

Ph.D. Student (f/m/d): Predictive Computer Simulations of Tissue Morphogenesis

The [Center for Advanced Systems Understanding \(CASUS\)](#) is a German-Polish research center for data-intensive digital systems research. We combine innovative methods from mathematics, theoretical systems research, simulations, data science, artificial intelligence, and computer science to provide solutions for a range of disciplines – materials science under ambient and extreme conditions, earth system research, systems biology and medicine, and autonomous vehicles.

CASUS was jointly founded in August 2019 by the [Helmholtz-Zentrum Dresden-Rossendorf \(HZDR\)](#), the [Helmholtz Centre for Environmental Research \(UFZ\)](#), the [Max Planck Institute of Molecular Cell Biology and Genetics \(MPI-CBG\)](#), the [Technical University of Dresden \(TUD\)](#) and the [University of Wrocław \(UWr\)](#). CASUS is located in the heart of Görlitz at the border between Germany and Poland. The CASUS start-up phase is hosted by the Helmholtz-Zentrum Dresden-Rossendorf and is financed by the [Federal Ministry of Education and Research \(BMBF\)](#) and the [Saxon State Ministry for Higher Education, Research and the Arts \(SMWK\)](#).

The [CASUS Department of Systems Biology](#) is looking for a PhD Student excited about **being able to computationally predict the shape a living tissue is going to develop into**. Consideration of candidates will begin immediately and will continue until the position is filled. Location of work is Görlitz, remuneration is according to the German Civil Service Tariff and HZDR employment conditions. No tuition charged.

The Scope of Your Job

The question of morphogenesis has fascinated scientists since Darwin and D'Arcy Thomson. How does a living tissue, such as an embryo or an organ, develop into a well-defined shape? What regulates the emergence of shape? How is shape encoded in the genes? How is the great variety of shapes we observe in nature generated by genetic mutation? How is shape control robust against noise and environmental fluctuations? At CASUS, we address these fundamental question in close collaboration with the [Center for Systems Biology Dresden](#) and the [Federal Cluster of Excellence "Physics of Life"](#) at TU Dresden, seeking answers to a century-old question with obvious applications in regenerative medicine. A prerequisite for the studies, however, is the availability of a predictive computer simulation of models or morphogenesis in order to prove their sufficiency and screen for viable parameters. In this project, we will develop and numerical tools and implement the simulation software in the open-source parallel computing framework [OpenFPM](#). The code should be able to simulate both data-driven and theory-driven models of tissue dynamics, including models of topological control of shape. The latter will be done in collaboration with CASUS's materials science department, as similar concepts exists in the field of complex shape-programmable materials. In the end, you might just have the world's first 3D simulation of biological morphogenesis.

Your Tasks

- Develop the numerical tools to solve mechano-chemical models of morphogenesis in complex and moving geometries
- Implement the simulation software in the open-source parallel computing framework [OpenFPM](#).
- Interface with the other CASUS Departments and with MPI-CBG to explore the hypothesis of topology-driven morphogenesis
- Apply your solutions to predict the shape of an epithelial fold in 3D
- Publish your results in academic, peer-reviewed journals
- Present your results at scientific meetings

Your Qualifications

- Master's degree in Computational Biology, Applied Mathematics, or Computational Physics
- A solid background in biology, in particular developmental biology and cell biology
- Excellent Programming skills in Python or C++
- Experience in computational statistics, inference, and machine learning
- Experience in video and image processing or computer vision
- Strong motivation to work in a collaborative and interdisciplinary environment
- Excellent communication skills in English and in a professional context (presentation of research results at scientific meetings, colloquial discussions, writing of manuscripts).

What We Offer

- A vibrant research community in an open, diverse, and international work environment
- Scientific excellence and high quality of training according to the [Helmholtz Doctoral Guidelines](#)
- Broad national and international science networks
- Cutting-edge, professionally managed high-performance computing resources
- Scientific computing and software engineering support team
- Salary according to the German Collective Wage Agreement for the Civil Service (TVöD)
- Comprehensive benefits package (30 vacation days per year, company pension plan (VBL), flexible working hours, in-house health management, relocation assistance).

Please submit your application (including a one-page cover letter, CV, academic degrees, transcripts, etc.) online on the HZDR application portal:

<https://www.hzdr.de/db/Cms?pNid=490&pOid=61506&pContLang=en>

Deadline:

Rolling application – open until filled.

For details please contact:

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