crossed, thus giving rise to a world that is "less dualist" (Mathews 2011) than the present one.

Henry Dicks is an environmental philosopher, currently teaching environmental ethics and environmental political philosophy at University Jean Moulin Lyon 3. His research focuses on the philosophy of biomimicry, which he analyses in its ontological, technological, ethical and epistemological dimensions. His recent work, *The Biomimicry Revolution: Learning from Nature How to Inhabit the Earth* (Columbia University Press, 2023), explores the philosophical significance of biomimicry, the imitation, emulation, and process of learning from nature.

Abstracts

Josef Barla

Death Work and the Emergence of Necrovalue in Synthetic Biology

Discussing two recent cases of genetically modified mosquitoes, I will argue that advances in synthetic biology are not only producing new knowledge about life processes, but also reworking death on a molecular scale. While the effects of the production of a surplus out of vitality have been explored extensively under the banner of a “politics of life itself” (Rose), death has rarely been taken up. But is death and its economization so insignificant that it requires no further consideration? What would it mean to move death into the center of theories of biovalue? Starting from the idea that both genetically modified organisms are technologically produced with the aim to reproduce after their release and ultimately to extinguish their own species over generations, not only is the opposition between physis and techné, “the grown and the made” (Habermas), erased here, but the relationship between life and death is fundamentally reworked as well. I will show that these organisms obliterate the boundary between the truly alive and the already dead. For it is precisely through the technoscientific hijacking of the organism’s capacity to reproduce that a genetic “off switch” is passed on to its offspring, which is aimed at the eradication of the entire species. Following this line of thought, I will argue that such life can be understood as performing a sort of “death work” that not only demonstrates the disposability of nonhuman life but also the emergence of what I call “necrovalue” as the shadow of biovalue. Since the *raison d’être* of this engineered life is to reproduce into oblivion, reproduction here functions as a form of metabolic “animal work” (Barua) that generates both surplus value of vitality and value through absence—that is, through “nonencounter” (Reis-Castro).

Josef Barla is Interim Professor of Sociology at the Institute of Sociology at Goethe University Frankfurt, and PI in the German Research Foundation-funded research training group “Fixing Futures: Technologies of Anticipation in Contemporary Societies”. He earned his PhD in Philosophy from the University of Vienna and has been a visiting fellow at the Science and Justice Research Center of the University of California at Santa Cruz, and at the Posthumanities Hub based at Linköping University. He is the author of “The Techno-Apparatus of Bodily Production: A New Materialist Theory of Technology and the Body” (transcript, 2019) and “Biokapital: Beiträge zur Kritik der politischen Ökonomie des Lebens” (co-edited with Vicky Kluzik and Thomas Lemke, Campus, 2022) as well as other publications at the intersection of ecology, race, and technology.

Fiorella Battaglia

What is the Role of Simulations and Models at the Interface of Biology and Technology?

There are conceptual, epistemological, and normative aspects to the dualism between life and technology. I am particularly interested in the epistemological aspects, which I will focus on by referring to the role of simulations and models in mechanisms and practices for knowledge production. The structure of my paper is as follows. In section 1, I will describe some representative case studies. Section 2 will provide clarifications on how key concepts such as ‘simulations’ and ‘models’ are used. This section will also discuss how the case studies described in the first section are based on a common idea, such as the idea that nature is technically controllable. Section 3 discusses some theoretical constraints peculiar to the case studies presented. It will be pointed out that the idea that nature is technically controllable underlies the dissolution of the boundaries between life and technology.

Fiorella Battaglia is the Head of the Laboratory for Ethics in the Wild at the Digital Humanities Centre, University of Salento, where she is also assistant professor of moral philosophy in the Department of Humanities. Her research focuses on challenging ethical questions resulting from emerging technologies and climate change, which shape both our social and epistemic practices and our moral experiences. After obtaining her MA degree in Philosophy from the University of Pisa, she earned her PhD in Philosophy and Politics from the University of Naples “L’Orientale” (2004) under the supervision of Rossella Bonito Oliva. In 2016, she completed her habilitation in Practical Philosophy and received her *venia legendi* from the Ludwig-Maximilians-Universität in Munich (Germany). She has also held an assistant professorship of Social Philosophy at the Berlin-Brandenburg Academy of Sciences and Humanities, at the Humboldt University in Berlin, an adjunct professorship of Epistemology at the Faculty of Medicine of the University of Pisa, and a visiting professorship at the Dirpolis and Biorobotics Institutes of the Sant’Anna School of Advanced Studies in Pisa.

Louisa Estadieu

Normativity and Presuppositions of the "Biomimetic Promise"

Biomimetics has emerged as a promising design approach for developing environmentally sustainable technologies by drawing inspiration from nature (Benyus 2002). At its core, the "biomimetic promise" claims that solutions inspired by nature are inherently more sustainable and superior to purely technical alternatives (von Gleich 2007). For example, a solar cell mimicking a leaf exemplifies the potential for eco-friendly innovations like recyclable and biodegradable materials.

The aim of the talk is to examine the normative assumptions inherent in the biomimetic promise in the context of current climate debate. First (i), I will explore the normative understanding of nature that underlies the biomimetic promise. Second, (ii) I will analyze what kind of (transformed) relationship between nature, society and technology the biomimetic promise points to. With a focus on concrete examples, I will then (iii) examine the extent to which the biomimetic promise and its associated assumptions, such as the sustainability of bioinspired technologies, actually hold true.

Louisa Estadieu is a Postdoc at the Cluster of Excellence livMatS in Freiburg, where she is part of the research group "sustainability and social implications of living materials systems". She obtained her PhD in 2023 with a dissertation on the relation between nature and mind in Hegel's Anthropology. In 2022, Louisa was Visiting Assistant in Research at Yale University. In her interdisciplinary Postdoc project, she explores various notions of knowledge and value transformation processes toward a 'sustainable' future, specifically transformations in human-nature, human-thing, and human-technology relations. Within this context, she also investigates the concept of trust for socio-material transformations.

Steven Gonzalez Monserrate

Life as Archive: Synthetic DNA & The Molecularization of Data Storage

Cast by entrepreneurs as a four billion year old “proof-of-concept” for durable information storage, synthetic deoxyribonucleic acid (DNA) is heralded to reconfigure data ecologies by molecularizing bits; an informatic biomimicry that investors, scientists, artists, engineers, and startups promise will be a corrective to the fragility (Kilbride 2021) and environmental toll of digital systems (Hogan 2018). In promotional discourses around this molecular storage industry, life is cast as an already perfect archive to be replicated, rather than repaired or augmented (Roosth 2019), as is the case in other biotechnology applications. For artists exploring this possibility, this move toward “genomic media” is not merely molecular but biopolitical; as the Grow-Your-Own-Cloud project so carefully articulates the need to turn living organisms (plants) into bioarchives or “non-fungible-plants” (NFPs) to democratize data stewardship and reclaim information from centralized data centers operated by governments and multinational corporations. Drawing on preliminary ethnographic research, this presentation asks, how life resists infrastructuralization for data storage. For technologists, practitioners, and industry actors, what definition of life is being invoked? What are the biopolitics of molecules or bits? How does the turn to DNA echo or diverge from previous historical shifts from analog to digital storage systems?

Roosth, Sophia. *Synthetic: How life got made*. University of Chicago Press, 2019.

Hogan, Mél. "Big data ecologies." *Ephemeria* 18, no. 3 (2018): 631.

Kilbride, William. "Why digital preservation has become more important in the time of Covid-19: A crisis requires rapid decision-making. Keeping a record of them is crucial now more than ever, says." *Research Information* 112 (2021): 11-12.

Steven Gonzalez Monserrate is a postdoctoral researcher in the Fixing Futures research training group at Goethe University in Frankfurt. A recent graduate of the History, Anthropology, Science, Technology & Society (HASTS) PhD program at the Massachusetts Institute of Technology, Dr. Gonzalez ethnographically investigates the environmental politics and impacts of data centers in New England, Arizona, Puerto Rico, Iceland, and Singapore. Committed to public engagement and accessible scholarship, his writing and research appears in venues including *Wired*, *Aeon*, *Popular Science*, *Anthropology News*, *ABC News*, *BBC News*, *NPR* and more. Website: www.stevengonzalezm.com

Gabriele Gramelsberger

Life from Scratch - Biohybrid Regimes of Generating Life

For more than a decade, scientists have been exploring the transition from non-living to living entities in order to create life from scratch, i.e., to move chemically from protoplasm to protocells and finally to artificial organisms. Today, synthetic biology aims to genetically engineer life from scratch, such as the synthetic *Mycoplasma mycoides* JCVI-syn3.0—an artificial single-celled organism with a minimal genome consisting of 473 genes. With the use of computer-aided design (CAD) for genome editing, rapid design of new organisms is now a “one-stop-shop” business. This talk will provide a brief introduction to the history of the re-genesis of life, followed by an overview of the current practice of synthetic biology of programming life. It will conclude with some philosophical reflections on biohybrid regimes of generating life.

Gabriele Gramelsberger is Professor for Theory of Science and Technology at RWTH Aachen University. Her research topic is the digitalization of science, in particular the introduction of new research methods such as computer simulation and machine learning. In 2018 she founded the Computational Science Studies Lab at RWTH Aachen University. She is a member of the North Rhine-Westphalian Academy of Sciences and Arts and Director of the Käthe Hamburger Center c:o/re “Cultures of Research.” Recent publications: *Philosophie des Digitalen zur Einführung* (Hamburg: Junius).

Christoph Hubatschke

Sympoietic Machines: Fragments of a Posthumanist Philosophy of Technology

In an extraordinary footnote in “Das Kapital”, Marx points out that a „critical history of technology“ is needed in a similar way to Darwin's “history of Nature's Technology”, asking: “Does not the history of the productive organs of man, of organs that are the material basis of all social organisation, deserve equal attention?” Only a couple of years later the writer Samuel Butler also refers to Darwin’s theory in his “Book of Machines” (Erewhon) to provide a colonial tale of the evolution of „tools“ culminating in a revolt against their masters. All too familiar are the classical narratives in which “technology” confronts “humanity” as a projective extension of the latter or as a threatening vis-à-vis. Such hegemonic narratives promote a way of thinking “in the classical schema” (Deleuze/Guattari) that theorises humans, society and technology as interrelated but ultimately self-contained spheres either understanding technology as the extended and guided evolution of humans or as a self-evolving species that increasingly threatens to displace humans. Building on the work of Gilles Deleuze, Félix Guattari and Donna Haraway, an understanding of sympoietic machinic assemblages is to be set against the classical schema that allows the relationship between technology, society and human beings to be understood as politically, epistemologically and ontologically inseparable. Against any essentialisation of humans and technology and beyond social Darwinist notions, these approaches attempt to think of a different kind of fundamental entanglement with technology. In the first part of the paper, the deleuzo-guattarian concept of machinic assemblages will be introduced and discussed in regard to Marx’ idea of a “critical history of technology” and ideas of the evolution of technology. In the second part, this concept will be extended with Haraway's reading of sympoiesis to include a posthumanist perspective. The paper will sketch fragments of a posthumanist philosophy of technology that not only questions common ideas of the “human” but also of what “technology” and a “critical history of technology” can be.

Christoph Hubatschke is a philosopher and political scientist in Vienna. He is co-founder of the research group H.A.U.S. (Humanoids in Architecture and Urban Spaces). He currently researches and teaches at the Universities of Vienna and Klagenfurt. He researches at the intersection of critical political theory and philosophy of technology with a focus on Deleuze/Guattari Studies, posthumanism, protest studies, post-structuralist theory of technology and critical perspectives on AI/humanoid robotics. Newest publication: *Minoritäre Technologien. Eine deleuzo-guattarische Technikphilosophie.* (Campus, March 2024)

Hannah Link

Designing Humanoid Robots. Knowledge Practices in Robotics

In light of recent advancements in robotics and artificial intelligence, my contribution explores the various ways and the extent to which humans and robots are interconnected in the field of robotics. Specifically, I investigate how the design of robots is inspired by notions of 'the human,' encompassing human anatomy, cognition, and social behavior. Based on ethnographic observations conducted in robotic laboratories over a period of three months, I analyze the technoscientific translation of notions of 'the human' into robotic bodies and AI architecture. Adopting a sociology of knowledge perspective informed by a posthumanist standpoint, I take into account notions of 'the human' and their performative impact while acknowledging that the human being is to be understood as a product of socio-material differentiation processes. In this context, the guiding questions are: How are ideas, assumptions, and theories about 'the human' embedded within the technological framework of robots? What users are anticipated, and what concept of 'the human' is envisioned in shaping a humanoid appearance and cognition? Ultimately, my contribution aims to offer insights into the intricate interplay between humans and robots by probing further into their conceptual and material entanglements.

Hannah Link is a research associate at the Institute of Sociology at Johannes Gutenberg University and the Collaborative Research Center Studies in Human Differentiation located in Mainz. Currently, she is working on her PhD project, which entails an ethnographic study that explores figures of 'the human' in robotics and the diverse ways these figures are implemented in robots. Her research interests include Sociology of Materiality, Posthumanism, Feminist Theory, and Sociology of Knowledge.

Dominika Lisý

A Relatable Subject Through Skin and Touch: Body Boundaries and Sensorial Hierarchies

Boundaries between human and robot are increasingly blurred with not only the designing of humanoid shapes, facial expressions, silicone skins, but also the development of multisensorial machine bodies that are supposed to see, feel, and think like humans or animals. In one of the overarching aims of my thesis, I ask how the boundary between human and robotic non-human can be drawn ethically. Exploring this shift in boundaries I lean on new materialist (Barad, Colebrook, Chen, Alaimo) and corporeal feminist work (Grosz, Wilson, Shildrick) and developed a figuration of the skin which allows me to think boundaries as flexible, permeable, yet sturdy and protective - like the human skin. This figuration challenges conceptual boundaries of traditional dualisms and emphasises their entanglement with materiality. My presentation will cover content of a thesis chapter which circles around two parts of a theoretical exploration regarding (1) the relation between bodies and boundaries, and (2) the difference of sensorial capacities of body boundaries, particularly touch. In the first part, I explain that bodies in general only come into being through a boundary. There are of course various perspectives on body formations, but one persistent feature is the boundary that can be experienced through the senses. I use my experiences with and reflections on skin-like and fur-like covers for robots to explore the role of the boundary together with Grosz's (1994) Möbius strip metaphor and Wilson's (2015) metabolic transference. I propose that the human/non-human boundary is dissolved because robotic skins mirror "the human" in form and functionality as a mechanism to approximate human "subject status". I refer to this dissolution as a process of legitimation of a body-subject, where the robot body through its material boundary is forming "touch points" for relation. In the second part of the chapter, I am exploring the experience of touch as a characteristic of the skin boundary and the relation between different senses in structuring ways of knowing – particularly, the privileging of vision over touch (Vasseleu 1998). Touch forms a sensorial boundary of proximity (unlike vision from a distance) that can either bring bodies into relation to one another or repel them from one another. I show that the neurophysiology of tactile sensing affords another reading that is neglected in haptic intelligence and that the imaginaries of artificial skin rely on the appropriation of tactility through visual logics. At-tending to the material aspects of peripheral and focal sensing, I propose to consider touch as a crucial for boundary formation and becoming of relational bodies.

Dominika Lisý is a PhD candidate at the Department of Thematic Studies, Division of Gender Studies at Linköping University under the supervision of Dr. Katherine Harrison and Prof. Harald Wiltsche. Her research is part of the Wallenberg AI, Autonomous Systems and Software Program – Humanities and Society (WASP-HS) project on "The ethics and social consequences of AI and caring robot". She obtained a BSc in Psychology at the University of Groningen, the Netherlands, an MA in Gender Studies at the University of Gothenburg, Sweden, and an MSc in Cognitive Neuroscience at the University of Skövde, Sweden. Her interdisciplinary PhD project is exploring metaphysical boundaries and affectivity in human-robot-relationality through a feminist philosophy of materiality and bodies, and her figuration of the skin.

Julia Rijssenbeek

New Encounters Between Life and Technology: Simondon and the Case of Synthetic Biology

How to understand new encounters between the living and the technological? A case of such new encounters is the biotechnological creations stemming from synthetic biology, where life and technology are related in more complicated and intimate ways. This developing biotechnological field frames its new entities as ‘artificial life’, ‘living technology’, ‘biohybrid systems’, etc. While synthetic biology too easily uses machine metaphors and technological frames for living entities, also traditional philosophical frameworks risk ontological reductionism in their efforts to understand life and technology in relation to each other. Gilbert Simondon’s theory of individuation helps to think about the similarities between living and technical beings, without reducing life forms to machines and without conflating technological objects with vital objects. In this presentation, my goal is twofold: first, to understand the relation between life and technology differently with the help of Simondon, and second, to confront Simondon’s theory with the new borderline cases resulting from synthetic biology. My hypothesis is that individuation helps us to understand these new encounters between the living beings and technologies and to bring conceptual clarity to dominant dualisms, like life and technology, artificial and natural. Finally, I will also show that synthetic biology can shed new light on Simondon’s way of understanding the relationship between life and technology.

Julia Rijssenbeek is a PhD researcher at Wageningen University conducting research on the philosophical and ethical implications of hybrid life forms in synthetic biology. She reflects on disruptions in concepts like machines and organisms, life and technology, artificial and natural in the life sciences. Her research is part of the Gravitation program Ethics of Socially Disruptive Technologies (ESDiT). In 2022, Julia was a visiting scholar at the Wyss Institute Biologically Inspired Engineering at Harvard University, applying and developing the model of Collaborative Ethics in the lab. Next to that, she is a researcher at the future studies think tank FreedomLab. In interdisciplinary projects, she explores and speculates on future human-technology-nature relationships through art, dance and film. Recent publications: Who Own Nature? Conceptual appropriation in discourses on climate and biotechnologies (Environmental Values).

Marco Tamborini

A Mouse Out of "Grey Rags and Dust": Bioinspiration and Technology Games

In this talk, I propose a shift from conceptual analysis to an examination of epistemic practices to unravel the foundations of several key concepts characterizing “living techno-natures.” I advocate for this shift by first introducing Ludwig Wittgenstein’s methodological insights from his *Philosophical Investigations*, emphasizing thus a transition from the conceptual to the practical realm. Second, I critique the limitations of pure conceptual analyses of the notion of “bio-inspired” technology, highlighting possible inherent pitfalls. Conversely, I propose promoting the analysis of epistemic practices to uncover the meaning of bioinspiration within diverse technology games. In the outlook, I then broadly reflect on the philosophical payoff of the shift I am supporting.

Marco Tamborini teaches philosophy at the Technical University of Darmstadt. His research focuses on the history and philosophy of biology, bioinspired and engineering disciplines (e.g., bionics, biorobotics, synthetic biology, architectural design, embodied AI), philosophical anthropology, philosophy of technology and technoscience as well as philosophy of culture from the 19th century to the present. Recent book publications: *The Architecture of Evolution: The Science of Form in Twentieth-Century Evolutionary Biology* (University of Pittsburgh Press 2022); *Entgrenzung: Die Biologisierung der Technik und die Technisierung der Biologie* (Meiner 2022); *Technikphilosophie. Neue Perspektiven für das 21. Jahrhundert* (with Kevin Liggieri und Olivier Del Fabbro) (wbg 2023); *Biorobotik zur Einführung* (Junius Verlag 2024).

Venue and directions

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