Lucas Amoudruz, PhD

lucas.amoudruz@wanadoo.fr github linkedin

SUMMARY

Research scientist with a strong focus on high-performance computing, numerical methods, machine learning, and Bayesian inference. Developed software targeting heterogeneous architectures for supercomputing clusters and for cloud platforms.

EXPERIENCE

Research Associate Oct. 2023 - present
Harvard University, United States
- Deployed MPI+CUDA software on cloud platforms.
- Simulations of blood with LAMMPS on cloud platforms, weak scaling efficiency above 95% up to 2'000 cores.

Postdoctoral fellow May 2022 - Oct. 2023
ETH Zurich, Switzerland (Located at Harvard University)
- Applied deep reinforcement learning to large scale, high fidelity simulations on multi-GPUs.
- Achieved speedup over reinforcement learning for path-planning by 2 orders of magnitude.

Scientific Assistant May 2016 - May 2022
ETH Zurich, Switzerland
- Co-developed Mirheo, a MPI+CUDA software for micro-fluidics simulations. Achieved 10x better time to solution that state of the art. Weak scaling above 98% up to thousands of GPUs.
- Calibrated and validated a red blood cell model against experiments using Bayesian inference.
- Designed control strategies for artificial microswimmers with reinforcement learning.

EDUCATION

PhD Mechanical Engineering Mar. 2022
CSELab, ETH Zurich, Switzerland
Doctoral thesis: "Simulation and control of artificial microswimmers in blood"

MSc Computational Science and Engineering May 2016
EPFL, Lausanne, Switzerland

BSc Physics July 2013
EPFL, Lausanne, Switzerland

SKILLS

Programming/HPC/Libraries/Development tools/presentation
C/C++/CUDA, MPI, python, BLAS, Lapack, HDF5, PyTorch, Tensorflow, JAX, Paraview, Git, Makefile, CMake, Unix shell, CI/CD, Latex, keynote, HTML

Languages
English (fluent), French (native), Spanish (beginner)

TEACHING

Fall 2021, 2022, 2023: TF, Harvard University: *Stochastic Methods for Data Analysis, Inference and Optimization*
2018-2019: TA, Head TA, Lecturer, ETHZ: *High Performance Computing for Science and Engineering I and II*
Spring 2017: TA, ETHZ: *Models, Algorithms and Data: Introduction to Computing*
Fall 2015: TA, University of Lausanne: *General Physics*
Fall 2014: TA, EPFL: *Introduction to Programming*

PUBLICATIONS

Amoudruz, L., Litvinov, S. and Koumoutsakos, P., 2025. Path planning of magnetic microswimmers in high-fidelity simulations of capillaries with deep reinforcement learning. *Physics of Fluids* 37, 071703

Amoudruz, L., Karnakov, P,. and Koumoutsakos, P., 2025. Contactless Transport of Particles using Hydrodynamics. *Journal of Fluid Mechanics*, 1014:A15.

Alexeev, D., Litvinov, S., Economides, A., **Amoudruz, L.**, Toner, M. and Koumoutsakos, P., 2025. Inertial focusing of spherical particles: The effects of rotational motion. *Physical Review Fluids*, *10*(5), p.054202.

Karnakov, P, **Amoudruz, L**.,. and Koumoutsakos, P., 2025. Closed-loop control and navigation in microfluidics through optimizing a discrete loss. *Physical Review Letters*, 134(4), p.044001.

Amoudruz, L., Economides, A. and Koumoutsakos, P., 2024. The Volume of Healthy Red Blood Cells is Optimal for Advective Oxygen Transport in Arterioles. *Biophysical Journal 123 (10), 1289-1296*.

Amoudruz, L., Economides, A., Arampatzis, G. and Koumoutsakos, P., 2023. The stress-free state of human erythrocytes: Data-driven inference of a transferable RBC model. *Biophysical Journal*, *122*(8), pp.1517-1525.

Amoudruz, L. and Koumoutsakos, P., 2022. Independent Control and Path Planning of Microswimmers with a Uniform Magnetic Field. *Advanced Intelligent Systems*, *4*(3), p.2100183.

Economides, A., Arampatzis, G., Alexeev, D., Litvinov, S., **Amoudruz, L**., Kulakova, L., Papadimitriou, C. and Koumoutsakos, P., 2021. Hierarchical Bayesian Uncertainty Quantification for a Model of the Red Blood Cell. *Physical Review Applied*, *15*(3), p.034062.

Alexeev, D., **Amoudruz, L**., Litvinov, S. and Koumoutsakos, P., 2020. Mirheo: High-performance mesoscale simulations for microfluidics. *Computer Physics Communications*, *254*, p.107298.

Wälchli, D., Martin, S.M., Economides, A., **Amoudruz, L**., Arampatzis, G., Bian, X. and Koumoutsakos, P., 2020, June. Load balancing in large scale bayesian inference. In *Proceedings of the Platform for Advanced Scientific Computing Conference* (pp. 1-12).

Economides, A., **Amoudruz, L**., Litvinov, S., Alexeev, D., Nizzero, S., Hadjidoukas, P.E., Rossinelli, D. and Koumoutsakos, P., 2017, June. Towards the Virtual Rheometer: High Performance Computing for the Red Blood Cell Microstructure. In *Proceedings of the Platform for Advanced Scientific Computing Conference* (pp. 1-13).

CONFERENCE TALKS

"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 Bacteria Flagella in Blood and Water", APS-DFD 2021, Phoenix, USA

"Fingering Instability in a Hele-Shaw cell", PASC 2018, Basel, Switzerland