Lucas Amoudruz

Research Scientist in Computational Science and Engineering

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github ORCID

Education

2022 Ph.D. Mechanical Engineering - ETH Zurich
Simulation and control of artificial microswimmers in blood - Advisor: Petros Koumoutsakos

2016 MSc Computational Science and Engineering - EPFL

2013 BSc Physics - EPFL

Academic Appointments

2025 – Lecturer, Harvard University

2022 – Research Associate, Harvard University

2022 – 2023 Postdoctoral Fellow, Harvard University

Teaching Experience

Lecturer

Fall 2025 Advanced Scientific Computing: Stochastic Methods for Data Analysis, Inference and Optimization - Harvard University - Graduate course (58 students)

2018 – 2020 High Performance Computing for Science and Engineering I & II - ETH Zurich - Co-lecturer (160 students)

Teaching Assistant

2026 AI, Computing and Thinking - Harvard University

2021 – 2023 Stochastic Methods for Data Analysis, Inference and Optimization - Harvard University

2017 High Performance Computing for Science and Engineering I & II - ETH Zurich

2017 Models, Algorithms and Data: Introduction to Computing - ETH Zurich

2015 General Physics - University of Lausanne

2014 Introduction to Programming - EPFL

Academic Service and Mentoring

- Supervised 10 students for semester, Bachelor, and Master theses
- Co-organizer, *Widely Applied Math Seminar*, Harvard SEAS
- Reviewer for *Biophysical Journal*, *CMAME*, *Advanced Intelligent Systems*, *Physics of Fluids*, and others

Grant Applications

2025 SALATA: Sustainable Building and Urban Future

2025 AWS/HDSI: Physics-aware foundation models for extreme atmospheric events - $197k

2021 EuroHPC: Targeted Drug Delivery with Microswimmers - 150k node hours

2016 CHRONOS: Simulation of Microfluidics for Mechanical Cell Separation - 2M node hours

Software

- Mirheo [C++/CUDA/MPI] framework for microfluidics simulations
- Korali [C++/OpenMP/MPI] framework for large-scale Bayesian inference

Publications

Full list on my Google Scholar profile.

1. **Amoudruz, L.**, Litvinov, S., Papadimitriou, C., Koumoutsakos, P. (2026). *Bayesian inference for PDE-based inverse problems using the optimization of a discrete loss.* Computer Methods in Applied Mechanics and Engineering, 455, 118903.
2. Guan, Y., **Amoudruz, L.**, Litvinov, S., Jakhar, K., et al. (2026). *Prediction of Extreme Events in Multiscale Simulations of Geophysical Turbulence using Reinforcement Learning.* arXiv preprint arXiv:2603.03351.
3. Rivetti, L., Buti, G., **Amoudruz, L.**, Ajdari, A., et al. (2026). *Probabilistic clinical target definition with nearest neighbor correlation.* Physics in Medicine & Biology, 71(1), 015031.
4. **Amoudruz, L.**, Buti, G., Rivetti, L., Ajdari, A., et al. (2025). *Ising energy model for the stochastic prediction of tumor islets.* arXiv preprint arXiv:2508.20804.
5. **Amoudruz, L.**, Litvinov, S., Murri, R., Eyrich, V., et al. (2025). *Scalable, Cloud-Based Simulations of Blood Flow and Targeted Drug Delivery in Retinal Capillaries.* Computer Physics Communications, 109967.
6. **Amoudruz, L.**, Litvinov, S., Koumoutsakos, P. (2025). *Optimal navigation of magnetic artificial microswimmers in blood capillaries with deep reinforcement learning.* Physics of Fluids, 37(7), 071703.
7. **Amoudruz, L.**, Karnakov, P., Koumoutsakos, P. (2025). *Contactless precision steering of particles in a fluid inside a cube with rotating walls.* Journal of Fluid Mechanics, 1014, A15.
8. Alexeev, D., Litvinov, S., Economides, A., **Amoudruz, L.**, Toner, M., Koumoutsakos, P. (2025). *Inertial focusing of spherical particles: The effects of rotational motion.* Physical Review Fluids, 10(5), 054202.
9. Karnakov, P., **Amoudruz, L.**, Koumoutsakos, P. (2025). *Optimal navigation in microfluidics via the optimization of a discrete loss.* Physical Review Letters, 134(4), 044001.
10. **Amoudruz, L.**, Economides, A., Koumoutsakos, P. (2024). *The volume of healthy red blood cells is optimal for advective oxygen transport in arterioles.* Biophysical Journal, 123(10), 1289–1296.
11. **Amoudruz, L.**, Economides, A., Arampatzis, G., Koumoutsakos, P. (2023). *The stress-free state of human erythrocytes: Data-driven inference of a transferable RBC model.* Biophysical Journal, 122(8), 1517–1525.
12. **Amoudruz, L.**, Koumoutsakos, P. (2022). *Independent control and path planning of microswimmers with a uniform magnetic field.* Advanced Intelligent Systems, 4(3), 2100183.
13. Economides, A., Arampatzis, G., Alexeev, D., Litvinov, S., **Amoudruz, L.**, et al. (2021). *Hierarchical Bayesian uncertainty quantification for a model of the red blood cell.* Physical Review Applied, 15(3), 034062.
14. Alexeev, D., **Amoudruz, L.**, Litvinov, S., Koumoutsakos, P. (2020). *Mirheo: High-performance mesoscale simulations for microfluidics.* Computer Physics Communications, 254, 107298.
15. Wälchli, D., Martin, S.M., Economides, A., **Amoudruz, L.**, et al. (2020). *Load balancing in large scale Bayesian inference.* PASC Conference, 1–12.
16. Economides, A., **Amoudruz, L.**, Litvinov, S., Alexeev, D., et al. (2017). *Towards the Virtual Rheometer: High Performance Computing for the Red Blood Cell Microstructure.* PASC Conference, 1–13.

Invited Talks

- *Optimal Path Planning at the Microscale for Artificial Microswimmers and Cellular Manipulation*, Harvard Rising Stars in Computational Science and Engineering 2025, Cambridge, MA, USA
- *Data-driven inference of a transferable red blood cell model*, CMBE 2024, Washington, DC, USA
- *Path planning of swimmers in complex flows with reinforcement learning*, APS-DFD 2023, Washington, DC, USA
- *Hierarchical Bayesian inference for a red blood cell model*, SIAM-UQ 2022, Atlanta, USA
- *Magnetic navigation of artificial bacterial flagella in blood and water*, APS-DFD 2021, Phoenix, USA
- *Fingering instability in a Hele-Shaw cell*, PASC 2018, Basel, Switzerland