



HUMAN & BIOTECHNOLOGY

Fields of Expertise TU Graz

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Human & Biotechnology

Gabriele Berg and Christian Baumgartner

Source: Lunghammer – TU Graz



A number of innovations will continue to characterise human and biotechnology in 2025.

Current developments include advances in personalised medicine, AI-supported diagnostics and therapy as well as bio-printing and tissue engineering for regenerative medicine. At the same time, biotechnological innovations are promoting sustainable solutions in various industrial sectors, for example through the microbial upcycling of plastic, cultivated food, biological pesticides or bio-based process technologies in the environmental, food and process industries. These results will contribute to the development of resource-saving and future-oriented applications in medicine, industry, agriculture and environmental protection.

We must also face up to the fact that the recognition of scientific achievement is no longer a given for our society: under the

motto “Stand up for science”, there are declarations to this effect worldwide. Science communication, in which groundbreaking research results are communicated to the public, is becoming increasingly important.

The members of the FoE are making a significant contribution to these developments with their research. Our young researchers in particular are active on the front line. For this reason we are planning an internal exchange among FoE members in 2025 with exciting presentations by our young scientists and visits to institutes.

We wish you every success with your projects and research plans this year, look forward to working with you in our FoE and cordially invite you once again to help shape our work.

We hope you enjoy reading the new issue of TU Graz research.

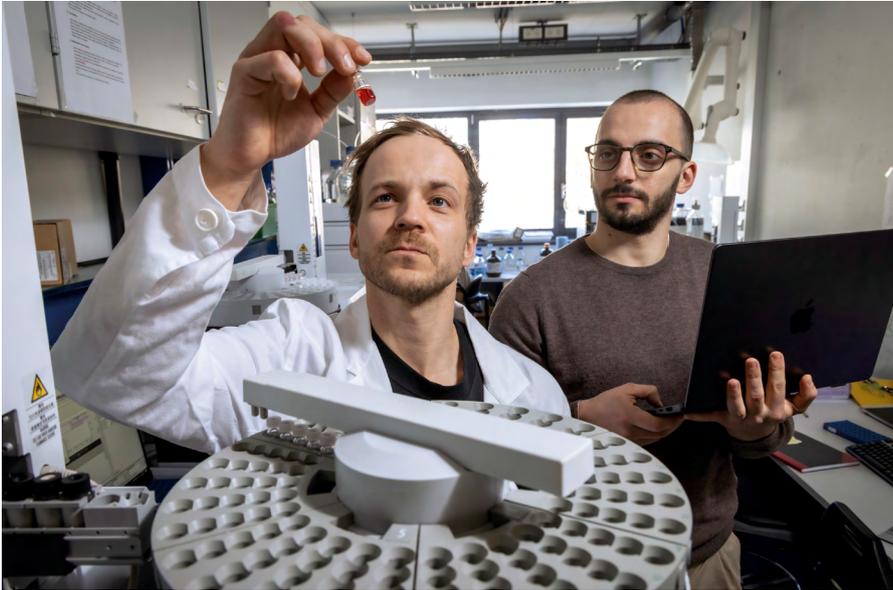
□ □ Aron Wanz, Tommaso Ancilli, Christine Kaiserer, Mykolas Malevičius

DigiBioTech

Artificial intelligence (AI) is revolutionising all aspects of science by recognising patterns in high-dimensional data and making targeted predictions.

Utilising this potential is the declared aim of the new lead project DigiBioTech, which is being funded by TU Graz to the tune of 1.96 million euros. DigiBioTech focuses on the integration of biotechnology and AI in order to improve enzymes in a targeted manner and even generate new ones. These are then

used in sustainable production processes, for example to fix carbon dioxide or to break down so-called forever chemicals. Computer-aided methods, and AI in particular, are in the process of bringing about major changes in the field of biotechnology. DigiBioTech aims to utilise this enormous innovation potential.



← AI-supported algorithms enable the interpretation of complex measurement data. Communication is crucial in the interdisciplinary research of Aron Wanz (Institute of Molecular Biotechnology, left) and Tommaso Ancilli (Institute of Machine Learning and Neural Computation, right).

A total of 17 scientists and ten doctoral students from TU Graz from the fields of biotechnology, process engineering and computer science will work closely together. The young scientists are now starting their projects in which they will collaborate closely between life sciences and data science and build bridges between the two worlds.

Now the real work begins – it's going to be interesting! This article introduces the first doctoral students to venture out of their comfort zone and break new ground in interdisciplinary work.

A key focus of DigiBioTech is not least the improved networking of biotechnol-

ogy and computer science in Graz. By integrating machine learning into biotechnological research, it is hoped that existing biocatalysts can be optimised much more efficiently for process engineering applications, for example, or that completely new enzymes can be developed using generative AI models – for example for breaking down toxic environmental poisons, the conversion of carbon dioxide into bioplastics or the optimisation of complex interactions between several enzymes.

In order for DigiBioTech to achieve these ambitious goals, existing machine learning methods must be adapted to the

specific requirements of biotechnology. The PhD candidates are therefore trained in both domains – the computer sciences and the laboratory as part of their training, which is a valuable preparation for future roles in science and industry.

Another important aspect of DigiBioTech is the generation of freely accessible, high-quality data sets. For enzyme activities and biotechnological process control in particular, there are currently hardly any publicly available data sets that can be used for training AI models. DigiBioTech aims to close this gap and thus make an important contribution to the democratisation of biotechnology.

→ **Deep mutational scanning involves both the microbial optimisation of selection strains by Christine Kaiserer (Institute of Molecular Biotechnology, right) and the interpretation of sequencing data by Mykolas Malevičius (Institute of Biomedical Informatics, left).**



Aron Wanz

Background: Since childhood, I have been fascinated by the natural sciences and the fundamental principles of life. My curiosity led me to pursuing a diploma in chemical engineering, where I developed a foundation in chemistry. Over time, my passion and understanding of life at the molecular level grew, leading me back to my hometown Graz to study molecular biology and biotechnology.

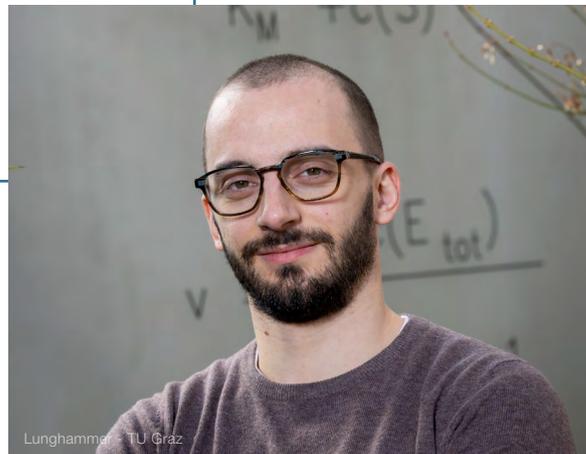
PhD Project: During my PhD at the IMBT Graz, I'll be working on the engineering of certain bifunctional heme peroxidases. We do not only want to engineer them for the efficient degradation of fluorinated carbohydrates, which pose a threat to the entire environment, but also investigate evolutionary interrelations that caused a shift from oxygen transport to the degradation of halogenated compounds such as PFAS. By exploring sequence, structure and function relationships and providing these datasets to my collaborator Tommaso we hope to get novel insights to improve our structural and mechanistic understanding of these interesting proteins.

Personal interests:

Sports climbing, bonsai, producing music

Tommaso Ancilli

PI: Robert Peharz



Tommaso Ancilli

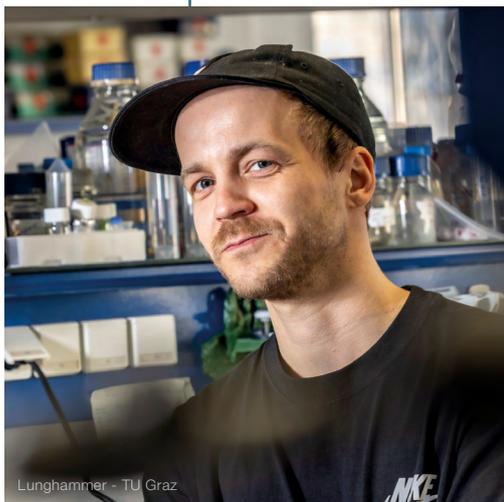
Background: I was born and raised in the beautiful city of Siena, in the heart of Tuscany. I completed both my bachelor's degree in mathematics and my master's degree in computer sciences there. My main interest is to apply machine learning algorithms to biological problems, a passion that was sparked during my master's thesis and led me to doing my PhD here in Graz.

PhD Project: I am highly motivated by the lead project because applying AI to biology has the potential to create a direct, tangible impact on society. In particular, the challenge of designing an optimized amino acid sequence to accelerate PFAS degradation is both inspiring and rewarding, given its potential to contribute to environmental clean-up. Moreover, the protein sequence design will be carried out in close collaboration with my colleague Aron from the IMBT. This interdisciplinary approach is crucial in today's scientific landscape, and the opportunity to deepen my knowledge in biotechnology makes this experience especially rewarding.

Personal interests:

Skiing, hockey, crossfit, reading novels, wine tasting

Aron Wanz / PI: Daniel Kracher



Christine Kaiserer

Background: I grew up in lower Austria as a bilingual child with Danish-Austrian roots. However, I have always had a curiosity for the “language” of biology and how DNA translates into biological function. Therefore, I chose natural sciences in my further education. I studied molecular biology followed by biotechnology here in Graz. During my master’s thesis at the IMBT I enjoyed working on an enzyme engineering project and decided to stay in this research field and do a PhD.

PhD Project: In my PhD project, I will create a huge “library” of mutated enzyme variants-, that will be sequenced and characterized by high-throughput methods. These experiments will generate a vast amount of information. With the help of Mykolas, my colleague from the Institute of Biomedical Informatics, all the sequencing data will be evaluated using machine learning. By doing this, we envision gathering knowledge about designing enzymes more efficiently in the future.

Personal interests:

Sports, cooking, photography



Christine Kaiserer

PI: Robert Kourist

Mykolas Malevičius

PI: Leyla Taher, Gerhard Thallinger



Mykolas Malevičius

Background: I grew up in Lithuania, but for my studies I moved to Sweden to study at the University of Linköping. During my bachelor’s degree I studied experimental biomedicine and in my master’s studies I pursued bioinformatics. I realised that I wanted to stay in academia and advance my knowledge of next-generation sequencing techniques and its data analysis.

PhD Project: My current research is focused on utilising machine learning to analyse hundreds of thousands of mutated versions of a given enzyme produced by my colleague Christine from the Institute of Molecular Biotechnology.

Personal interests:

Learning about different cultures and history, visiting museums and art galleries, spending time with friends