Alexander **Strack**

Researcher · Computational Engineer · HPC Expert

University of Stuttgart
Institute of Parallel and Distributed Systems
Scientific Computing
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Position

Researcher *12/2022–present*

University of Stuttgart, Germany

Scientific Computing

Intern *06/2024–08/2024*

Los Alamos National Laboratory, U.S.

Co-design Summer School

Education

Ph.D. Computer Science *2022–present*

University of Stuttgart, Germany

Advisor: Prof. Dr. Dirk Pflüger (University of Stuttgart)

M.Sc. Simulation Technology *2020–2022*

University of Stuttgart, Germany, 2 year program, 120 ECTS *1.2 / GPA 3.8 / 95%*

Thesis: Active Learning Optimization for Dynamical System Identification with Gaussian Processes

B.Sc. Simulation Technology *2017–2020*

University of Stuttgart, Germany, 3 year program, 189 ECTS *2.2 / GPA 2.8 / 70%*

Thesis: Dynamic Workload Balancing for Heterogeneous Systems

Research Focus

- **High-Performance Computing (HPC)**: Optimizing large-scale computational workflows.
- **Asynchronous Many-Task (AMT) Systems**: Leveraging task-based parallelism for dynamic resource utilization.
- **Performance Portability**: Ensuring consistent performance across heterogeneous computing environments.
- **Emerging Hardware Architectures**: Exploring next-generation accelerators and instruction sets such as ARM and RISC-V.
- **Software Co-design**: Bridging the gap between hardware-level optimization and high-level applications in Scientific computing and Machine Learning.

Technical Skills

Languages	C/C++, Python, MATLAB
Parallelization	HPX, MPI, OpenMP, CUDA, SYCL
Other	LaTeX, Bash

Publications

Journals

[P1] Joseph Schuchart, Patrick Diehl, Michael Bauer, Aurelien Bouteiller, Gregor Daiss, Engin Kayraklioglu, Shreyas Khandekar, Thomas Herault, John Holmen, Ritvik Rao, **Alexander Strack**, Elliott Schlaughter, Jennifer Spinti, Jeremy Thornock, Alex Aiken, Olivier Aumage, Martin Berzins, George Bosilca, Bradford hamberlain, and Laxmikant Kale. "A Survey of Distributed Asynchronous Many-Task Models and Their Applications". In: *Preprint* (Dec. 2025). DOI: 10.36227/techrxiv.176652588.81044275/v1.

[P2] Julien Loiseau, Hyun Lim, Andrés Yagüe López, Mammadbaghir Baghirzade, Shihab Shahriar Khan, Yoonsoo Kim, Sudarshan Neopane, **Alexander Strack**, Farhana Taiyebah, and Ben Bergen. "HARD: A performance portable radiation hydrodynamics code based on FleCSI framework". In: *SoftwareX* 32 (2025), p. 102441. ISSN: 2352-7110. DOI: https://doi.org/10.1016/j.softx.2025.102441. URL: https://www.sciencedirect.com/science/article/pii/S2352711025004078.

Conferences & Workshops

[P3] **Alexander Strack**, Christopher Taylor, and Dirk Pflüger. "Parallel FFTW on RISC-V: A Comparative Study Including OpenMP, MPI, and HPX". In: *High Performance Computing*. Ed. by Sarah Neuwirth, Arnab Kumar Paul, Tobias Weinzierl, and Erin Claire Carson. Cham: Springer Nature Switzerland, 2026, pp. 586–597. ISBN: 978-3-032-07612-0. DOI: https://doi.org/10.1007/978-3-032-07612-0_45.

[P4] Maksim Helmann, **Alexander Strack**, and Dirk Pflüger. "GPRat: Gaussian Process Regression with Asynchronous Tasks". In: *Asynchronous Many-Task Systems and Applications*. Ed. by Patrick Diehl, Qinglei Cao, Thomas Herault, and George Bosilca. Cham: Springer Nature Switzerland, 2026, pp. 83–94. ISBN: 978-3-031-97196-9. DOI: https://doi.org/10.1007/978-3-031-97196-9_7.

[P5] **Alexander Strack** and Dirk Pflüger. "A HPX Communication Benchmark: Distributed FFT Using Collectives". In: *Euro-Par 2024: Parallel Processing Workshops*. Ed. by Silvina Caino-Lores, Demetris Zeinalipour, Thaleia Dimitra Doudali, David E. Singh, Gracia Ester Martín Garzón, Leonel Sousa, Diego Andrade, Tommaso Cucinotta, Donato D'Ambrosio, Patrick Diehl, Manuel F. Dolz, Admela Jukan, Raffaele Montella, Matteo Nardelli, Marta Garcia-Gasulla, and Sarah Neuwirth. Cham: Springer Nature Switzerland, 2025, pp. 271–274. ISBN: 978-3-031-90203-1. DOI: https://doi.org/10.1007/978-3-031-90203-1_25.

[P6] **Alexander Strack**, Christopher Taylor, Patrick Diehl, and Dirk Pflüger. "Experiences Porting Shared and Distributed Applications to Asynchronous Tasks: A Multidimensional FFT Case-Study". In: *Asynchronous Many-Task Systems and Applications*. Ed. by Patrick Diehl, Joseph Schuchart, Pedro Valero-Lara, and George Bosilca. Cham: Springer Nature Switzerland, 2024, pp. 111–122. ISBN: 978-3-031-61763-8. DOI: https://doi.org/10.1007/978-3-031-61763-8_11.

[P7] **Alexander Strack** and Dirk Pflüger. "Scalability of Gaussian Processes Using Asynchronous Tasks: A Comparison Between HPX and PETSc". In: *Asynchronous Many-Task Systems and Applications*. Ed. by Patrick Diehl, Peter Thoman, Hartmut Kaiser, and Laxmikant Kale. Cham: Springer Nature Switzerland, 2023, pp. 52–64. ISBN: 978-3-031-32316-4. DOI: https://doi.org/10.1007/978-3-031-32316-4_5.

Posters

[P8] Mammadbaghir Baghirzade, Shihab Shahriar Khan, Yoonsoo Kim, Sudarshan Neopane, **Alexander Strack**, Farhana Taiyebah, Julien Loiseau, and Hyun Lim. "Computational Radiation Hydrodynamics with FleCSI". In: *The International Conference for High Performance Computing, Networking, Storage, and Analysis*. 2024.

[P9] **Alexander Strack**, Mammadbaghir Baghirzade, Shihab Shahriar Khan, Yoonsoo Kim, Sudarshan Neopane, Farhana Taiyebah, Julien Loiseau, and Hyun Lim. "Radiation Hydrodynamics at Scale with FleCSI-HARD". In: *Salishan Conference on High Speed Computing*. 2025.

Source Code & Artifacs

[A1] *GPRat: GitHub Code Repository*. URL: https://github.com/SC-SGS/GPRat.

[A2] *HARD: GitHub Code Repository*. URL: https://github.com/lanl/HARD.

[A3] *HPX-FFT: GitHub Code Repository*. URL: https://github.com/constracktor/HPX-FFT.

Talks

Invited Talks

[T1] *Asynchronous Tasks in Scientific Computing*. Invited Talk. At Oden Institute. UT Austin (U.S.). Feb. 2025.

[T2] *Leveraging HPX for FFT and Cholesky Decomposition*. Invited Talk. At Division of Computer Science & Engineering. Louisiana State University (U.S.). Feb. 2024.

Peer-Reviewed Presentations

[T3] *Hierarchical Collective Operations for HPX*. Presentation. At International Parallel Tools Workshop (IPTW). Stuttgart (Germany). Nov. 2025.

[T4] *Parallel FFTW on RISC-V: A Comparative Study including OpenMP, MPI, and HPX*. Paper Presentation. At ISC High Performance Conference Workshops (RISC-V). Hamburg (Germany). June 2025.

[T5] *Radiation Hydrodynamics at Scale with FleCSI-HARD*. Poster Presentation. At Salishan Conference on High Speed Computing. Gleneden Beach (U.S.). Apr. 2025.

[T6] *GPRat: Gaussian Process Regression with Asynchronous Tasks*. Paper Presentation. At Workshop on Asynchronous Many-Task Systems and Applications (WAMTA). St. Louis (U.S.). Feb. 2025.

[T7] *A HPX Communication Benchmark: Distributed FFT using Collectives*. Poster Presentation. At International European Conference on Parallel and Distributed Computing (Euro-Par). Madrid (Spain). Aug. 2024.

[T8] *Experiences Porting Distributed Applications to Asynchronous Tasks: A Multidimensional FFT Case-study*. Paper Presentation. At Workshop on Asynchronous Many-Task Systems and Applications (WAMTA). Knoxville (U.S.). Feb. 2024.

Supervising

M.Sc. Thesis: *Extending GPRat to Support Distributed Computing* — *Winter Semester 2025/2026*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the manuscript.

30 ECTS

M.Sc. Thesis: *Heterogeneous Solvers for Linear Systems with Symmetric Positive-Definite Matrices Using SYCL* — *Winter Semester 2025/2026*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the manuscript.

30 ECTS

M.Sc. Research Project: *Portability for GPRat: Combining HPX with SYCL and oneMath* — *Winter Semester 2025/2026*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the report.

9 ECTS

M.Sc. Research Project: *Extension of HPX-FFT to 3D* — *Winter Semester 2025/2026*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the report.

9 ECTS

M.Sc. Research Project: *Control of an Inverted Pendulum using Gaussian Processes* — *Winter Semester 2025/2026*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the report.

9 ECTS

B.Sc. Thesis: *Hierarchical Collectives for HPX* — *Summer Semester 2025*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the manuscript.

12 ECTS

B.Sc. Thesis: *Real-time visualized and GPU-accelerated Lattice Boltzmann simulations* — *Summer Semester 2025*

- *Supervisor.* Duties include co-supervising the technical work, and guiding the development of the manuscript.

12 ECTS

B.Sc. Thesis: *Accelerator Support for GPRat: A Task-based Gaussian Process Library in Python* — *Winter Semester 2024/2025*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the manuscript.

12 ECTS

M.Sc. Thesis: *Distributed Task-based Conjugated Gradients: A Comparison between HPX and MPI+X* *Summer Semester 2024*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the manuscript. *30 ECTS*

M.Sc. Thesis: *GPPPy: Leveraging HPX and BLAS to accelerate Gaussian Processes* *Summer Semester 2024*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the manuscript. *30 ECTS*

M.Sc. Research Project: *Task-based Solar System Simulations using Senders/Receivers* *Summer Semester 2024*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the report. *9 ECTS*

B.Sc. Research Project: *Task-based Lattice-Boltzmann with HPX* *Summer Semester 2024*

- *Supervisor.* Duties include preparing the topic, supervising the technical work, and guiding the development of the report. *9 ECTS*

Teaching

B.Sc. Seminar: *Concepts of Modern C++* *Winter Semester 2025/2026*

- *Organizer and superviser.* Seminar topics include fundamental concepts of the C++ programming language as well as advanced features closely aligned with recent and upcoming C++ standard developments. *3 ECTS*

M.Sc. Lab Course: *Solar System Simulation* *Winter Semester 2025/2026*

- *Co-organizer.* The goal of the course is to efficiently parallelize an N-body simulation of our solar system, implementing the Barnes-Hut algorithm with MPI+OpenMP. *9 ECTS*

B.Sc. Programming Project: *Galaxy Crash* *Winter Semester 2025/2026*

- *Co-organizer.* The goal of this project is to implement and visualize the crash of the Milky Way and the Andromeda Galaxy with C++. Starting with a naive approach, the Barnes-Hut algorithm is used to improve scalability. *6 ECTS*

M.Sc. Seminar: *Strategies of Modern High-Performance Computing* *Summer Semester 2025*

- *Organizer and co-superviser.* Seminar topics include core concepts in optimization, tools for shared-memory and distributed-memory parallelization, and programming for emerging hardware platforms. *3 ECTS*

M.Sc. Lab Course: *Solar System Simulation* *Summer Semester 2025*

- *Co-organizer.* The goal of the course is to efficiently parallelize an N-body simulation of our solar system, implementing the Barnes-Hut algorithm with MPI+OpenMP. *9 ECTS*

B.Sc. Programming Project: *Galaxy Crash* *Summer Semester 2025*

- *Co-organizer.* The goal of this project is to implement and visualize the crash of the Milky Way and the Andromeda Galaxy with C++. Starting with a naive approach, the Barnes-Hut algorithm is used to improve scalability. *9 ECTS*

B.Sc. Seminar: *Concepts of Modern C++* *Winter Semester 2024/2025*

- *Organizer and co-superviser.* Seminar topics include fundamental concepts of the C++ programming language as well as advanced features closely aligned with recent and upcoming C++ standard developments. *3 ECTS*

M.Sc. Lab Course: *Solar System Simulation* *Winter Semester 2024/2025*

- *Co-organizer.* The goal of the course is to efficiently parallelize an N-body simulation of our solar system, implementing the Barnes-Hut algorithm with MPI+OpenMP. *9 ECTS*

B.Sc. Programming Project: *Galaxy Crash* *Winter Semester 2024/2025*

- *Co-organizer.* The goal of this project is to implement and visualize the crash of the Milky Way and the Andromeda Galaxy with C++. Starting with a naive approach, the Barnes-Hut algorithm is used to improve performance.

6 ECTS

M.Sc. Seminar: *Strategies of Modern High-Performance Computing* *Summer Semester 2024*

- *Organizer and co-superviser.* Seminar topics include core concepts in optimization, tools for shared-memory and distributed-memory parallelization, and programming for emerging hardware platforms.

3 ECTS

B.Sc. Seminar: *Concepts of Modern C++* *Winter Semester 2023/2024*

- *Organizer and co-supervisor.* Seminar topics include fundamental concepts of the C++ programming language as well as advanced features closely aligned with recent and upcoming C++ standard developments.

3 ECTS

M.Sc. Seminar: *Advanced Parallel Computing* *Summer Semester 2023*

- *Co-organizer and co-supervisor.* Seminar topics include core concepts in code optimization and parallel computing for shared-memory and distributed-memory environments.

3 ECTS

Service to Profession

Student Volunteer *2025*

- The International Conference for High Performance Computing, Networking, Storage, and Analysis, SC25, St. Louis (U.S.)

Further Qualifications

Academic Writing in English *2024*

University of Stuttgart, Germany

C++ Software Design (Advanced) *2023*

HLRS, Germany

Professional Memberships

ACM SIGHPC Student Member *2024–present*