CONSTRUCTOR UNIVERSITY

USG
est. 2001

Presenting Research Opportunities at Constructor University

2nd Annual Research Day

Wednesday,
October 4, 2023

14:15 – 18:00

IRC Campus Center

BOOKLET

Rapid links

Giuseppe Abreu
Peter Baumann
Andreas Birk
Klaus Boehnke
Klaus Boehnke, Franziska Deutsch, Ulrich Kühnen
Klaudia Brix
Hilke Brockmann
Omid Fatahi Valilai
Ben Godde
Igors Gorbovickis
Fangning Hu
Marc-Thorsten Hütt
Stephan Juricke
Stefan Kettemann
Ulrich Kleinekathöfer
Ulrich Kortz
Ulrich Kühnen, Klaus Boehnke, Franziska Deutsch, Sonia Lippke, Jan Lorenz
Jan Lorenz
Keivan Mallahi-Karai
Arnulf Materny
Armin Müller, Tobias ten Brink
Ivan Ovsyannikov
Sören Petrat
Petr Popov
Gerd-Volker Röschenthaler
Andreas Seebeck
Jürgen Schönwälder
Sebastian Springer
Anna Tevyashova
Julia Timpe
Matthias S. Ullrich
Hendro Wicaksono
Isabel Wünsche

Head of the Research Group

Prof. Dr. Giuseppe Abreu
Wireless Communications and Signal Processing

Describe your research project in three sentences and one picture

- Physical-layer (PHY) and Multiaccess-layer (MAC) techniques for beyond 5G and 6G Wireless Communications systems aimed at high speed, ultra-low latency, energy and spectrally efficient, robust, and secure multi-point wireless connectivity for applications ranging from internet of things (IoT) to augmented and virtual reality (AR/VR) and more.

- Joint communications and sensing technologies for vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and vehicle-to-human (V2H) – altogether also referred to as V2X –systems aimed at high-precision positioning, trajectory-tracking and environmental awareness to enable connected autonomous driving.

- Post-quantum and lightweight security mechanisms for communications systems exploiting features of the wireless channel and signals.

Why do you like doing research?

I enjoy solving hard problems, especially when the solution can be presented in elegant and simple ways that hide the sophistication required to achieve them. I also enjoy knowing that many of the problems we engineers solve have a true potential to impact the lives of real people.

How can, in particular undergraduate, students contribute?

Undergraduate students who apply themselves sufficiently early, and who are ready to truly commit to it, can start training to doing research in my group typically during the second year of study as an ECE major. My research is fundamentally theoretical or algorithmic, such that a strong mathematical background and reasonable programming skills suffice. Some of my PhD students in fact started as junior research assists during their undergraduate studies and afterwards went straight into PhD, skipping the requirement of having a M.Sc. Degree entirely.

How can students join your research?

Students are always welcome to approach me, and I am always willing to find interesting projects for students. But there are challenges... Interested students must, however, have the necessary grasp of mathematics, be dedicated and motivated.

Give two examples of past student projects

Example 1: Advanced Wireless Localization Scheme and Analytical Tools: This project started with an undergraduate student, who was given the task of improving on a wireless localization algorithm I developed myself, known as the Super Multidimensional Scaling (SMDS) algorithm, and which was the basis for starting my first start-up https://zigpos.com. The objective was to reduce the complexity of the method and, if possible, increase the precision by introducing advanced linear algebra techniques. The work led to several variations of SMDS algorithm, including the Complex SMDS and the Turbo SMDS. Subsequently the student went on a fast-track to do his PhD, which was concluded **Summa cum Laude** in 2018, when the student was only 24 years old. He is now the founder and CEO of https://www.natix.io.

Example 2: Advanced Waveforms and Receivers for Joint Communications and Sensing with Application to V2X Systems: Yet another project which started with an undergraduate student, who was first inserted in an on-going project sponsored by Continental AG. The student started his activities already from the second semester, studying the message-passing algorithm in order to develop a new decoder for an emerging type of modulation scheme, referred to as quadrature spatial modulation (QSM), suitable to multi-antenna systems at high frequency bands. Thanks to the success of his work, the work resulted in various patents and a full journal paper at the most prestigious journal of the field, propelling the student to pursue his PhD on a fast-track basis (i.e., without the requirement of a Masters Degree), supported by Continental AG under an expanded research project (see https://www.jacobs-university.de/news/future-6g-technology-jacobs-university-bremen-and-continental-intensify-cooperation).

Head of the Research Group

Peter Baumann, Professor of Computer Science

Describe your research project in three sentences and one picture

The Large-Scale Scientific Information System research group focuses on Array Databases, a special type of database system which allows managing and analysing massive multi-dimensional arrays, alo called datacubes. Such data appear as sensor, image, and statistics data in many applications, like geo sciences (ex: 1-D sensor time series, 2-D satellite maps, 3-D x/y/t satellite image time series and x/y/z exploration data, 4-D x/y/z/t climate and ocean data) and life sciences (ex: human brain imaging, gene expression analysis). Among the main outcomes so far are (i) rasdaman, the pioneer Array DBMS, (ii) datacube standards like ISO SQL/MDA.

Why do you like doing research?

While we do hardcore computer science we collaborate with experts from all sorts of domains. It is rewarding to see that we can help them with their (big) data wrangling, and at the same time there is something new to learn from them every day.

How can, in particular undergraduate, students contribute?

We are programming-centric, doing nontrivial stuff (like templated C++). If you have solid skills in C++, Java, and Web development and if you are willing to immerse into topics (like remote sensing and geo raster data) then come join us and help us to advance engine and applications further!

Which research opportunities do you offer to master students?

The same as for undergraduates.

How can students join your research?

Learn about our research and our projects on https://l-sis.org, and then just contact me by email for a first chat.

Give two examples of past student projects

ORBiDANSe (Orbital Big Data Analytics Service): Porting the rasdaman datacube engine to a nano-sat, subsequently tested in orbit.
AI-Cube: Integrating Machine Learning with Datacubes.

Head of the Research Group

Andreas Birk, Robotics

Describe your research project in three sentences and one picture

The group of Andreas Birk investigates the Artificial Intelligence (AI) side of robotics, especially with respect to machine perception and world-modeling for intelligent autonomous systems. The related research includes contributions to fundamental methods, e.g., for robust registration in 2D and 3D, as well as to real-world applications in unstructured environments, e.g., in marine systems, search and rescue operations, or logistics.

Why do you like doing research?

I guess, it is in my genes ... 🙂

How can, in particular undergraduate, students contribute?

There are two options that are ideally even combined. First, contributions can be made through programming, which requires excellent coding skills in C++ and deep knowledge of fundamental principles of algorithms and data-structures. Ideally, there is also experience with the Robot Operating System (ROS). The second option are theoretical contributions that are linked to specific ideas and concepts, which typically require deep mathematical knowledge from areas like signal processing, stochastics, or discrete optimization.

How can students join your research?

The best way to join is to do a research-oriented BSc thesis. For this purpose, a very limited number of according topics is offered every year. This is only a reasonable option if (a) you have had a deep look at the offered research topics and (b) you found a topic where you are very confident that you have the necessary deep theoretical and practical background. A research-oriented BSc thesis is high risk and it requires a high amount of independent studying. The reward is a high likelihood that the work will lead to a strong publication.

Research-oriented topics are published in a special section on the following webpage:
http://robotics.jacobs-university.de/TMP/BScTheses/.

Head of the Research Group

Prof. Dr. Klaus Boehnke

Describe your research project in three sentences and one picture

The research that we conduct in my team always has clear political connotations. It has to do with social cohesion, xenophobia, right-wing extremism, value change, value transmission, migration to Germany, and last but not least, peace. We typically work with cross-cultural, large-scale surveys to generate new knowledge.
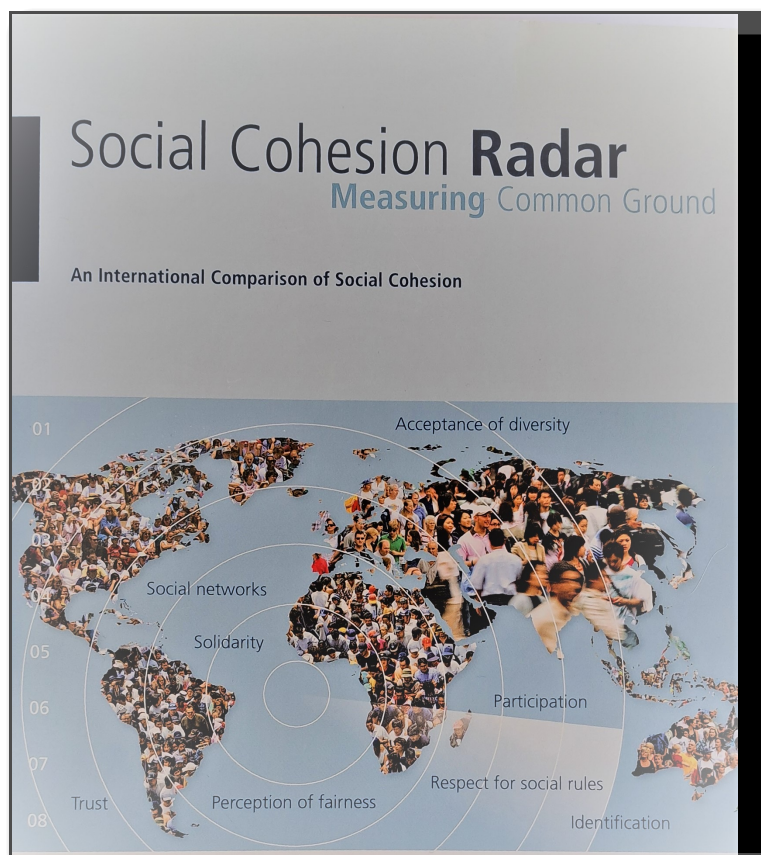
Why do you like doing research?

For me research **is** political activism. My ultimate – lofty sounding – research aim is to make this world a better place.

How can, in particular undergraduate, students contribute?

As I often work with self-collected data, students can most prominently help collecting data (e.g., in their home country) and in getting the collected survey data (e.g., paper-pencil questionnaires) on the computer. After they have completed their stats courses, they can also assist with data analysis.

How can students join your research?

Just pass by my office in RIV, Room 112. I have an open-door policy. I am a dedicated office sitter, but if you want to make 100% sure that I am there, write me an advance email or give me a call before you come (3401).

Give two examples of past student projects

Example 1: Jacobs students collected data in their home countries on self-developed items to assess paternal warmth (in parenting) and we published the work in a high-impact journal: [Boehnke, K., Arnaut, C., Bremer, T., Chinyemba, R., Kiewitt, Y., Koudadjey, A. K., Mwangase, R., & Neubert, L. (2014). Toward emically informed cross-cultural comparisons: A suggestion. Journal of Cross-Cultural Psychology, 45(10), 1655-1670. DOI: 10.1177/0022022114547571dd]

Example 2: Students collected data among fellow students using a new version of the so-called "Social Axioms Questionnaire" and the study results made it into a multi-country research report (mentioning Jacobs University): [Leung, K., Lam, B. C. P., Bond, M. H., Conway, L. G. III, Gornick, L. J., Amponsah, B., Boehnke, K., Dragolov, G., Burgess, S. M., Golestaneh, H. Busch, H. Hofer, J., Dominguez Espinosa, A. d. C., Fardis, M. Ismail, R., Kurman, J., Lebedeva, N., Tatarko, A. N., Sam, D. L., Mendes Teixeira, M. L., Yamaguchi, S., Fukuzawa, A., Zhang, J., & Zhou, F. (2012). Developing and evaluating the social axioms survey in eleven countries: Its relationship with the five-factor model of personality. Journal of Cross-Cultural Psychology, 43, 833-857. doi: 10.1177/0022022111416361]

Heads of the Research Group

| Klaus Boehnke | Franziska Deutsch | Ulrich Kühnen |

Describe your research project in three sentences and one picture

We assessed basic values of representative samples from Germany and the UK at the onset of the Corona Pandemic and one year later. Does the Pandemic yield any value change and in what direction? How are these values associated to political attitudes and opinions such as conspiracy theories?

Why do you like doing research?

We are social scientists. Mere intuitions or beliefs about the world are insufficient bases for accepting far reaching implications. As scientist we are self-critical enough to instead rely on empirical evidence. As social scientists we want to make contributions to public discourses about social and political questions. In sum, we care about what is true and what is good.

How can undergraduate or master students contribute?

We are happy to supervise small research projects using the data that we collected. Such projects may for instance develop into a Bachelor's thesis or a Master's thesis. We are open to creative ideas.

How can students join your research?

Just drop us a line.

Head of the Research Group

**Prof. Dr. Klaudia Brix**, Molecular Cell Biology – Biomedicine of Proteolysis

Klaudia Brix took up her current position as Professor of Cell Biology in 2002 and is the SPC (Study Program Chair) of BCCB at Constructor University. Her teaching activities in BCCB and MCCB comprise molecular cell biology, biomedicine, and chemical biology, and she chairs the exchange with the NYU-SURP program. She is convinced that early research involvement of our students is more than (just) a USP of Constructor University.

Klaudia Brix was Chair of the 2012 Gordon Research Conference (GRC) on Proteolytic Enzymes and Their Inhibitors and of the 2018 GRC on Protein Processing, Trafficking, and Secretion. She was Co-Coordinator of the Germany-wide, DFG-funded priority program "Thyroid Trans Act" from 2012 to 2019, and is currently a Member of the Core Group of the EU-COST action ProteoCure.

Describe your research project in three sentences and one picture

Klaudia Brix is an expert in molecular biomedicine and quantitative cell biology. Her group's work specializes on the significance of proteolysis in epithelial organs and is well-connected with the research activities of the life scientists and chemists at the School of Science. Research topics comprise protein trafficking in eukaryotic cells, significance of cysteine cathepsin and kallikrein proteases in health and disease, primary cilia, SARS-CoV-2 Spike protein interactions with host cells, intestine mucosal models, and auto-regulation of thyroid gland functions.
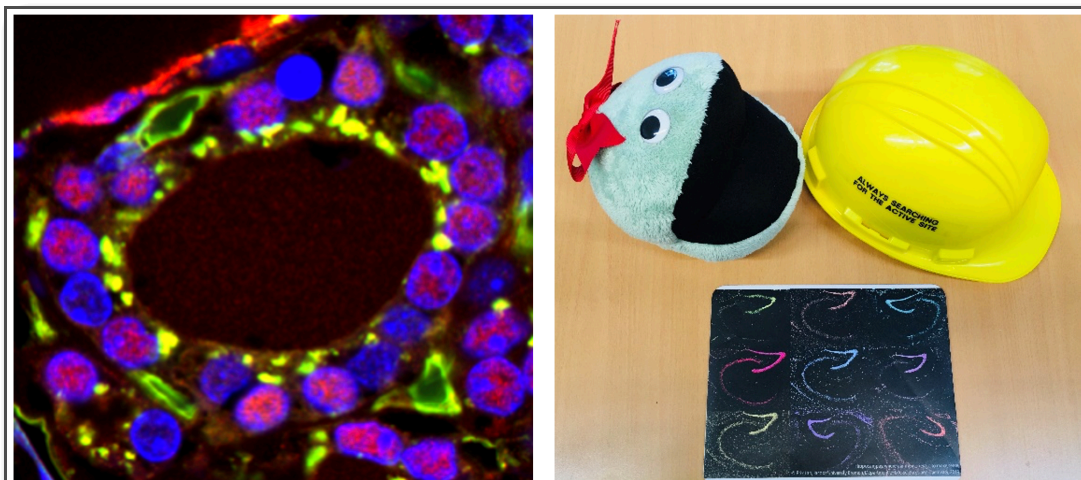
Why do you like doing research?

Experimental research means to learn about new topics and methods every day, which is demanding but also enriching. The complementary of experimental approaches is another important aspect. Understanding how cells and tissues are built and interact with each other to enable healthy body function is central in all research endeavors of our group. Only when the underlying principles are known, we can attempt clarifying what goes mechanistically wrong in the onset and progression of diseases. Doing research in the field of proteolysis means to interact with a very supportive network of experts willing to share.

How can, in particular undergraduate, students contribute?

Undergraduate Students can contribute in on-going research projects during their BSc thesis. Graduate Students would be very welcome in an MSc program in the Molecular Life Sciences.

How can students join your research?

Students can join our research group meetings to learn more about the ongoing research projects.

Give two examples of past student projects

Example 1: Project on the interaction of the Spike protein of SARS-CoV-2 with neuronal cells and the possible impacts on changes of the cytoskeleton, such as occasionally observed clinically for peripheral neurons of COVID-19 patients. Experimental approaches and methods entailed cell culture, immunoblotting and high-end immunofluorescence microscopy to investigate expression and localization of the virus-related proteins and possible receptors, as well as Spike protein-priming proteases, Cell-Profiler based quantitative image analyses of the respective changes in certain cytoskeletal elements, and contribution to presentation of the results to the third-party funding body.

Example 2: Project on the significance of cysteine cathepsin protease activity to maintain primary cilia of thyroid epithelial and carcinoma cells. The significance of primary cilia relates to their role in denoting thyroid health or disease when changed in frequency or length on human thyrocytes in situ. Experimental approaches and methods entailed cell culture, immunoblotting experiments to demonstrate expression and secretion of proteases, and immunostaining of cells with specific cilia markers to monitor changes in frequencies and lengths of the cellular antennas. To enable semi-automated, highly reproducible data analysis, the student performed confocal laser scanning microscopy at near-super resolution, and analyzed hundreds of micrographs quantitatively by Cell-Profiler-based pipelines to allow identification of the delicate cilia structures.

Head of the Research Group

Prof. Dr. Hilke Brockmann, Professor of Sociology

Describe your research project in three sentences and one picture

I am interested in how unequal people integrate in societies, in the dynamics of social change, and in what makes people happy. Feelings of happiness and human life satisfaction are core drivers of people's decisions, actions, and thus social change. My research focuses on inequality and happiness, technological progress and happiness, and demographic change and happiness.
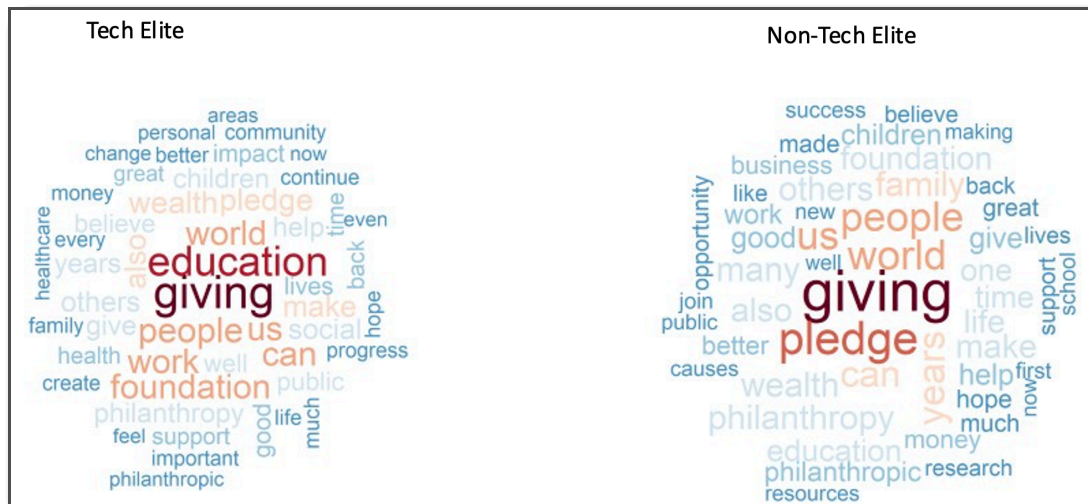
Why do you like doing research?

I share with many other researchers from diverse disciplines as well as with a growing group of politicians and economic advisors that happiness and subjective well-being research can transform our understanding of economic progress, of a good life and a smart society. I am happy that I can contribute to this valuable and important research and to its implementation.

How can, in particular undergraduate, students contribute?

Students can join my projects. They can help with the data, support during events, and by participating in our next summer school on Wealth data science research.

How can students join your research?

Just check out my job postings. Coming soon.

Give two examples of past student projects

Example 1: Internet use and the happiness among elderly in Europe
**Example 2:** Echo chambers among European Parliamentarians

11

Head of the Research Group

Dr. Fatahi Valilai, Omid

- Computer Integrated Manufcaturing & Production systems.

- Digital Transformation for production design & development.

Describe your research project in three sentences and one picture

We are trying to elaborate ideas for transforming production systems and the supply chains using the information technology driven mechanisms. We are eager to demonstrate the interactions in smart manufacturing systems in a globalized and network structure with sustainable ambition. We use the operations research and system analysis and design approaches to model, simulate and optimize the production systems for benefiting from the Industry 4.0 paradigm. We also try to focus on smartness in terms of multi agent system and using Blockchain technology as an enabler.

Our Research schema
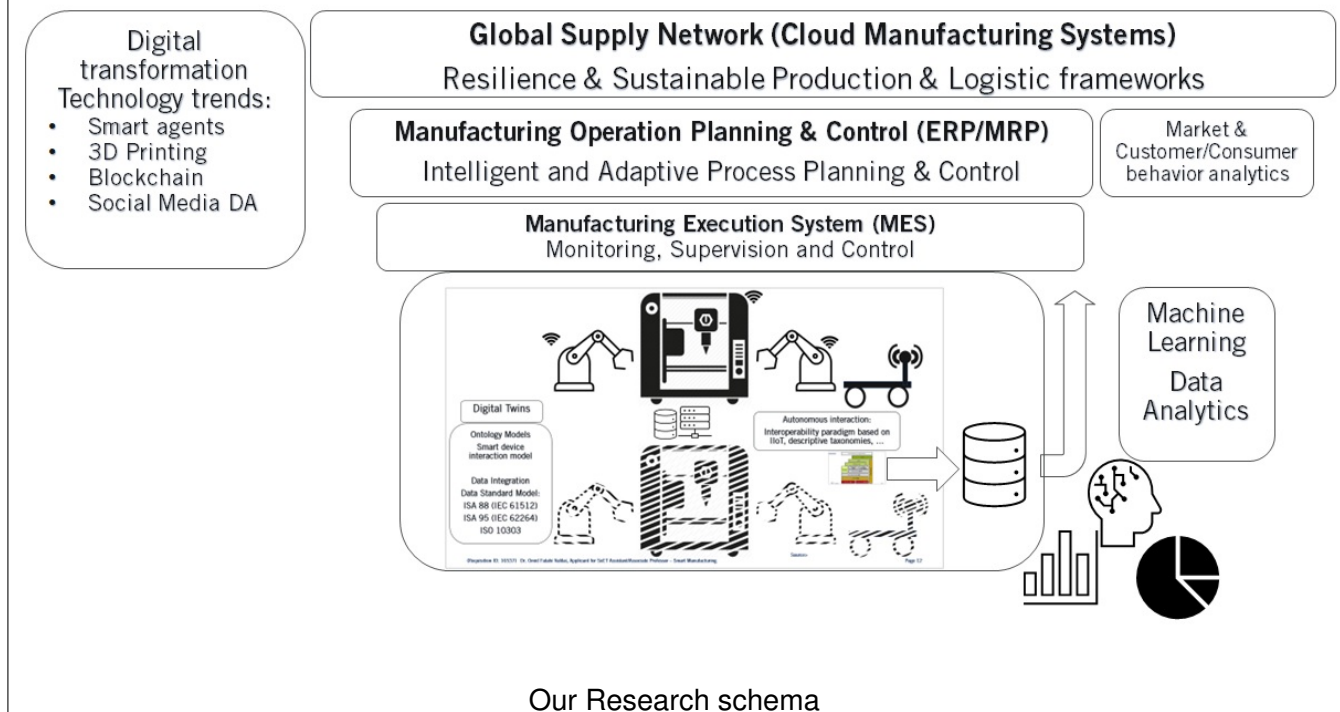
Why do you like doing research?

We like to play a major role in shaping the new models for Production and manufacturing systems and supply chains. We are trying to help the 3 pillars of Sustainability to be realized in modern future generation of production and supply chains. We are eager to shape the definition of smart manufacturing and production system and use emerging technology for digital transformation of conventional production and logistic systems.

How can, in particular undergraduate, students contribute?

We have successful experience of engaging and mentoring undergraduate students or using their course materials in real cases and help them to accomplish the stages of doing a research. so if you are interested to do a research and you don't know how to start, we will happy to have you in our team.

Which research opportunities do you offer to master students?

For Master students, we will be happy to mentor them for a complete research journey. We will help you the proper definition of a research topic within our scope and help you step by step to conduct the literature review and developing a solution and completing the validation and verification. We will help you or the publication and presentation of your research in dominant conference or Journal publications.

How can students join your research?

Please feel free to contact me and my work group colleagues:
Email: OFatahiValilai@Constructor.University
Office: South Hall, Office 209 Tel: 0421 200-3077
Website: https://sites.google.com/view/fatahivalilai-omid/research

Abbildung 1: Scan Me !!

Give two examples of past student projects

Example 1: I am happy to introduce Mr. Sohaib Salman. He collaborated through our research project in 2022 and successfully accomplished a research journey. You can read more here about it: Linkedin Post

Head of the Research Group

Professor Ben Godde, Professor of Neuroscience

From left to right: Prof. Godde, Radwa Khalil (postdoc), Hadis Imani (PhD student), Amir Jahanian Najafabaadi (PhD student)

Describe your research project in three sentences and one picture

Our main interest is in perceptual, motor, and cognitive learning and brain plasticity during the adult lifespan, particularly into old age. We develop and evaluate interventions for maintaining and improving functioning during aging, such as perceptual or motor training or physical and creative activities. Our methods include electroencephalography, neurobiofeedback, and non-invasive brain stimulation. Check my homepage for details: https://constructor.university/benjamin-godde
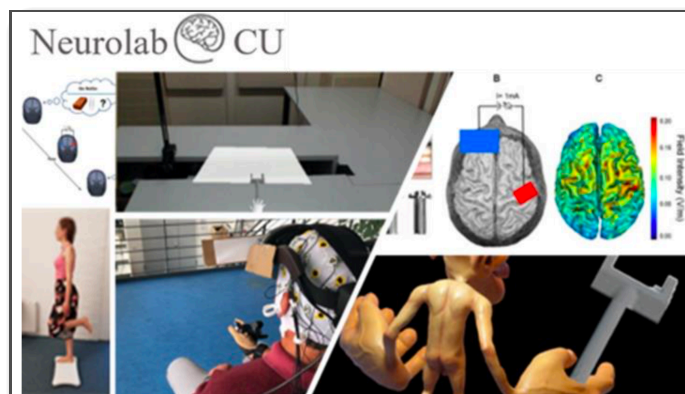
Why do you like doing research?

Neuroscience is an interdisciplinary and very dynamic field where each day I learn something new about our brains you cannot find in any textbook. To be part of this is extremely exciting and the reason why I wanted to become a researcher since childhood.

How can, in particular undergraduate, students contribute?

UG students can contribute by assisting during experiments, doing literature research, communicating to the (German) participants and public, or just doing some pilot experiments. This partly might require some fundamental knowledge in Neuro-science/psychology/biology. 3rd year students are welcome to discuss ideas for thesis projects early in their 5th semester.

Which research opportunities do you offer to master students?

Master students from data science, computer science, robotics or any other related discipline are welcome to contact me for potential study or thesis projects. An example of past thesis projects is the classification of EEG data with ML algorithms.

How can students join your research?

Students can contact me or my work group members any time. A good starting point would be taking my 2nd year courses in Neuroscience. Note: Neuroscience studies and experiments need to be well prepared and specific equipment. Thus, there might be periods without any experiments. Also, a great amount of flexibility is required.

Give two examples of past student projects

Example 1: In a recent student project, two guest students from Wellesley, studied brain oscillations related to creative processes in dancers performing either improvised or structured dance. They used our wireless EEG devices with which we are able to measure brain activity in mobile settings. The students brought their own idea and designed, prepared, and performed the study under my supervision.
Example 2: In a running project, a student examines how tools like golf clubs are integrated into the own body schema. He uses behavioral tests and electroencephalography with the same mobile device to assess changes in perception and peripersonal space induced by long-term experience with the tool and associated alterations in brain activations.

Head of the Research Group

Igors Gorbovickis
Research area – dynamical systems and their relations with complex analysis, ergodic theory and renormalization. I am also interested in some questions from metric geometry.

Describe your research project in three sentences and one picture

Dynamical systems are mathematical models of real life evolutionary processes. The aim of the theory of dynamical systems is to understand the mechanisms behind certain fundamental phenomena that can be shared by various seemingly quite different dynamical systems. Examples of such phenomena may include questions of stability (e.g., Is our solar system stable?) or onset of chaos in completely deterministic systems (e.g., Why can't we always give an accurate weather forecast?).
Dynamical systems often give rise to complicated fractal pictures:
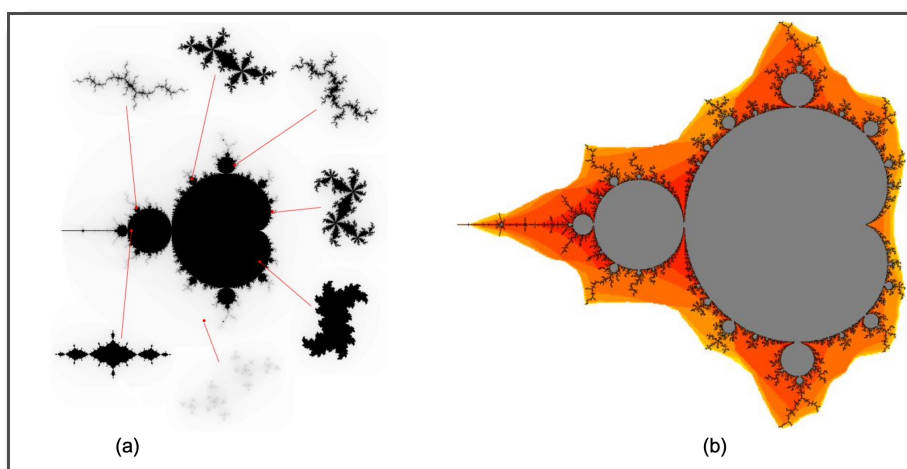
(a) The Mandelbrot set in the center and several Julia sets with different parameters; (b) The Mandelbrot set (in gray) and the accumulation set of the critical points of the multipliers (in color).

Why do you like doing research?

It is thrilling to discover something new and get a better understanding of the world around us!

How can, in particular undergraduate, students contribute?

There are several projects that could involve programming and collecting empirical data from numerical simulations. There are also several purely mathematical projects.

Which research opportunities do you offer to master students?

Some mathematically more involved projects can be offered.

How can students join your research?

I can be reached for example by email.

Head of the Research Group

Dr. Fangning Hu, Belief Propagation Applications

Describe your research project in three sentences and one picture

Belief Propagation is a message-passing algorithm to efficiently perform inference based on graph models, such as Bayesian networks, factor graphs, and Markov random fields. It is commonly used in artificial intelligence and information theory. A successful application is to recover corrupted data over noisy channels in 4G, and 5G communication systems by low-density parity-check (LDPC) codes which apply Belief Propagation to approximate the a-posteriori marginal probability of each information bit on a factor graph.
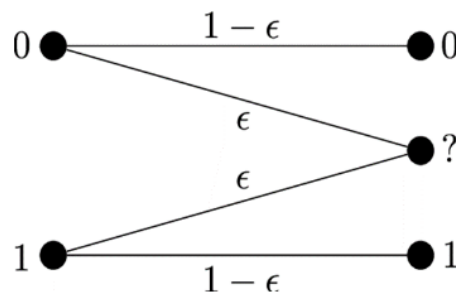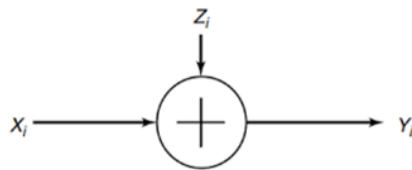
Why do you like doing research?

It is very exciting to contribute to the new technologies that enable people a more comfortable life.

How can, in particular undergraduate, students contribute?

The undergraduate students equipped with sufficient knowledge of statistic inference and programming in Python/Matlab could start the research project on Belief Propagation applications. Knowledge of machine learning will be a plus.

Which research opportunities do you offer to master students?

The master students equipped with sufficient knowledge of statistic inference and programming in Python/Matlab could start the research project on LDPC decoding. Knowledge of channel coding will be a plus.

How can students join your research?

Undergraduate students could do projects in the 5th semester and the graduate students could do projects in the 3rd semester with me and later do the thesis based on the projects.

Give two examples of past student projects

Example 1: Applying the belief propagation on Soduko solver.
Example 2: Applying the belief propagation on LDPC decoding.

Head of the Research Group

Marc-Thorsten Hütt, Professor of Computational Systems Biology

Describe your research project in three sentences and one picture

We study dynamical processes on graphs, mostly by numerical simulation and by analyzing how architectural features of graphs affect the collective dynamics.

We then apply the results of these investigations, either on the level of theoretical understanding or on the practical level of designing data analysis techniques to a diverse set of disciplines: **biology** (graphs are derived from interacting genes and from biochemical reactions), **medicine** (network-level interpretation of clinical 'omics' data), **neuroscience** (structure-function relationships in the brain), **industrial production** (synchronization of material flow in production networks) and many more.
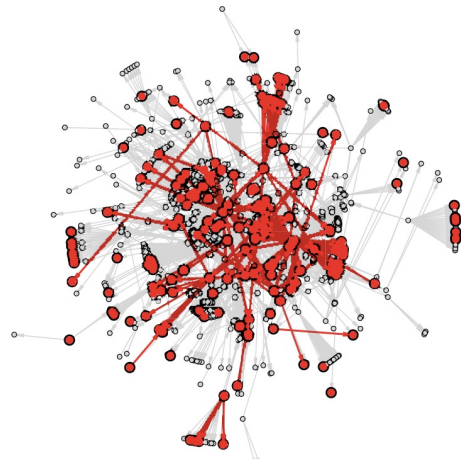
Transcriptome data (representing gene activity) mapped onto a gene regulatory network

Why do you like doing research?

I have always been passionate about self-organized patterns. The basic idea that interactions among elements under specific rules can lead to collective behaviors (synchronization, spiral waves and other wave phenomena, patches and stripes)

The fact that these patterns emerge from local interactions is the core idea of self-organization. And now applying these concepts to dynamical processes on graphs and re-discovering some of these patterns has a certain beauty for me personally.

How can, in particular undergraduate, students contribute?

Over the years I have seen a range of people making the transition from students in my courses to members of my research group. To me this is a reminder, how important it is to consider teaching and research as an entity.

An essential component of my day is to discuss research with the people in my group. I enjoy to establish strong ties between the topics of bachelor and master theses I supervise and the research topics in my group.

In the past I had CS students providing efficient implementations of some of the computational methods we are using, or BCCS students helping me identify suitable data sets and analyze them. Over the last three years the majority of students working with me came from the Data Engineering master program.

I have also supervised bachelor theses in IEM. The topics there are mostly related to network representations of production and distribution data, as well as compiling, cleaning and processing company data in several collaborative projects with industry partners.

Which research opportunities do you offer to master students?

Students in the master programs at Constructor University are particularly well equipped to participate in interdisciplinary research projects. In my group, students from Data Engineering and Data Science for Society and Business are welcome to be part of the collaborative projects, where we analyze biological, chemical, and medical data.

How can students join your research?

From my perspective, a perfect research topic is about the match between the supervisor and the student. And the majority of topics of student projects in the past came up during the discussion with the student – with me describing my current research interests and the student highlighting their methodological strengths and topical passions.

Give two examples of past student projects

Example 1: Harshal Deepak Bendale (Data Engineering, class of 2021) programmed the Cohortizer web application as part of his SA job: sysbio.jacobs-university.de/software/

Example 2: Jackson Whiteley (CS, class of 2022) has programmed the network coherence calculator cytoscape app as part of his bachelor thesis: apps.cytoscape.org/apps/networkcoherencecalculator

Head of the Research Group

Stephan Juricke Climate and ocean physics and modelling

Describe your research project in three sentences and one picture

To be able to understand and predict anthropogenic climate change and its consequences, we need to use sophisticated climate models that describe the evolution of the climate system through time. We develop and improve these climate models in collaboration with the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven with a specific focus on ocean and sea ice components by improving the numerical methods and the representation of physical processes. We then use these ocean and climate models (Fig. 1) to gain insight into the workings of the climate system and the interplay of the various processes involved.
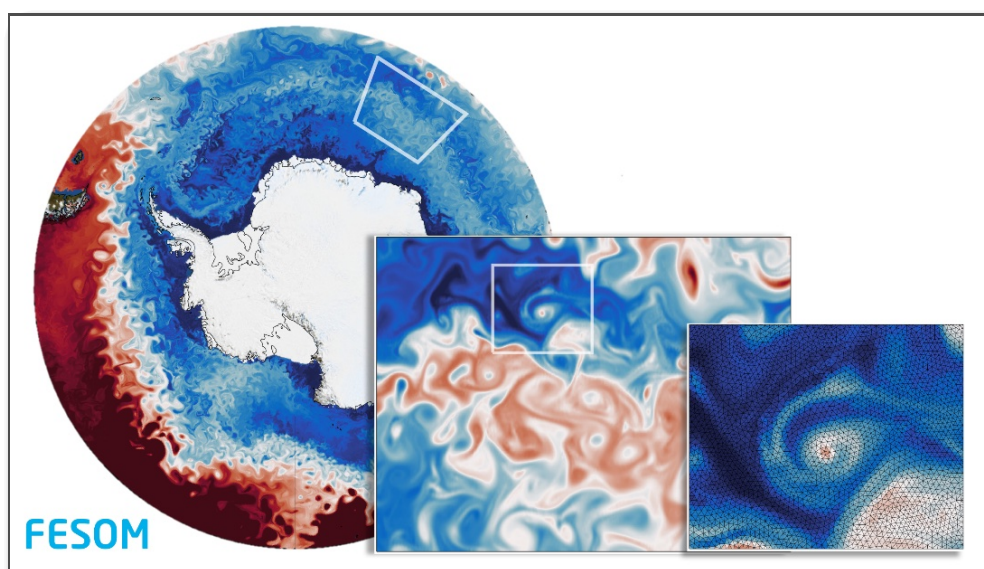

Figure 1 *Southern Ocean temperature at 100m as simulated by the ocean model FESOM with 4.5 km model resolution. From fesom.de*

Why do you like doing research?

Research helps us to better understand the environment that we live in and gives us the tools to protect it, for the sake of the planet, humanity, and all other living beings alike. It is tremendously diverse, fascinating, and necessitates complex thinking as well as creativity.

How can, in particular undergraduate, students contribute?

We have a large amount of data that is produced by climate models and observations, and basically not enough people to look at all this to discover new process interactions and advance our understanding. We also need help to develop and code new diagnostic tools for our simulations, as well as numerical and physical improvements of our models. Finally, distributing the information that we generate to the public in easily accessible ways is another challenge for which we need support.

How can students join your research?

Just approach me. Depending on your interests and skills, we can discuss and develop ideas for how to contribute. There is also the opportunity to support one of my PhD students in their work.

Give two examples of past student projects

Example 1: Development and implementation (in python) of new diagnostic tools that can be used to investigate how kinetic energy (energy due to an objects motion) in the ocean is transferred between different spatial scales and ultimately converted into other forms of energy (e.g. heat).

Head of the Research Group

Prof. Dr. Stefan Kettemann, Complex Systems

Describe your research project in three sentences and one picture

My current projects are on quantum phase transitions and the quantum dynamics in disordered quantum systems with long range interactions such as doped semiconductors, on new physics at the crossover between BCS-Superconductivity and Bose- Einstein condensates in thin films, and on modeling and forecasting power grid dynamics and energy markets.
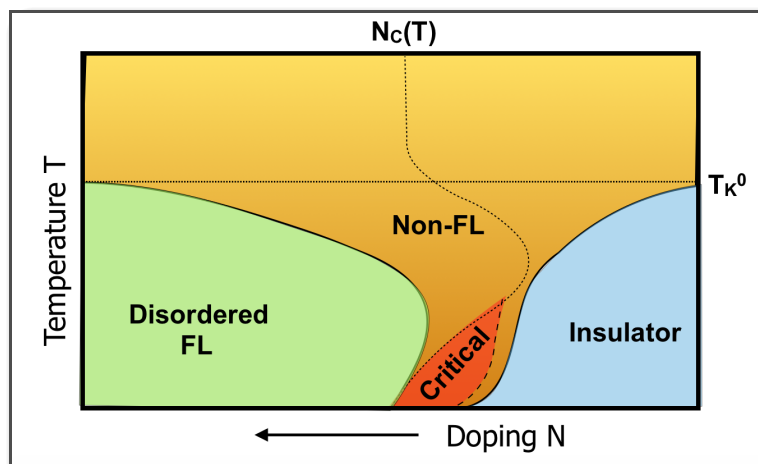
Why do you like doing research?

When you reach out and pursue your ideas you will always discover new things. It is necessary and fun to learn from others, but it is even better to discover something for the first time yourself.

How can, in particular undergraduate, students contribute?

I like that most undergraduate students are open for new ideas, so I give them often problems for which I did not yet secure research funding and this results sometimes in unforeseen new projects.

How can students join your research?

Send me an email skettemann@constructor.university

Give two examples of past student projects

Example 1: Superconducting p-n Junctions with bachelor of physics student Avinash Niroula, published as A. Niroula, G. Rai, S. Haas, S. Kettemann, Spatial BCS-BEC Crossover in Superconducting pn-Junctions, Phys. Rev. B 101, 094514 (2020). Lead to collaboration with experimental group at Tsinghua Univ., China. first results are submitted to Nature Communications (2022).
Example 2: Solution of the Schrödinger equation on the Cayley tree with bachelor of physics student Deepak Aryal, published as D. Aryal, S. Kettemann, Complete Solution of the Tight Binding Model on a Cayley Tree: strongly localised versus extended states, J. Phys. Commun. 4, 105010 (2020)

Head of the Research Group

Prof. Ulrich Kleinekathöfer, Professor of Theoretical Physics

Prof. Kleinekathöfer with members of the "Computational Physics and Biophysics Group".

Describe your research project in three sentences and one picture

The "Computational Physics and Biophysics Group" performs theoretical calculations and computer simulations including method development on various systems. From the physics side, we are mainly interested in (dissipative) quantum dynamics and applications of statistical physics which are applied to excitation energy and electron transfer in biological systems such as light-harvesting complexes and to biological nanopores. Our group coordinates the European Doctoral Network PhotoCaM "Photosynthetic Antennas in a Computational Microscope" and is part of the Priority Program "Utilization and Development of Machine Learning for Molecular Applications – Molecular Machine Learning".

For more details, please see https://constructor.university/comp_phys.

Why do you like doing research?

Research is fun (but also hard work)! Solving "puzzles" in research can be quite rewarding. At the same time, I do enjoy the friendly collaborations with colleagues from all over the world.

How can students join your research?

Undergraduate students can join the lab starting with their BSc project. Master students interested in data analysis and programming might also find an interesting project in the group.

Give two examples of past student projects

Examples of publications together with BSc students:

Example 1: J. D. Prajapati, C. Mele, M. A. Aksoyoglu, M. Winterhalter and U. Kleinekathöfer, Computational Modeling of Ion Transport in Bulk and through a Nanopore Using the Drude Polarizable Force Field, J. Chem. Inf. Model. 60, 3188–3203 (2020).

Example 2: M. I. Mallus, Y. Shakya, J. D. Prajapati and U. Kleinekathöfer, Environmental Effects on the Dynamics in the Light-Harvesting Complexes LH2 and LH3 Based on Molecular Simulations, Chem. Phys. 515, 141–151 (2018).

Head of the Research Group

Prof. Dr. Ulrich Kortz
http://ukortz.user.jacobs-university.de/
Synthetic inorganic chemistry, metal-oxo clusters, structural chemistry (XRD, NMR), catalysis, biomedicine, materials science

Describe your research project in three sentences and one picture

http://ukortz.user.jacobs-university.de/research/
The research activities of the Kortz group at Jacobs University Bremen are mainly focused on the discovery of novel functional materials using a multitude of state-of-the art solution and solid-state analytical techniques (e.g. NMR, XRD, IR, UV-vis, AA, TGA-DSC). The catalytic, magnetic, biomedical, and electrochemical properties of the novel compounds are also investigated. The Kortz group also has several industrially sponsored research projects in the areas of catalysis, energy, and environmental applications.
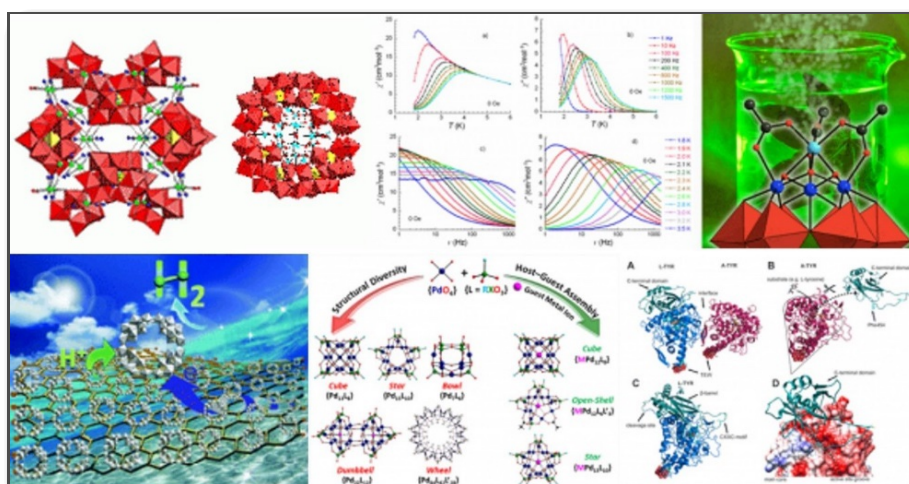
Why do you like doing research?

I like discovering novel compounds with novel structure, composition and properties. Only chemists can prepare novel materials and study them afterwards. We work on fundamental as well as real world industrial projects. To date our research has resulted in 327 publications (36 with undergraduate coauthors) and 15 patents.

How can, in particular undergraduate, students contribute?

Undergrads can join my research group as early as in their 1st year of study. They can support the research projects of PhD students or postdoctoral researchers and eventually even work independently after initial training. Since 2002 the contribution of undergrads has resulted in 36 publications with undergraduate students as coauthors. http://ukortz.user.jacobs-university.de/publications/publications-with-jacobs-bsc-student-coauthors/

How can students join your research?

Send an email to ukortz@constructor.university or talk to me after class to make an appointment.

Give two examples of past student projects

http://ukortz.user.jacobs-university.de/publications/publications-with-jacobs-bsc-student-coauthors/

Heads of the Research Group

**Research Training Group (RTG) "Social Dynamics of the Self"**

The RTG is funded by the German Research Foundation (DFG). It is part of the Bremen International Graduate School of Social Sciences (BIGSSS) and composed of nine Faculty members and thirteen Doctoral Researchers from Constructor University and the University of Bremen.

Doctoral Researchers: Pay Laurin Jessen, Carina Hartz, Gamze Ipek, Tanya Keni and Dariya Koleva (all first cohort); Aya Alwais, Rida Bano, Mastewal Bitew, Alice Cementi, Kabir Gosh, Borbala Greskovics, Sophia Landzettel, Katharina Schiffer (all second cohort). Faculty from Constructor University: **Ulrich Kühnen** (speaker), Klaus Boehnke, Franziska Deutsch, Sonia Lippke and Jan Lorenz

Describe your research project in three sentences and one picture

In an ongoing cycle of mutual constitution, culture and the self make each other up and therefore need to be studied in concert. Individuals are socio-culturally shaped shapers of their socio-cultural environment:
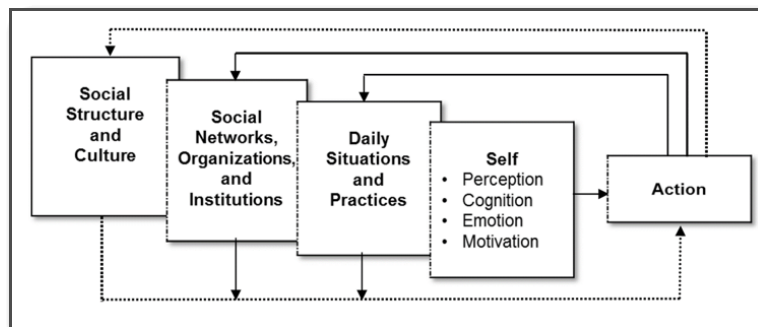
There are two fundamental ways of defining the self: Either by unique and **independent** features (such as traits, abilities, attitudes) or by social and **interdependent** ones (e.g. social roles, relationships). In the context of our RTG early-career Doctoral Researchers from various social science disciplines study the self's social embeddedness to better understand human thinking, feeling, and action. Topics range from social morality over life goals and well-being, to honor cultures, resistance and solidarity in online communities, to social cohesion.

Why do you like doing research?

We are convinced that every scientific discipline has its blind spots. To overcome this, our research program is characterized by interdisciplinarity, combining research perspectives particularly from psychology, sociology and political science. That way we come closer to understanding individual as well as societal phenomena.

How can, in particular undergraduate, students contribute?

There are possibilities to get involved in the research projects of our Doctoral Researchers, including developing ideas for a Bachelor's thesis. In addition, we sometimes hire SAs to support us in doing our research.

Which research opportunities do you offer to master students?

There are possibilities to get involved in the research projects of our Doctoral Researchers, including developing ideas for a Master's thesis. In addition, we sometimes hire SAs to support us in doing our research.

How can students join your research?

Feel free to approach one of the RTG Doctoral Researchers or Faculty!

Head of the Research Group

Jan Lorenz

Assistant Professor in Social Data Science, Research in Computational Social Science with a focus on agent-based models and complex socio-economic systems

Describe your research project in three sentences and one picture

I want to model and explain **dynamics of opinion formation** and how it leads to phenomena like polarization, consensus, or plurality and consequently influences democratic collective decision making through deliberative interaction. This is interdisciplinary touching, for example, **social psychology, game theory**, and the dynamics of **complex systems** because opinion formation is a partly emotional processes with elements of strategic behavior unfolding in societies with interacting individuals which can trigger systemic effects going beyond the scope of individuals. Practically, I am interested in the design of democratic institutions, the aggregation of the wisdom of the crowd, and mapping political spaces.
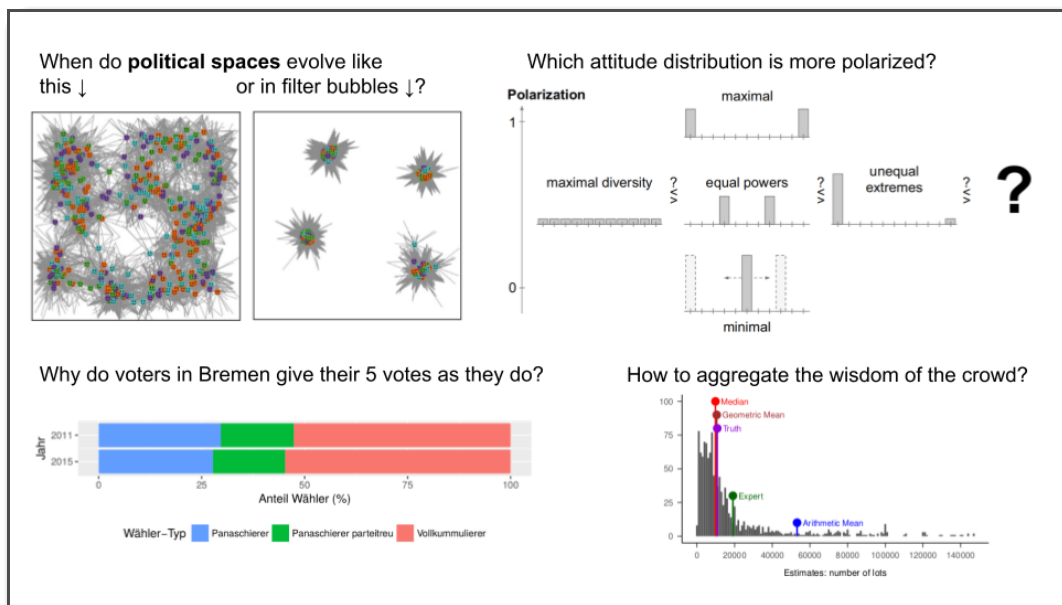
Why do you like doing research?

I like to look at social data in an unconventional way. I like to develop measures and visualizations for things like political polarization, information bubbles, spatial segregation, inequality and growth. I like to study social mechanisms with computer simulation and then match them to the real world.

How can, in particular undergraduate, students contribute?

I am looking forward to guide student project where students aim at finding their own new insights. Besides that I may sometimes have a student job which involves programming R packages, producing data dashboards, or systematically analyzing agent-based models with simulation.

## How can students join your research?

jlorenz@constructor.university or contact Jan Lorenz on Teams

Head of the Research Group

Keivan Mallahi-Karai, Mathematics: group theory, probability theory and application

Describe your research project in three sentences and one picture

Over the past few years, in a collaborative and interdisciplinary work with Adele Diederich, we have introduced and studied two dynamic models, the Cube models and the Disk model, developed for describing the processes that underly of human decision-making. These models use a stochastic framework to shed light on how we navigate choices when confronted with a multitude of alternatives. The mathematical tools employed encompass the theory of random walks, Brownian motions, and stochastic calculus.

The Cube model in 2D   The Disk model
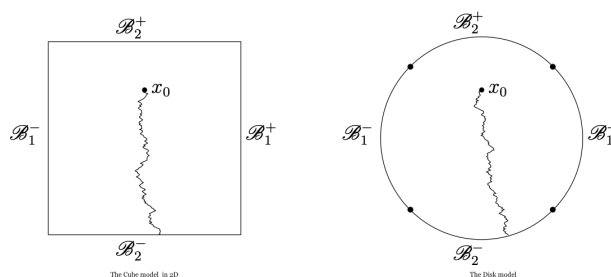
Why do you like doing research?

Generally, getting to the bottom of things in exciting in both pure and applied math. But, one of the challenges specific to doing research in applied areas is that of building simple models that can explain and account for the complexity we observe in the real world. As a pure mathematician, collaborating outside my own field has also been a fascinating learning experience for me.

How can, in particular undergraduate, students contribute?

At least two qays:

(a) helping with simulations of stochastic processes. This mostly requires coding skills.

(b) helping with mathematical aspects: mathematical analysis of developed models. This requires more advanced mathematical skills.

Which research opportunities do you offer to master students?

Master students can become collaborators in research projects conducted in our research group.

How can students join your research?

Email me, and we can talk.

Give two examples of past student projects

Dania Sana: Simulation of mathematical models of decision making, 2021-2022.

Head of the Research Group

Prof. Dr. Arnulf Materny, Professor or Chemical Physics

Describe your research project in three sentences and one picture

We are using laser spectroscopy in order to investigate material properties on a molecular level. In our "Raman laboratory", we detect vibrational spectra, which can be considered to be fingerprints of molecules, and use them to e.g. characterize biofilms on microplastics particles. In our femtosecond laboratory, we are using ultrashort laser pulses in order to study elementary dynamics, e.g. occurring in organic semiconductors.

Why do you like doing research?

Already more than 40 years ago, I was working on a project in school ("termpaper"), which involved lasers. Since that time, I have been fascinated by optics and later, during my studies, by quantum mechanics. The combination of the two fields directly lead me to laser spectroscopy where many fascinating things can be learnt about various molecular systems.

How can, in particular undergraduate, students contribute?

In general, projects in laser labs always require constant supervision due to laser safety regulations. Therefore, projects will always have to join existing projects. In these projects they can be involved in experiments and the data evolution.

Which research opportunities do you offer to master students?

Master students of a physics graduate program may be offered research topics in ongoing projects.

How can students join your research?

Students should get into contact with me. Depending on running Ph.D. or postdoc projects, the possibility of a participation can be discussed.

Give two examples of past student projects

Example 1: Investigation of coated plastic foils using Raman spectroscopy in cooperation with a company in Bremen.
Example 2: Participation in experiments using time-resolved nonlinear Raman spectroscopy for the investigation of dynamics in ionic liquid samples.

Heads of the Research Group

Dr. habil. Armin Müller, Principal Investigator in Collaborative Research Center 1342 "Global Dynamics of Social Policy" of the German Research Foundation. Focus of research: political economy, social policy and education in China from a comparative perspective

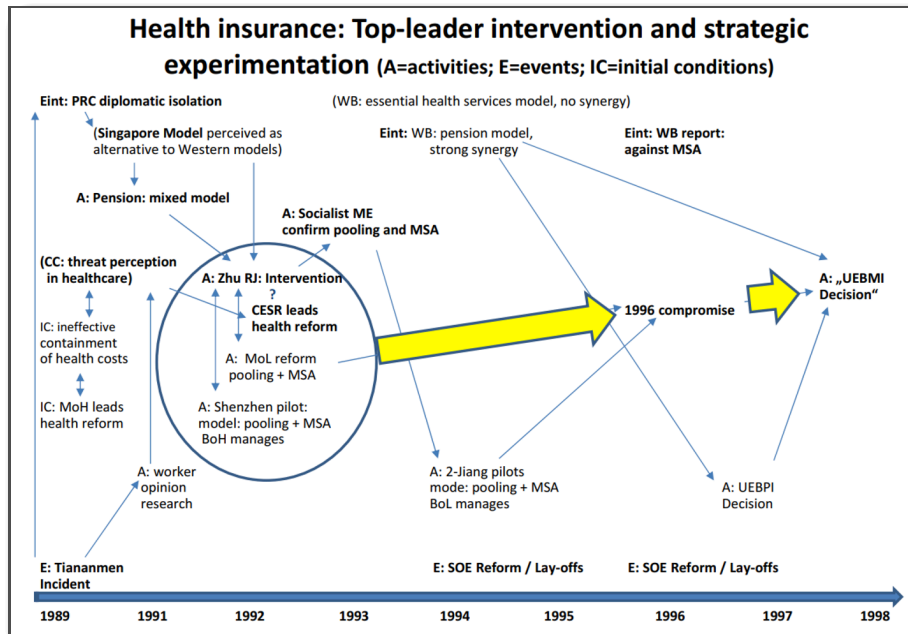Tobias ten Brink, Professor of Chinese Economy and Society, with a focus on International and Comparative Political Economy, and Principal Investigator in Collaborative Research Center 1342 "Global Dynamics of Social Policy" of the German Research Foundation.

Describe your research project in three sentences and one picture

The first stage of the CRC project analyzed the complex causal chains leading to the introduction of social insurance programs in urban China during the transition away from the planned economy. A core issue was the interplay between national socio-economic development trends, such as the reform of state-owned enterprises, and the influence of international organizations. The second phase (2022-2025) analyzes the development of coverage rates and benefit levels of Chinese social insurance.

Health insurance: Top-leader intervention and strategic experimentation (A=activities; E=events; IC=initial conditions)

Why do you like doing research?

Reality is like an onion.
It's fun to discover it layer by layer.

How can, in particular undergraduate, students contribute?

Students can contribute to data collection and literature search. Chinese language skills are required most of the time.
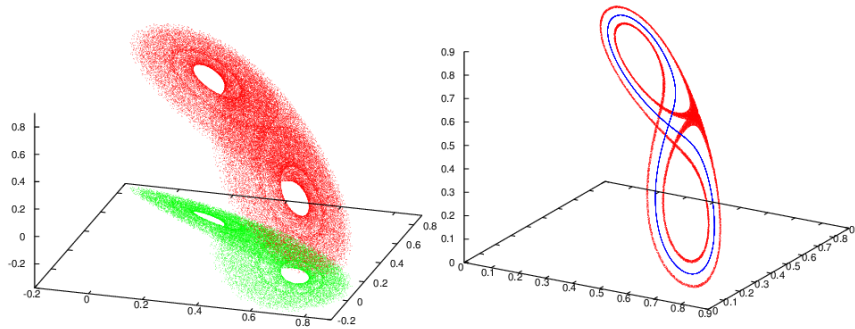
How can students join your research?

We regularly publish job announcements at CU, and students may learn about research projects in the classroom.

Head of the Research Group

Dr. Ivan Ovsyannikov, Mathematics. Research area: Dynamical systems, bifurcations, chaos

Describe your research project in three sentences and one picture

A discrete Lorenz attractor

In real Physical, Biological, Chemical, Financial and other systems catastrophes may occur. Mathematically, such phenomena are called Bifurcations. The main goal of my research is to study bifurcations, in order to describe their character, what one can expect from them and how dangerous they can be.

Why do you like doing research?

The most exciting thing about Dynamical Systems is that you study mathematical problems with theoretical methods, but the results can be applied in various fields of science and technology. In particular, help to prevent catastrophes.

How can, in particular undergraduate, students contribute?

Based on the interests of the student, we can decide a project that combines theoretical and computer-related topics

Which research opportunities do you offer to master students?

Master students are welcome to work on theoretical or applied projects

How can students join your research?

Just approach me and we will set up a meeting

Give two examples of past student projects

Example 1: A proof of the existence of a chaotic attractor in the Lorenz model (the 14th Smale problem)
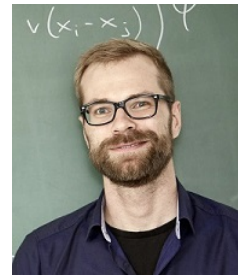**Example 2:** A description of the dynamics of an unbalanced ball on a plane with an arbitrary friction

Head of the Research Group

Sören Petrat

Mathematical Physics, in particular

- many-body quantum mechanics,
- Bose–Einstein condensates,
- Fermi gases.

Describe your research project in three sentences and one picture

One of my recent research projects is about a mathematical description of a Bose gas at very low temperature. Such gases can exhibit a new state of matter called Bose–Einstein condensation, where all particles behave macroscopically in a quantum mechanical way; see the picture on the right. In my research project we managed to systematically describe this matter on all scales for a mean-field model: the condensate scale which describes most of the particles, the Bogoliubov scale which describes free quasi-particles (or sound waves), and systematically all smaller scales which describe the interaction between the quasi-particles.
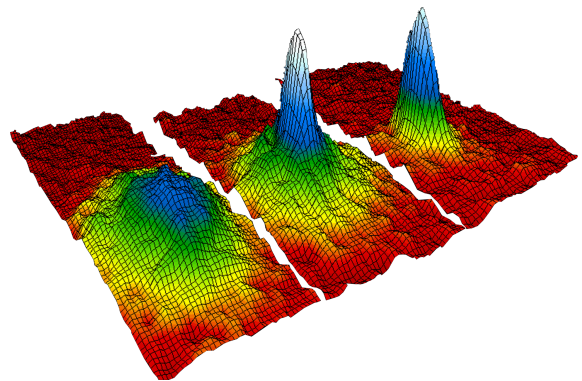
Why do you like doing research?

I was always interested into the fundamental physical laws that govern our world. I hope to come closer to their understanding with my research.

How can, in particular undergraduate, students contribute?

Several of my research projects are accessible to undergraduate students. They involve theoretical understanding, proofs, and computations. I currently have several math and physics students involved in research projects. Outside of my field I am regularly offering research projects on finance (from a math and statistics point of view), and optimization (Operations Research), occasionally also on applications of Machine Learning.

Which research opportunities do you offer to master students?

In Data Engineering I offer projects about the stock market and mathematical finance.

How can students join your research?

You can just approach me directly after class, in my office, or via email.

Give two examples of past student projects

Example 1: *Perturbation theory on the Canonical Coherent States.* In this math Bachelor thesis project we applied a complicated perturbation theory to a simpler example and computed explicitly corrections to the behavior of a harmonic oscillator.

Example 2: *A Study of Correlation: Dow Jones Industrial Average Index and its Individual Stocks.* In this Data Engineering project we were looking for changes in stock market correlations over time, and in particular their relations to ETFs.

Head of the Research Group

Petr Popov, Applied Mathematics

Describe your research project in three sentences and one picture

Our goal is to unlock the full potential of artificial intelligence and machine learning for advanced molecular design.

Our research stands on three pillars :

- Machine learning
  We use both classical machine learning approaches (e.g. convex optimization) and deep learning approaches to derive powerful models for molecular design or molecular property prediction.

- Molecular Modelling
  We use the structural bioinformatics and cheminformatics tools, e.g. molecular docking and molecular dynamics, to study molecular complexes on the atomic level.

- High Performance Computing
  We use HPC servers to perform large-scale molecular modelling, machine learning, and inferencing the derived models.

Why do you like doing research?

Because it is a puzzle, which solution can be useful for all of us.

How can, in particular undergraduate, students contribute?

We have cutting-edge research projects, where there is always a room for a student to contribute.

Which research opportunities do you offer to master students?

MSc projects in the fields of molecular modelling, cheminformatics, structural bioinformatics, and machine learning applied to those fields.

How can students join your research?

Write an email to ppopov [at] constructor.university describing your interests/motivation and attaching a CV.

Give two examples of past student projects

Example 1: https://pubs.rsc.org/en/content/articlehtml/2022/dd/d2dd00021k
Example 2: https://academic.oup.com/nargab/article/3/4/lqab111/6441762

Head of the Research Group

Prof. Gerd-Volker Röschenthaler, Basic and Applied Fluorine and Phosphorus Chemistry

Dr. Romana Pajkert   Dr. Volodymyr Kozel   Dr. Sergey Tverdomed   Ita Hajdin, M.Sc.   Prof. Gerd-Volker Röschenthaler

Describe your research project in three sentences and one picture

Syntheses and Studies of Fluorine- and Phosphorus-containing Compounds for application in Material Science and Medicinal Chemistry
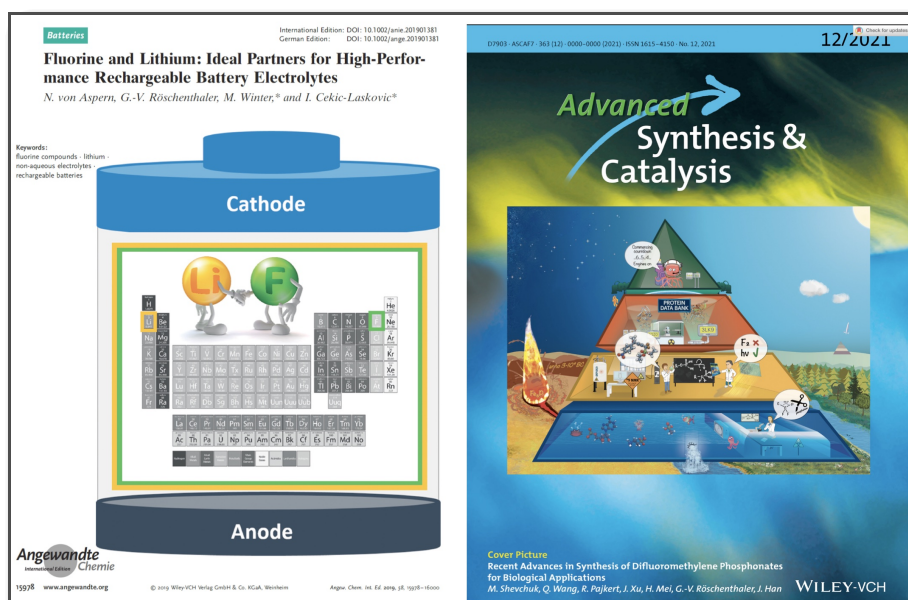
Why do you like doing research?

Research for me is very exciting because of designing and investigating new compounds, study their properties and looking for possible application different areas. These goals can only be achieved with a dedicated team and in the framework of international cooperation.

How can, in particular undergraduate, students contribute?

Since our synthetic chemistry procedures need special precautions, undergraduate students will be carefully introduced into this field of fluorine and phosphorus chemistry, With this guidance they can then contribute remarkably and will have scientific success.

How can students join your research?

Just call me and make an appointment.

Give two examples of past student projects

Example 1: Synthesis of difluoromethyl phosphonate-containing 1,2,3-triazoles through 'click' chemistry
Example 2: [3,3]-Sigmatropic rearrangements of partially fluorinated allylic phosphoesters.

Head of the Research Group

Andreas Seebeck

PostDoc: Hayat Khan
PhD: Lukas Schmidt
SAs: Paula Castillo, Oscar Kirkwood, Maria Ort-
mann, Stasa Vasilic, 1 vacant position

Join Our Research Group!

Describe your research project in three sentences and one picture

Our research focus lies on empirical financial accounting and capital market research. The primary research areas are:

- Sustainability and diversity in finance, accounting, and tax (e.g., integrated reporting, GRI, board gender diversity)

- Disclosure and audit regulation (e.g., extended audit reports, corporate risk disclosure),

- Data and text mining in accounting, finance, and tax (e.g., machine learning, NLP, Artificial Intelligence)

Exciting research cooperations exist with FAU Nuremberg, HSG St. Gallen, RUB Bochum, etc.
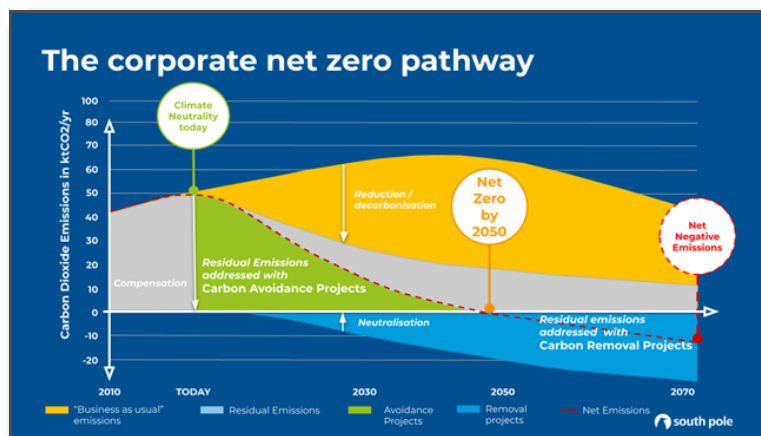
Why do you like doing research?

It allows us to make a difference in the world in the following ways: (1) Mentor researchers' thinking who then change the world through consulting, professional service, teaching. (2) Affect practice, usually high-level decision makers. (3) Affect standard setters.
The accelerating threat of climate change raises the urgency of commitment to climate transition, including the important role of global financial markets to align investment with net zero. Our research findings can contribute to this important transition.

How can, in particular undergraduate, students contribute?

Being interested in sustainable finance/accounting/tax topics and motivated to learn and contribute to our diverse research group. Our research group and the topics we are working on are diverse and so are the ways YOU can contribute. If you are interested, please reach out to us, tell us about your interests and we will figure out ways in which you can best contribute.

Which research opportunities do you offer to master students?

Master students can support in one of the various exciting research projects at the intersection of finance, accounting, and data science, including:

1. Using textual analysis on a combination of financial reports and news articles to better predict firms that might face financial distress or bankruptcy in the near future.

2. Applying NLP to predict stock price movements based on the tone and content of financial news articles or analyst reports.

3. Evaluating financial statements or other corporate disclosures to detect potential fraud or earnings manipulation.

4. Creating an NLP model that can read and understand financial reports, producing an automated score or grade based on various financial health metrics.

5. Analyzing whether more readable financial statements (i.e., clearer, simpler language) lead to better investor understanding and potentially better market reactions.

6. Investigating whether the communication style of CEOs or CFOs during interviews, press releases, or investor meetings has a consistent effect on stock prices.

How can students join your research?

You can join our team by becoming a student assistant (currently 1 vacant position), writing your Bachelor theses at the chair, or by individual agreement.

Give two examples of past student projects

In all of our research projects, students play an important role. They contribute to data gathering and processing, literature reviews, Python coding, discussions, and act as sparring partners.
Two of the most recent published studies are:
Seebeck, A., Kaya, D. (2022) The Power of Words: An Empirical Analysis of the Communicative Value of Extended Auditor Reports, European Accounting Review, Forthcoming. (https://papers.ssrn.com/sol3/papers.cfm).
Seebeck, A., Vetter, J. (2022) Not Just a Gender Numbers Game - How Board Gender Diversity Affects Corporate Risk Disclosure, Journal of Business Ethics, 177(2), S. 395-420. (https://link.springer.com/article/10.1007/s10551-020-04690-3).

Head of the Research Group

Jürgen Schönwälder, Professor of Computer Science
Computer Networks and Distributed Systems

Describe your research project in three sentences and one picture

I am interested in all topics related to the systems aspects of computing machines with a specific focus on computer networking and computer security. When the Internet was invented, many people had some idealistic ideas that unrestricted access to information for everybody and low-cost communication would contribute to a better world. Meanwhile, we know that the Internet is used for many activities that do not drive us to a better world, and I am interested to find ways to harden computing systems and their system software against attacks and vulnerabilities originating from buggy system software.

To contribute to my research activities, students have to pursue a passion to understand how program execution works at the system level and all the way down to the hardware level. Some of our research is empirical, e.g., when we conduct measurement campaigns on the deployed Internet to gain insights how technology is deployed and used.
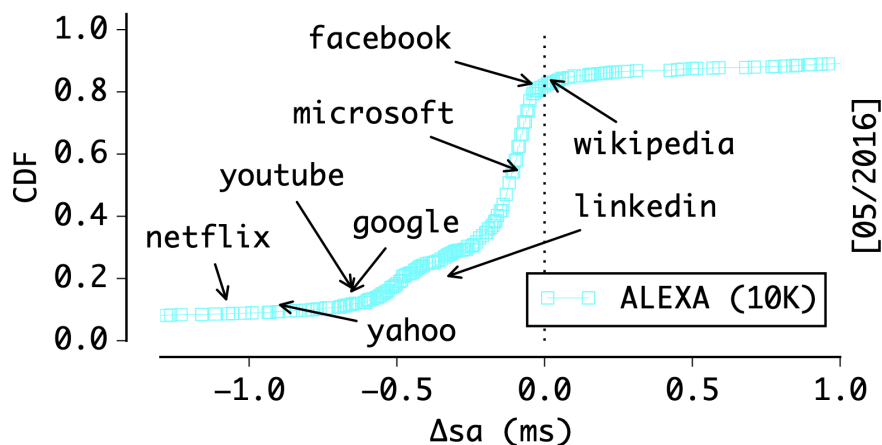
The figure shows a plot from a paper discussing the latency differences of the two Internet protocols IPv4 and IPv6 in 2016.

Why do you like doing research?

I enjoy learning new things and research is the ultimate way to learn new things. I have a deep passion for computers, and I enjoy developing technologies that are of practical relevance. The Internet had fascinated me long before it became a commodity and I ended up contributing to the development of Internet standards. I am in addition a big fan of open source projects, I am utilizing Linux systems since the first public kernel appeared in 1991. Over the numerous years I have worked on computer technology, I got increasingly interested in computer security at the device, network, and system level.

How can, in particular undergraduate, students contribute?

The best way to start is to learn the necessary foundations by taking relevant courses and operating systems, computer networks, and computer security. If you hit topics that inspire you to go deeper, talk to me. Conceivably our conversation develops into an idea for a thesis project, which is in many cases the most significant format of research collaboration.

Which research opportunities do you offer to master students?

I supervise thesis projects in the computer science and software engineering program, more specifically in the cybersecurity track. I am also available for research projects for students who want to go deep and use their time as a master student to work towards publishable results. About 80% of master students I have worked with contributed as co-authors to publications in the past.

How can students join your research?

Simply contact me by email or during open office hours, or approach me when I walk around on campus. Finding a research topic is an iterative interactive process where ideas are born and revised and eventually discussions turn into concrete topics.

Since my research is system specific, we regularly build prototype systems to evaluate novel approaches. Occasionally we design larger measurement experiments. Excellent programming skills at the system level are needed in addition to creativity and a keen interest to dig deep and overcome technical challenges.

Give two examples of past student projects

Example 1:
Shikhar Bhushan worked on a Python API for the NETCONF protocol in 2009. He released his source code and it has then evolved into the main Python API for accessing network devices via NETCONF. The software is meanwhile used by big networking companies like Cisco Systems. We also published a workshop paper on the design of the API.

Example 2:
Vladislav Perelman did both his bachelor thesis and his master thesis project in our research group, which resulted in three publications, one of them in the well cited IEEE Communications Magazine. He investigated how protocols used to manage devices such as routers and switches can be adopted to devices on the Internet of Things with severe resource constraints.

Head of the Research Group

Sebastian Springer, Professor of Biochemistry and Cell Biology

Describe your research project in three sentences and one picture

We're biologists, more precisely molecular immunologists. We work on the molecular mechanisms that underlie the immune response against viruses and tumors. In fact, we've worked for 20 years on the same mechanism, which is central for the immune system. As you can see in the picture, on the left, when a virus infects a cell, some virus particles can be broken up into small particles called peptides. These peptides (the little pentagons) are then loaded onto so-called **MHC class I proteins**, which then travel with them to the surface of the cell. There, specialized cells of the immune system, so-called cytotoxic (or: killer) T cells, can recognize the virus peptides, and then they can kill the infected cell. That sounds cruel but it prevents the spreading of the virus, and it happens many times every second in your body. A similar mechanism is in place to detect tumor cells (or cells that might become tumor cells later). We investigate pretty much everything that has to do with these proteins: their synthesis, folding, peptide binding in cells, trafficking to the surface (and back into the cell at the end of their lives). We do this to learn about the immune system, but also to make general conclusions about how cells, and proteins, work. We are **basic scientists**, so the application is in the background, but sometimes our discoveries turn out to be useful, and we have even set up a company once. From time to time, we also have side projects in slightly more crazy areas, depending on what else we would like to explore. The methods we use are from cell biology (mammalian cell culture and analysis), biochemistry (protein purification and analysis), and biophysics (protein analysis and protein-ligand interaction).
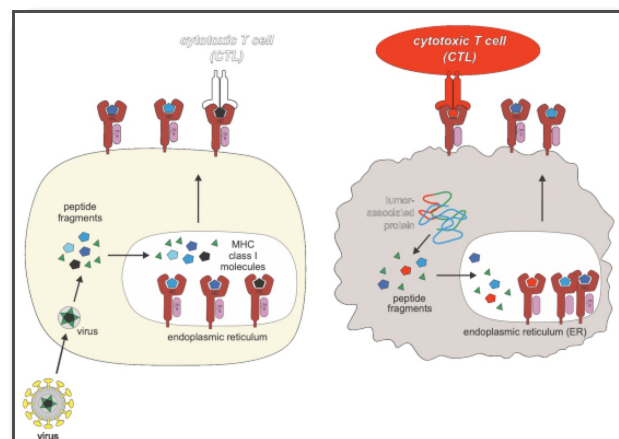
Why do you like doing research?

Well, of course, the first thing is that I've done research since my undergraduate days, and I've stayed in academia because I enjoy doing it. It's also important because at Jacobs, we're proud of offering teaching through research, such that undergraduates get to spend time in the research laboratory. It makes me happy to launch my coworkers on careers in research (this includes my Master students, PhD students, and postdoctoral fellows). Research is really a way of humanity recognizing nature, or nature recognizing itself, and it is a creative, artistic endeavor. If we are lucky, then some of what we do will also help other people.

How can, in particular undergraduate, students contribute?

We always have undergraduate students in the lab, every day. Most of them during their third year, since they do their BSc thesis, and their preparation. Some come earlier, during their second or sometimes even first year. Real research projects are complex and difficult, and it takes time and tenacity to come to results. This is why we are interested in students who want to stay with us for a long time, spend a lot of time in the lab, carefully learn the methods, and try to be as useful as possible. There is always a lot of training involved, and those people who train undergraduate students in the lab also need to generate results (and perhaps finish their PhD thesis). Therefore, we cannot offer research projects 'for the experience of doing research', but we can only accept students who want to contribute to actual results. For those who do not want to do lab work, but are still interested in doing a project, we always have literature-based projects, where we have to find out some facts from publications that we would like to base our research on. For others who do not want to become actively involved but who just want to be part of a molecular immunology group, they can visit our group seminar and learn about the papers we read and about the scientific progress that happens in our group.

Which research opportunities do you offer to master students?

When Constructor University opens a Master program in our area, then we will be ready. Master students are important for trying new approaches, including industry collaborations and other applied projects.

How can students join your research?

Write me an email.

Give two examples of past student projects

Example 1: Bachelor thesis, class of 2022: Production of MHC class II proteins in mammalian cells, purification, and peptide binding. This involved: tissue culture, transfection and transduction of mammalian cells, protein isolation by affinity chromatography, biophysical characterization of the purified protein by tryptophan fluorescence, peptide binding studies by fluorescence anisotropy and by microscale thermophoresis.

Example 2: Bachelor thesis, class of 2021: Literature-based (no laboratory). A literature survey of the ways in which plant-based materials are texturized for use in meat substitute food products.

Head of the Research Group

Prof. Dr. Anna Tevyashova, Medicinal Chemistry

Describe your research project in three sentences and one picture

Invasive fungal mycoses may affect over 300 million people each year and are responsible for the death of 1.5 million individuals globally. During last few years my research has been focused on finding perspective antifungal drug candidates. As a part of Constructor University, I plan to continue my research with focus on discovery and development of new potent and safe antimicrobials.
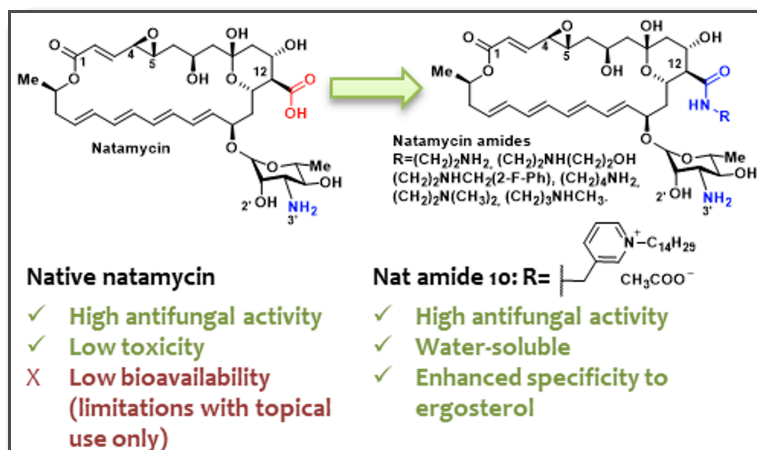
Why do you like doing research?

I find research fascinating because it allows us to explore the unknown and address critical challenges. In the context of antibiotic research, it's especially important because the emergence of drug-resistant pathogens poses a serious global threat to public health. Discovering new antibiotics is essential to combat these resistant infections and ensure effective treatment for future generations.

How can, in particular undergraduate, students contribute?

In a standard research project, a junior researcher is supposed to answer a precise research question, receiving guidance and mentorship from an experienced researcher (PhD).

How can students join your research?

Enroll in one of my courses, demonstrate a genuine interest in the subject matter, and express curiosity about my research area by reaching out to me for further discussion.

Head of the Research Group

History Group
Headed by: **Julia Timpe, PhD**; Distinguished Lecturer in History
(see also: https://juliatimpe.weebly.com/)
Research Fields:
Modern European History/ Modern German History
History of Nazi Germany, World War II & the Holocaust/ History of Everyday Life / Digital History

Describe your research project in three sentences and one picture

There are several ongoing research projects, all exploring aspects related to the history of Nazi Germany, World War II and the Holocaust. Some focus strongly on the everyday experience of individuals living during the Third Reich examining questions such as "how did ideology & political practices effect 'ordinary' peoples' lives, thinking, emotions, practices, etc.?", "how did individuals and groups adapt – or resist – in the realm of the everyday"?), doing so, in particular, by analyzing ego-documents such as letters and diaries. A current book project in this realm explores the experiences of female front performers working for the Wehrmacht during World War II. Additionally, work is done in the field of "Digital History," e.g. as part of the PhD project by Frederike Buda, who studies the history and networks of the circle of Nazi-period industrialists known as the "Freundeskreis Reichsführer SS".

Why do you like doing research?

Historical research allows you to uncover things about the past which might be surprising – or counterintuitive –, and they help you to better understand our present (political, cultural, economic, social) situation. As writer L.P Hartley once put it, "The past is a foreign country; they do things differently there" – I like exploring this 'foreign country' and would say it can be quite exciting!

How can, in particular undergraduate, students contribute?

In general, undergraduate students could contribute to the research agenda of the History Group through their research work done in their Bachelor Thesis. There are also opportunities to join ongoing student research projects – for more, see below.

Which research opportunities do you offer to master students?

The currently ongoing student project is also open to master students. Additionally, master students are encouraged to contact the Research Group if they plan to investigate historical topics in their MA theses (esp. if these are related to the research foci of the History Group.)

How can students join your research?

Currently, the History Group is recruiting additional members for the ongoing student research project "Home & Away / Fern & Nah: An ordinary man's experience of Nazi Germany & WWII". The project is based on an analysis of letters and diaries as well as photographs and home movies from the 1930s and 1940s. All material comes from the private archive of a man from Northern Germany, who served in the Wehrmacht during World War II. Utilizing Digital History methods, the project aims to explore the experiences of this "ordinary" German soldier during the Nazi period and his time at front as well as his attitude towards the war and the Nazi regime. The first phase of project is devoted to mapping (and visualizing) his movements and activities during World War II and, more generally, to digitizing and analyzing his letters, diaries, photos and films.

Give two examples of past student projects

Example 1: Ongoing – since 2021: Home & Away / Fern & Nah: An ordinary man's experience of Nazi Germany & WW II" (see above) Project website (still under development): https://homeawaywwii.hypotheses.org/

Example 2: In 2016: Student Research/ Foreign Exchange Project (together with Dr. Ulrike Huhn), titled "Zwangsarbeit und regionale Erinnerung in Bremen und Nikojalew" (in English: Forced Labor and Regional Memory in Bremen and Mykolaiv). This project, which took place in 2016 (at Uni Bremen in collobaration with partners in the Ukraine and at the University of Mykolaiv), included small-scale student research projects into topics related to the history of forced labor done in Bremen during World War II by Ukrainian people, as well as a trip to Kiev, Odessa and Mykolaiv in 2016, where students met with Ukrainian Holocaust survivors and participated, together with Ukrainian students, in the workshop ęęCaptivity and Forced Labor During World War II: Historical Research and Memory.ęę This project and specifically the excursion was chronicled in a blog (in German): https://bremkraine.hypotheses.org/exkursion. (See also: U. Huhn and J. Timpe, "Eine europäische Vernetzungsgeschichte: Bremen und Mykolajiw im 2. Weltkrieg: Austausch zwischen Bremer und ukrainischen Geschichtsstudierenden," Resonanz: Magazin für Lehre und Studium an der Universität Bremen (2018); online: https://blogs.uni-bremen.de/resonanz/2018/04/20/bremen_mykolajiw/.)

Head of the Research Group

Prof. Dr. Matthias S. Ullrich, Molecular Microbiology, Marine Microbiology, Plant Microbiology

Describe your research project in three sentences and one picture

We are working on different research frontiers in molecular life sciences on microbes interacting with their prefeentially photosynthetic hosts. This includes plant metabolomics, food microbiology, antibiotics research, and environmental (marine) microbiology. We are using different model organisms to better understand the function of genes and gene products involved in diverse interactions.

Why do you like doing research?

Research helps me to make sense of my professional life. Research helps me to stay up-to-date with my teaching content. Finally, our research generates revennues, income for the university, and jobs. I love to lead others in research, and I simply enjoy discoveries and the satisfying moment when a hypothesis is proven or clearly disproven.

How can, in particular undergraduate, students contribute?

Undergraduate students – preferentially from BCCB, MCCB, or CBT – with a particular interest in microbiology can apply to become research team members in their third or fourth semester. Preference will be given to students who actively participate in my courses and have taken the associated microbiology lab course. However, I am generally open to any other students from the natural sciences, who sincerely want to do research work.

How can students join your research?

The safest way is to approach me directly in person (after class or in my office) and by sending an email and arrange for an appointment in person. What always helps is that the student candidate informs him/herself about what we are doing research on in pubmed, google scholar, and the JUB website paying particular attention to our publications of the past years. Then the candidate should identify a topic of research of particular interest and express this during our first meeting.

Give two examples of past student projects

Example 1: Identification of novel plant-based antibiotics
Example 2: Developing a method to fingerprint plant material based on short sequence repeats

Head of the Research Group

Prof. Dr. Dr.-Ing. Yilmaz Uygun
Logistics Engineering and Technologies Group

Describe your research project in three sentences and one picture

My research group focuses on the following topics in production and logistics:

1. **Inventory Management for highly volatile demand patterns** – we developed a unique and patentable algorithmic approach to control inventory and keep it at a very low level while simultaneously being able to deliver at any time. This approach was piloted in different industries with tremendous success (several industry funds)

2. **Sustainable and Circular Supply Chain Management** – we found novel approaches for applying and improving circular economy especially in the automotive industry with the help of dynamic simulation models (several industry funds)

3. **Large-scale Additive Manufacturing** – we built the largest delta-type 3D printer for the so called Fused Filament Fabrication that is currently being prepared for spinning out of the lab as a startup company (funded by BMWK – Exist)

4. **Vertical Axis Wind Turbines** – we built a unique medium-scale vertical axis wind turbine that is currently being tested on a school building in Friesland (funded by Metropolregion Nordwest)

5. **Requirements Management for Logistics and Engineering** – we enabled and improved machine-learning-based requirements changes in logistics. Currently we are working on ways to dealing with requirements for large requirements documents for large engineering projects (industry funded as well as self funded joint research with M.T. Hütt)

6. **Dynamic Production Planning and Scheduling** – we developed novel algorithmic approaches to deal with scheduling problems especially in the steel industry (industry funded joint research with M.T. Hütt)

7. **Global Manufacturing Digitalization Index** – a joint initiative with the Industrial Performance Center of MIT to develop a manufacturing digitalization index to compare and rank the maturity of manufacturing companies (industry and state funded research)

Why do you like doing research?

My main driver for cooking research is understanding complex issues in industrial processes and solving such real-world problems based on scientific approaches.

How can, in particular undergraduate, students contribute?

We always hire motivated students for the different research projects who contribute in many ways, such as doing preparatory work, experiments, own developments, etc.

How can students join your research?

Students may reach out to me directly yuygun@constructor.university

Head of the Research Group

Prof. Dr.-Ing. Hendro Wicaksono
http://hendro-wicaksono.de/

Methods: applied machine learning, causal machine learning, explainable artificial intelligence, natural language processing, semantic data integration, linked data and knowledge graph, data-driven simulation and optimization

Applications: supply chain management, sustainability management, smart cities and transportation management, smart energy systems, agriculture 4.0

Describe your research project in three sentences and one picture

Our research focuses on data-driven industrial solutions addressing the whole Data, Information, Knowledge, Wisdom (DIKW) pyramid. The solutions allow holistic support for decision-making from information, prediction, and simulation to action. They have been developed through research projects in smart energy systems, manufacturing and supply chain management, smart cities, and agriculture, funded by multiple funding agencies and companies.

Why do you like doing research?

By doing research, we can try to solve society's problems systematically and with a strong basis. Even if we cannot achieve positive outcomes, we can still gain knowledge of how to solve the problems. Research is challenging but fun because it always leads to critical and creative thinking.

How can, in particular undergraduate, students contribute?

We encourage, especially early years students, to contribute to our research in different ways, for example, actively contributing to the project works in the courses, individual study courses, theses, and (voluntary) research assistantships. Students can choose their fields of interest in the methods and application fields (see the research field section above). Besides gaining knowledge in methods, the students working on methods can experience the possible applications. The students focusing on application fields will be able to have insights into data-driven methods that can be applied to solve problems in the respective fields.

Which research opportunities do you offer to master students?

The master students can join our group through Advanced Project 1 and 2 by applying data management and analytics techniques in short projects. They can also deepen their knowledge according to their study program and research interests through master theses. The master students should work full time for at least 3.5 months on their master theses. Similar to undergraduate students, master students can choose their fields of interest in the methods and application fields (see the research field section above).

How can students join your research?

Until now, Bachelor and Master students from different study programs (IEM, CS, IMS, IBA, DE, SCM, Math) have been working in our research group. They have joined our research through the following:

1) Bachelor theses, especially IEM, CS, and IMS students.

2) Master theses, especially SCM, DE, and DSSB students.

3) Advanced projects for DE students.

4) Voluntary student research assistantships, especially for the 1st and 2nd year students who want to gain pre-knowledge for internships or theses.

5) Student research assistantships, as long as project funding is available.

6) Teaching assistantships.

7) Independent Study Course (ISC)

Give two examples of past student projects

Example 1: Causal machine learning for accelerating the adoption of circular economy at the micro and macro level.
Example 2: Explainable artificial intelligence to optimize the processes in agri food supply chain.

Head of the Research Group

Prof. Dr. Isabel Wünsche
Art & Art History
Russian Art & Culture Group <https://russian-art.net>

Describe your research project in three sentences and one picture

My research focuses on modern and contemporary art of the 20th and 21st centuries. I am specifically looking at the ways in which artists work, the ideas behind the creative process, how the art works are perceived by the public, and what impact they have in shaping our cultural identity. I also study the role of art institutions, including museums and galleries, exhibitions, art publications, artists' networks, etc. My specific interests are the avant-garde movements, abstract art, and the global spread of modernism.

Why do you like doing research?

I do research in order to gain new insights into how we see and understand the world and explore the foundations of human culture and creative activity.

How can, in particular undergraduate, students contribute?

I usually offer student assistant jobs for conference and workshop assistance, literature search, data collection, website management, etc.

Which research opportunities do you offer to master students?

MA students with background knowledge in modern art and visual culture would be welcome to join one of my collaborative research projects, which would allow them to pursue independent research, get involved in the study of art works and museum collections, scholarly literature, archival research, data collection, and provide research assistance for conferences and publication projects.

How can students join your research?

Take one of my courses, show interest in the subject matter and my research field, and inquire with me.

Give two examples of past student projects

- Research assistance for the research and publication project "100 Years 0n: The First Russian Art Exhibition of 1922"

- Research assistance for the ARC research project "Bauhaus Australia: Emigres, Refuges and the Modernist Transformation of Education in Art, Architecture, and Design, 1930 to 1970"

- BA student project and PhD research project as part of my DAAD research project on German-Portuguese Artistic Relations in the 20th Century

- BA student project and PhD research Project as part of my DAAD research project on German-Croatian Artists' Networks