

Guanghui Song

Lushan Road (S), Yuelu District, Changsha, 410082, China

✉ sheensong@hnu.edu.cn | 🏠 <https://sheensong.top/academic>

RESEARCH INTERESTS

Guanghui Song is a PhD candidate at [Hunan University](#), under the supervision of [Prof. Jie Zhao](#). He obtained a Master's degree from the State Key Laboratory of Mathematical Engineering and Advanced Computing, Information Engineering University. His research interests lie at the intersection of advanced compilation techniques and high-performance computing, with a particular focus on polyhedral compilation, mixed-precision computational acceleration, high-level synthesis (HLS), and hardware acceleration. His work aims to enable the efficient and seamless utilization of diverse hardware platforms, thereby enhancing both computational performance and system usability.

EDUCATION

- **Hunan University** September 2024 - Present
PhD in Computer Science Changsha, China
 - CYCLE Lab at [College of Computer Science and Electronic Engineering](#)
 - Supervised by [Prof. Jie Zhao](#)
- **Information Engineering University** September 2020 - July 2023
MPhil in Computer Science Zhengzhou, China
 - State Key Laboratory of Mathematical Engineering and Advanced Computing (SKL-MEAC)
 - Supervised by Prof. Shaozhong Guo and Assoc. Prof. Jinchen Xu
- **Henan University of Technology** September 2016 - July 2020
BEng in Computer Science Zhengzhou, China
 - Department of Computer Science and Technology
 - GPA: 3.51

WORK EXPERIENCES

- **Li Auto Inc.** July 2023 - August 2024
AI Compiler R&D Engineer Shanghai, China
 - Collaborated with chip architects to assist in the design and optimization of chip architecture, contributing to the development of hardware-software co-design strategies for the targeted AI chips.
 - Contributed to the development and optimization of AI operator libraries, ensuring their compliance with both functional and performance requirements critical to algorithm execution on specialized hardware.
 - Engaged in the design and development of a cutting-edge AI compiler, facilitating the efficient compilation of algorithmic models and operator libraries into executable files compatible with AI chip architectures.
 - Provided ongoing maintenance for the AI compiler and operator libraries, addressing and resolving performance and functionality issues identified during Virtual Platform, RTL simulations, and FPGA verification.
- **Thewake Systems Co. Ltd** June 2022 - September 2022
Compiler Development Intern Beijing, China
 - Contributed to the porting, development, and testing of the self-developed Fiuggi Compiler Collection (FCC), with a focus on enhancing its automatic parallelization capabilities based on LLVM 13.
 - Conducted rigorous benchmarking of the FCC compiler, comparing its multi-threading performance against that of ICC, GCC, LLVM, and AOCC using the [Polybench benchmark suite](#).

SELECTED PROJECTS

- **MixPrecHLS** 2024 - Present
A High-Level Synthesis Framework for Automatic Mixed-Precision Computation [🔗]
 - Designed an automatic mixed-precision optimization framework in MLIR (In progress).
 - Integrated automatic mixed-precision optimization with HLS-specific transform and analysis library, including loop and pragma optimizations, outperforming the state of the art (Our goal).
- **PrecTuner** 2021 - 2023
A Holistic Approach to Automatic Mixed-Precision Code Generation and Tuning for Affine Programs [🔗]
 - Developed an approach to holistically generate mixed-precision code and predict its optimal performance, avoiding the need to evaluate all code variants.
 - Implemented an automatic code generation and tuning framework, significantly reducing the burden of users to benefit from the reduced-precision optimization.
 - Integrated mixed-precision code generation with various loop transformations, outperforming the state of the art and exhibiting a good scalability to parallel execution on both CPU and GPU.

- PPoPP 2024** Jincheng Xu*, **Guanghai Song***, Bei Zhou, Fei Li, Jiangwei Hao, and Jie Zhao†, **A Holistic Approach to Automatic Mixed-Precision Code Generation and Tuning for Affine Programs**. In *Proceedings of 29th ACM SIGPLAN Annual Symposium on Principles and Practice of Parallel Programming (PPoPP 2024)*, 02–06 March, 2024, Edinburgh, United Kingdom, pages 55-67. <https://doi.org/10.1145/3627535.3638484>.
- ASE 2023** Zuoyan Zhang*, Bei Zhou, Jiangwei Hao, Hongru Yang, Mengqi Cui, Yuchang Zhou, **Guanghai Song**, Fei Li, Jincheng Xu, and Jie Zhao†, **Eiffel: Inferring Input Ranges of Significant Floating-point Errors via Polynomial Extrapolation**. In *Proceedings of 38th IEEE/ACM International Conference on Automated Software Engineering (ASE 2023)*, 11-15 September, 2023, Kirchberg, Luxembourg, pages 1441-1453. <https://doi.org/10.1109/ASE56229.2023.00139>

JOURNAL PUBLICATIONS

- 2024** Fei Li*, Shaozhong Guo, Jiangwei Hao, Ming Hou, **Guanghai Song**, Jincheng Xu†, **Basic Math Library Implementation for RISC-V**, *Acta Electronica Sinica*, 2024, 52(5): 1633-1647 (in Chinese). <https://doi.org/10.12263/DZXB.20220375>
- 2023** **Guanghai Song***, Shaozhong Guo, Jie Zhao, Xiaohan Tao, Fei Li, Jincheng Xu†, **Automatic Mixed Precision Optimization for Stencil Computation**, *The Journal of Software*, 2023, 34(12): 5704-5723 (in Chinese). <https://doi.org/10.13328/j.cnki.jos.006757>
- Fei Li*, Shaozhong Guo, Bei Zhou, **Guanghai Song**, Jiangwei Hao, Jincheng Xu†, **Performance optimization of RISC-V basic math library**, *Computer Engineering & Science*, 2023, 45(09): 1532-1543 (in Chinese). <https://doi.org/10.3969/j.issn.1007-130X.2023.09.002>

LANGUAGES

- **Mandarin** : Mother tongue (Daily use)
- **English** : Fluent (Con conversationally fluent)

AWARDS AND SCHOLARSHIPS

- **Li Auto Inc. Proactive "Excellent Individual"** March 2024
- **Information Engineering University First Class Academic Scholarship** June 2023
- **Information Engineering University Second Class Academic Scholarship** June 2022
- **Information Engineering University Second Class Academic Scholarship** June 2021
- **Henan University of Technology "Excellent Recent Graduates"** June 2020
- **Henan University of Technology Innovation and Entrepreneurship Scholarships** October 2019
- **Henan University of Technology "Excellent Student Assistant"** December 2018
- **Ministry of Education of China National Inspiration Scholarships** December 2017

SKILLS

- Proficient in programming languages such as C/C++, Shell, and Python
- Solid foundation in polyhedral compilation optimization theories and extensive experience in programming and debugging on Linux systems
- Familiar with end-to-end compilation based on MLIR targeting domestic hardware platforms
- Experienced in operator development and optimization for autonomous driving algorithms, such as UniAD, on both general-purpose and domestic platforms
- Skilled in using compilation frameworks and tools, including LLVM, ISL library, and PPCG
- Proficient in loop optimizations and commonly used techniques for performance testing
- Familiar with typical algorithms for implementing transcendental functions and precision tuning

REFERENCES

1. **Jie Zhao**
Professor
Hunan University
Email: jiezhao@hnu.edu.cn
Relationship: PhD supervisor
2. **Jincheng Xu**
Associate Professor
Information Engineering University
Relationship: Thesis co-advisor