Kai Zhao

Current Position
Assistant Professor
Department of Computer Science
Florida State University

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Education

Ph.D. in Computer Science — 2017–2022
University of California, Riverside — Riverside, CA
Advisor: Dr. Zizhong Chen

B.S. in Computer Science — 2010–2014
Peking University — Beijing, China

Research Interests

High Performance Computing
Scientific Data Management, Analytics, and Visualization
Fault Tolerance and Resilience in Machine Learning and HPC
Large Scale Deep Neural Networks
Parallel and Distributed Systems

Professional Experience

- Assistant Professor, Florida State University, Tallahassee, FL — 2023-present
- Assistant Professor, University of Alabama at Birmingham, Birmingham, AL — 2022-2023
- Research Aide, Argonne National Laboratory, Lemont, IL — 2019
- Senior Software Engineer, Wacai Technology Co., Ltd., Hangzhou, China, — 2017
- Software Engineer, MicroStrategy, Hangzhou, China — 2016
- Software Engineer, Alibaba Group, Hangzhou, China — 2014-2016

Grants

- **Site PI**, Argonne National Laboratory DOE, *Lossy compression for streaming data*, $240K — 2024-2026
- **Site PI**, NSF CSSI, *Collaborative Research*: *Frameworks*: *FZ*: *A fine-tunable cyberinfrastructure framework to streamline specialized lossy compression development*, $540K (total $3.1M)
  Lead PI: Franck Cappello @ UChicago; Co-PI: Sheng Di @ UChicago; Site PIs: Dingwen Tao @ IU, Hanqi Guo @ OSU; Postdoc: Robert Underwood @ UChicago — 2023-2027

Teaching Experience

- FSU CDA4150/5155: Computer Architecture — Fall 2023
- UAB CS632/732: Parallel Computing — Spring 2023
- UAB CS332/532: Systems Programming — Fall 2022

Refereed Conference Publications

1. **[SIGMOD'23]** Jinyang Liu, Sheng Di, **Kai Zhao**, Xin Liang, Sian Jin, Zizhe Jian, Jiajun Huang, Shixun Wu, Zizhong Chen, and Franck Cappello, "High-performance Effective Scientific Error-bounded Lossy Compression with Auto-tuned Multi-component Interpolation." *Proceedings of the* 2024 *International Conference on Management of Data*, Santiago, Chile, June 9 - 15, 2024.
2. **[HiPC'23]** Arham Khan, Sheng Di, **Kai Zhao**, Jinyang Liu, Kyle Chaid, Ian Foster, and Franck Cappello, "SECRE: Surrogate-based Error-controlled Lossy Compression Ratio Estimation Framework." *Proceedings of the IEEE* 29*th International Conference on High Performance Computing, Data, and Analytics*, Goa, India, Dec 18 - 21, 2023.
3. **[BigData'23]** Jinyang Liu, Sheng Di, Sian Jin, **Kai Zhao**, Xin Liang, Zizhong Chen, and Franck Cappello, "SRN-SZ: Deep Leaning-Based Scientific Error-bounded Lossy Compression with Super-resolution Neural Networks." *Proceedings of* 2023 *IEEE International Conference on Big Data* , Sorrento, Italy, Dec 15 - 17, 2023.
4. **[SC'23]** Daoce Wang, Jesus Pulido, Jesus Pulido, Jiannan Tian, Sian Jin, Houjun Tang, Jean Sexton, Sheng Di, **Kai Zhao**, Bo Fang, Zarija Lukic, Franck Cappello, James Ahrens, and Dingwen Tao, "AMRIC: A Novel In Situ Lossy Compression Framework for Efficient I/O in Adaptive Mesh Refinement Applications." *Proceedings of the* 35*rd ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, Denvor, CO, USA, Nov 12 - 17, 2023.

5. **[ICS'23]** Jinyang Liu, Sheng Di, **Kai Zhao**, Xin Liang, Zizhong Chen, and Franck Cappello, "FZ: A flexible auto-tuned modular error-bounded compression framework for scientific data." *Proceedings of the* 37*th ACM International Conference on Supercomputing*, Orlando, FL, June 21 - 23, 2023.
6. **[CCGrid'23]** Yafan Huang, **Kai Zhao**, Sheng Di, Guanpeng Li, Maxim Dmitriev, Thierry-Laurent D. Tonellot and Franck Cappello, "Towards Improving Reverse Time Migration Performance by High-speed High-fidelity Lossy Compression." *Proceedings of he* 23*rd IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing*, Bangalore, India, May 1 - May 4, 2023.
7. **[VLDB'23]** Pu Jiao, Sheng Di, Hanqi Guo, **Kai Zhao**, Jiannan Tian, Dingwen Tao, Xin Liang, and Franck Cappello, "Toward Quantity-of-Interest Preserving Lossy Compression for Scientific Data." *Proceedings of the* 49*th International Conference on Very Large Data Bases*, Vancour, Canada, Aug 28 - Sep 1, 2023.
8. **[ICDE'23]** Md Hasanur Rahman, Sheng Di, **Kai Zhao**, Robert Underwood, Guanpeng Li, and Franck Cappello, "A Feature-Driven Fixed-Ratio Lossy Compression Framework for Real-World Scientific Datasets." *Proceedings of the* 39*th IEEE International Conference on Data Engineering*, Anaheim, CA, USA, April 3 - 7, 2023.
9. **[PPoPP'23]** Jieyang Chen, Xin Liang, **Kai Zhao**, Hadi Zamani Sabzi, Laxmi Bhuyan, and Zizhong Chen, "Improving Energy Saving of One-sided Matrix Decompositions on CPU-GPU Heterogeneous Systems." *Proceedings of the* 28*th ACM SIGPLAN Annual Symposium on Principles and Practice of Parallel Programming*, Montreal, Canada. Feb 25 - Mar 1, 2023.
10. **[HiPC'22]** Yuanjian Liu, Sheng Di, **Kai Zhao**, Sian Jin, Cheng Wang, Kyle Chard, Dingwen Tao, Ian Foster, and Franck Cappello, "Optimizing Multi-Range based Error-Bounded Lossy Compression for Scientific Datasets." *Proceedings of the IEEE* 28*th International Conference on High Performance Computing, Data, and Analytics*, Bengaluru, India, Dec 17-20, 2022.
11. **[SC'22]** Jinyang Liu, Sheng Di, **Kai Zhao**, Xin Liang, Zizhong Chen, and Franck Cappello, "Dynamic Quality Metric Oriented Error Bounded Lossy Compression for Scientific Datasets." *Proceedings of the* 34*rd ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, Dallas, TX, USA, Nov 13 - 18, 2022. Acceptance Rate: 25.3% (81/320)
12. **[HPDC'22]** Xiaodong Yu, Sheng Di, **Kai Zhao**, Jiannan Tian, Dingwen Tao, Xin Liang, and Franck Cappello, "Ultra-fast Error-bounded Lossy Compression for Scientific Dataset." *Proceedings of the* 31*th International Symposium on High-Performance Parallel and Distributed Computing*, Minneapolis, USA, June 27 - July 1, 2022. Acceptance Rate: 19% (21/108)
13. **[ICDE'22] Kai Zhao**, Sheng Di, Danny Perez, Zizhong Chen, and Franck Cappello, "MDZ: An Efficient Error-bounded Lossy Compressor for Molecular Dynamics Simulations." *Proceedings of the* 38*th IEEE International Conference on Data Engineering*, Online, May 9 - 12, 2022.
14. **[SC'21]** Sihuan Li, Sheng Di, **Kai Zhao**, Xin Liang, Zizhong Chen, Franck Cappello, "Resilient Error-bounded Lossy Compressor for Data Transfer." *Proceedings of the* 33*rd ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, St. Louis, MO, Nov 14 - 19, 2021. Acceptance Rate: 23.6% (86/365)
15. **[Cluster'21]** Jinyang Liu, Sheng Di, **Kai Zhao**, Sian Jin, Dingwen Tao, Xin Liang, Zizhong Chen, Franck Cappello, "Exploring Autoencoder-Based Error-Bounded Compression for Scientific Data." *Proceedings of the* 23*nd IEEE International Conference on Cluster Computing*, Online, Sep 7 - 10, 2021. Acceptance Rate: 29% (48/163)
16. **[Cluster'21]** Jiannan Tian, Sheng Di, Xiaodong Yu, Cody Rivera, **Kai Zhao**, Sian Jin, Yunhe Feng, Xin Liang, Dingwen Tao, Franck Cappello, "CuSZ+: Optimizing Error-Bounded Lossy Compression for Scientific Data on GPUs." *Proceedings of the* 23*nd IEEE International Conference on Cluster Computing*, Online, Sep 7 - 10, 2021. Acceptance Rate: 29% (48/163)
17. **[ICS'21]** Yujia Zhai, Elisabeth Giem, Quan Fan, **Kai Zhao**, Jinyang Liu, and Zizhong Chen, "FT-BLAS: A High Performance BLAS Implementation With Online Fault Tolerance." *Proceedings of the* 35*th ACM International Conference on Supercomputing*, Online, June 14 - 17, 2021. Acceptance Rate: 24% (38/157)
18. **[ICDE'21] Kai Zhao**, Sheng Di, Maxim Dmitriev, Thierry-Laurent D. Tonellot, Zizhong Chen, and Franck Cappello, "Optimizing Error-Bounded Lossy Compression for Scientific Data by Dynamic Spline Interpolation." *Proceedings of the* 37*th IEEE International Conference on Data Engineering*, Chania, Crete, Greece, Apr 19 - 22, 2021. Acceptance Rate: 27% (151/549)

19. **[PACT'20]** Jiannan Tian, Sheng Di, **Kai Zhao**, Cody Rivera, Megan Hickman, Robert Underwood, Sian Jin, Xin Liang, Jon Calhoun, Dingwen Tao, and Franck Cappello, "cuSZ: An Efficient GPU Based Error-Bounded Lossy Compression Framework for Scientific Data." *Proceedings of the* 29*th International Conference on Parallel Architectures and Compilation Techniques*, Atlanta, GA, USA, Oct 3 - 7, 2020. Acceptance Rate: 25% (35/137)
20. **[Cluster'20]** Sihuan Li, Sheng Di, **Kai Zhao**, Xin Liang, Zizhong Chen, and Franck Cappello, "Towards End-to-end SDC Detection for HPC Applications Equipped with Lossy Compression." *Proceedings of the* 22*nd IEEE International Conference on Cluster Computing*, Kobe, Japan, Sep 14 - 17, 2020. Acceptance Rate: 24% (32/132)
21. **[HPDC'20] Kai Zhao**, Sheng Di, Xin Liang, Sihuan Li, Dingwen Tao, Zizhong Chen, and Franck Cappello, "Significantly Improving Lossy Compression for HPC Datasets with Second-Order Prediction and Parameter Optimization." *Proceedings of the* 29*th International Symposium on High-Performance Parallel and Distributed Computing*, Stockholm, Sweden, June 23 - 26, 2020. Acceptance Rate: 22% (16/71)
22. **[SC'19]** Sihuan Li, Hongbo Li, Xin Liang, Jieyang Chen, Elisabeth Giem, Kaiming Ouyang,**Kai Zhao**, Sheng Di, Franck Cappello, and Zizhong Chen, "FT-iSort: Efficient Fault Tolerance for Introsort." *Proceedings of the* 31*st ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, Denver, Colorado, USA, Nov 17 - 22, 2019. Acceptance Rate: 20% (72/344)
23. **[ICS'19]**Jieyang Chen, Nan Xiong, Xin Liang, Dingwen Tao, Sihuan Li, Kaiming Ouyang, **Kai Zhao**, Nathan DeBardeleben, Qiang Guan, and Zizhong Chen, "TSM2: Optimizing Tall-and-Skinny Matrix-Matrix Multiplication on GPUs." *Proceedings of the* 33*rd ACM International Conference on Supercomputing*, Phoenix, AZ, USA, June 26 - 28, 2019. Acceptance Rate: 23% (45/193)
24. **[SC'18]** Jieyang Chen, Hongbo Li, Sihuan Li, Xin Liang, Panruo Wu, Dingwen Tao, Kaiming Ouyang, Yuanlai Liu, **Kai Zhao**, Qiang Guan, and Zizhong Chen, "Fault Tolerant One-sided Matrix Decompositions on Heterogeneous Systems with GPUs." *Proceedings of the* 30*th ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, Dallas, Texas, USA, Nov 11 - 16, 2018. Acceptance Rate: 19% (55/288)

Refereed Journal Publications

1. **[TPDS'23]** Yujia Zhai, Elisabeth Giem, **Kai Zhao**, Jinyang Liu, Jiajun Huang, Bryan Wong, Christian Shelton, and Zizhong Chen, "FT-BLAS: A Fault Tolerant High Performance BLAS Implementation on x86 CPUs" *IEEE Transactions on Parallel and Distributed Systems*, 2023.
2. **[TBD'22]** Xin Liang*, **Kai Zhao***, Sheng Di, Sihuan Li, Robert Underwood, li M. Gok, Jiannan Tian, Junjing Deng, Jon C. Calhoun, Dingwen Tao, Zizhong Chen, and Franck Cappello, "SZ3: A Modular Framework for Composing Prediction-Based Error-Bounded Lossy Compressors." *IEEE Transactions on Big Data*. August 2022. *Authors contributed equally.
3. **[TPDS'22]** Yuanjian Liu, Sheng Di, **Kai Zhao**, Sian Jin, Cheng Wang, Kyle Chard, Dingwen Tao, Ian Foster, and Franck Cappello, "Optimizing Error-Bounded Lossy Compression for Scientific Data With Diverse Constraints" *IEEE Transactions on Parallel and Distributed Systems*, July 2022.
4. **[TPDS'21] Kai Zhao**, Sheng Di, Sihuan Li, Xin Liang, Yujia Zhai, Jieyang Chen, Kaiming Ouyang, Franck Cappello and Zizhong Chen, "FT-CNN: Algorithm-Based Fault Tolerance for Convolutional Neural Networks." *IEEE Transactions on Parallel and Distributed Systems*, Volume 32, Issue 7, July 2021.

Refereed Workshop Publications

1. **[IWBDR-2]** Jinyang Liu, Sihuan Li, Sheng Di, Xin Liang, **Kai Zhao**, Dingwen Tao, Zizhong Chen, and Franck Cappello, "Improving Lossy Compression for SZ by Exploring the Best-Fit Lossless Compression Techniques" *Proceedings of the* 2*st International Workshop on Big Data Reduction @BigData'*21, Orlando, FL, USA, Dec 15 - 18, 2021.
2. **[IWBDR-1] Kai Zhao**, Sheng Di, Xin Liang, Sihuan Li, Dingwen Tao, Julie Bessac, Zizhong Chen, and Franck Cappello, "SDRBench: Scientific Data Reduction Benchmark for Lossy Compressors" *Proceedings of the* 1*st International Workshop on Big Data Reduction @BigData'*20, Online, Dec 10 - 13, 2020.
3. **[DRBSD-7]** Yuanjian Liu, Sheng Di, **Kai Zhao**, Kyle Chard, Wentao Ding, Sian Jin, Cheng Wang, Ian Foster, and Frank Cappello, "Understanding Effectiveness of Multi-error-bounded Lossy Compression for Preserving Ranges of Interest in Scientific Analysis" *Proceedings of the* 7*th International Workshop on Data Analysis and Reduction for Big Scientific Data*, St. Louis, MO, USA, Nov 14th, 2021.

Service

- **Organizing Committee:** IWBDR (co-chair)
- **Programs Committee:** HPCC, IWBDR
- **Reviewer:** SC, ICS, HPDC, IPDPS, ICPP, CCGrid, BigData, TPDS, TPAMI, ICMLA, ICSNC, SELSE, UAAI

Invited Talks

- "Data Reduction and Error Resilience for Exascale Applications", College of Information Sciences and Technology, Penn State University 03/2022
- "Data Reduction and Error Resilience for Exascale Applications", Department of Computational and Data Sciences, George Mason University 03/2022
- "Data Reduction and Error Resilience for Exascale Applications", Department of Computer Science, University of Kentucky 01/2022

Honors and Awards

- R&D 100 Award (SZ compression framework) 2021
- Laxmi N. Bhuyan Fellowship, University of California, Riverside 2021
- Dissertation Year Program Fellowship, University of California, Riverside 2021
- Dean's Distinguished Fellowship, University of California, Riverside 2017
- Second Prize in Microsoft Student Challenge, Microsoft Research Asia 2012
- First Prize of National Olympiad in Informatics in Henan Provinces, China 2009