Yuhong Liu

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Education

Jan. 2026 (expected) **Dr. rer. nat.** in Mathematics — University of Bonn (Germany)
Advised by Prof. Jan Hasenauer, Prof. Raoul-Martin Memmesheimer

Jun. 2021 **M.S.** in Computational Finance and Risk Management — University of Washington (USA)
Advised by Prof. Douglas Martin

May 2019 **B.S.** ***Magna Cum Laude*** in Financial Mathematics — Baruch College, CUNY (USA)

Work Experience

Oct. 2021 - Current **University of Bonn/University Hospital Bonn/University Hospital Mainz** - PhD Researcher

- Developed and refined mechanistic ODE models of biological systems through iterative optimization and model selection.
- Implemented uncertainty quantification methods (MCMC, likelihood profiles, ensemble approaches) and structural/practical identifiability analysis to assess both parameter and prediction uncertainty.
- Formulated methods to address autocorrelation in data using SDE models with hierarchical optimization approaches.
- Advanced the stability analysis of continuous sensitivity analysis methods, unifying forward and adjoint formulations.
- Contributed to a theoretical framework using PDE models and data analysis, with emphasis on optimization and sensitivity analysis to evaluate efficiency and robustness in dynamical systems.

Nov. 2019 - Jun. 2021 **University of Washington** - Research Assistant

- Co-designed a multimodal imaging solution integrating visual and thermal sensing with algorithm development, enhancing detection capabilities for human search and rescue under challenging field conditions.

Jun. 2020 – Aug. 2020 **Google Summer of Code (GSoC)** – Developer (Maintainer until May 2025)

- Created an R package (`robustGarch`) for robust estimation of GARCH process model parameters under additive outliers.
- Implemented two approaches: (1) maximum likelihood with a bounded loss function, and (2) a filtering method that reduces the effect of outliers on subsequent variance predictions.
- Extended functionality, implemented rigorous testing, and maintained the package using modern software development practices (version control, documentation, continuous integration).

Research Output

My research focuses on developing and applying mathematical and computational models to understand complex biological and physical systems, with a particular emphasis on **bridging theory with experimental data**. Across multiple projects, I have contributed in complementary roles — from **hypothesis generation and model construction to data integration and software development** — leading to a range of impactful outputs. One major contribution was the development of an ODE-based model to investigate the role of MID1 binding in regulating RNA stability. In this project, I was responsible for **the formulation of the model and generation of testable hypotheses, which subsequently guided follow-up experiments validating the proposed mechanisms**. I also designed and implemented a mechanistic ODE model to study the interactions between oncolytic viruses and tumour cells in zebrafish, incorporating parameter estimation, uncertainty quantification, and mixed-effects modelling to assess therapeutic outcomes at the individual level. In computational neuroscience, I co-developed a mean-field modelling framework for quadratic integrate-and-fire neuron networks with conductance-based synaptic interactions.

Beyond theoretical modelling, I have contributed to data-driven and engineering-oriented projects. I developed and continue to maintain an R package for robust GARCH modelling, enabling reliable time-series analysis in the presence of outliers. Additionally, I co-designed a multimodal data integration pipeline combining visual and thermal imaging using deep learning for human detection in search-and-rescue scenarios. These projects demonstrate my technical skill set — including **ODE modelling, parameter optimization, uncertainty quantification, deep learning, and software engineering**. My work has been presented at international conferences across control theory, computational neuroscience, systems biology, and computational biology, and I place **strong emphasis on reproducibility by releasing well-documented code to support community use and future research**.

Journal Paper

[J3-IP] **Yuhong Liu**, Dilan Pathirana, Jan Hasenauer. *"HORIZON: Hierarchical Optimization for Residual Inference with Zero-drift Ornstein-Uhlenbeck Noise"*. **(Manuscript in preparation)**

[J2-IP] **Yuhong Liu**, Annika Reisbitzer, Domagoj Dorešić, Jan Hasenauer, Sybille Krauß, and Tatjana Tchumatchenko. *"Data-driven model reveals increased stability of CAG-expanded huntingtin RNA due to MID1 binding"*. **(Submitted)**

[J1] Christoffer G. Alexandersen, Chloé Duprat, Aitakin Ezzati, Pierre Houzelstein, Ambre Ledoux, **Yuhong Liu**, Sandra Saghir, Alain Destexhe, Federico Tesler, and Damien Depannemaecker. *"A Mean Field to Capture Asynchronous Irregular Dynamics of Conductance-Based Networks of Adaptive Quadratic Integrate-and-Fire Neuron Models"* Neural Computation 36, no. 7 (2024): 1433-1448. **(First 7 authors are co-first authors)**

Conference Paper

[C2] **Yuhong Liu**, Dilan Pathirana, Jan Hasenauer. *"Parameter estimation and model selection for the quantitative analysis of oncolytic virus therapy in zebrafish". 14th IFAC Symposium on Dynamics and Control of Process Systems, including Biosystems.* Jun 2025.

[C1] Christopher R. Hayner, Timothy Zhou, Neil Gupta, **Yuhong Liu**, Parker Mayhew, and Juris Vagners. *"Real-time Human Detection with Integration of Visual and Thermal Data from High Altitude sUAS,"* AIAA 2021-0397. *AIAA Scitech 2021 Forum.* January 2021.

Repository

Parameter Estimation and Model Selection for the Quantitative Analysis of Oncolytic Virus Therapy in Zebrafish Embryos - `OV`

A package for robust-GARCH model - `robustGarch`

Teaching

Winter 2025/26 — University of Bonn

Advanced Methods for Parameter Inference

Winter 2020 — University of Washington

CFRM 425 B: R Programming for Quantitative Finance

Awards

2020 — **Stipend** - Google Summer of Code Program

2019 — **Travel Award** - 50 Years of Applied Mathematics at University of Washington

2019 — **Fifth Place** - City University of New York Math Challenge

2018, 2019 — **Dean's List** - City University of New York, Baruch College

2017 — **Third Place** - Traders@MIT Quantitative Trading Competition

Mentorship

Undergraduates

Pembe Gizem Özdil (PhD student in Computational Neuroscience at EPFL)

Sabrina Zerrade (Now applying for graduate school in Computational Biology)

Public Outreach

Outreach and Service

Jan. 2022 - Current Women in Network Science (WiNS) Society

- Feb. 2025 - Current Executive committee - Grad Student Representative
- Feb. 2023 - Current Mentorship Program - Founder
- Jan. 2022 - Current Seminar - Co-organizer

Sep. 2022 Bernstein Conference 2022 - Photographer

May 2022 12th German Neuroscience Olympiads - Backyard Brain Experiment Demonstrator

Mar. 2022 Cosyne 2022 Tutorial on Spiking Neural Networks - Teaching Assistant

Mar. 2021 - Jun. 2021 UW Women in Applied Mathematics Mentorship Program - Mentor

Research Feature

"Hide and Seek: Training a drone to save lives"

Skills

Applied Mathematics & Modeling

- **Probability & Statistics:** probability theory, statistical inference, stochastic processes, Monte Carlo simulation, and data analysis for both traditional modeling and machine learning applications.
- **Optimization & Numerics:** numerical analysis, linear algebra, gradient/stochastic optimization, numerical PDE methods, and optimization techniques used in machine learning.
- **Dynamical Systems:** modeling of ODEs, SDEs, and PDEs with parameter estimation, identifiability, sensitivity, and uncertainty quantification.

Package Development

- 3+ years of scientific software development (developer of `robustGarch`), experienced in collaborative workflows, version control, and testing.

Programming

- `Python`, `MATLAB`, `R`, `C++`, `SQL`, and `Julia`;
- HPC, Git, LaTeX.

Soft Skills

- Teamwork, communication, and project management skills from collaborations and multi-developer projects.
- Proactive and self-driven, with initiative in method development and workflow improvement.

Language

- fluent in Mandarin and English, intermediate proficiency in German (B1).

Professional Activity

Training Program

Sep. 2022 EITN Fall School in Computational Neuroscience 2022

Jul. 2022 First Italian Summer School in Geometric Deep Learning 2022