Mike Rainey

Education

2007–2010 **Ph.D.**, *University of Chicago*, Chicago, Computer Science

2004–2007 **M.S.**, *University of Chicago*, Chicago, Computer Science

2000–2004 **B.S.**, *Indiana University*, Bloomington, Computer Science & Cognitive Science

Employment

2021–2026 **Project Scientist**, *Carnegie Mellon University*, Pittsburgh, PA, USA
Carried out research on task-parallel/multicore programming.

2019–2020 **Project Scientist**, *Carnegie Mellon University*, Pittsburgh, PA, USA
Carried out research on task-parallel/multicore programming.

2018–2019 **Principal Software Research Engineer**, *Indiana University*, Bloomington, IN, USA, Parallel Programming Languages and Compilers
Carried out research on task-parallel/multicore programming.

2013–2018 **Researcher**, *INRIA*, Paris, FR
Carried out research on task-parallel/multicore programming.

2010–2013 **Postdoctoral researcher**, *Max Planck Institute for Software Systems*, Kaiserslautern, DE
Carried out research on task-parallel/multicore programming.

2007 **Summer internship**, *Intel*, Santa Clara, CA, USA
Under supervision of Anwar Ghuloum, performed research on language support for multicore systems.

2006–2007 **Programming project**, *University of Chicago*, Chicago, IL, USA
Extended the MLRISC code generator to support the AMD64. Supported by NSF Grant CRI: Standard ML Software Infrastructure. Principal investigators: David MacQueen and John H. Reppy.

2003–2004 **Research assistant**, *Indiana University*, Bloomington, IN, USA
Under supervision of David S. Wise, designed and evaluated performance of cache-aware and multiprocessor matrix-factoring algorithms. Supported by NSF Grant CRI: A Paradigm of Parallel Programming for Morton Ordered Matrices.

Honors

2020 **SIGPLAN Research Highlight**, *"Provably and Practically Efficient Granularity Control" (PPoPP 2019)*
Selected by ACM SIGPLAN as a Research Highlight.

Publications

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Conferences

[Rai+26] Mike Rainey, Michael H. Borkowski, Michael Vollmer, Chaitanya S. Koparkar, Mikah Kainen, and Vidush Singhal. "LoCalMem: Type-Directed Adaptive Serialization for Location- and Content-Addressable Memory". In: vol. 10. ICFP. New York, NY, USA: Association for Computing Machinery, Aug. 2026. URL: http://mike-rainey.site/papers/localmem.pdf.

[Kop+24] Chaitanya Koparkar, Vidush Singhal, Aditya Gupta, Mike Rainey, Michael Vollmer, Artem Pelenitsyn, Sam Tobin-Hochstadt, Milind Kulkarni, and Ryan R. Newton. "Garbage Collection for Mostly Serialized Heaps". In: ISMM. New York, NY, USA: Association for Computing Machinery, June 2024. URL: https://a.pelenitsyn.top/Papers/2024-gibbon-gc.pdf.

[Sin+24] Vidush Singhal, Chaitanya Koparkar, Joseph Zullo, Artem Pelenitsyn, Michael Vollmer, Mike Rainey, Milind Kulkarni, and Ryan R. Newton. "Optimizing Layout of Recursive Datatypes with Marmoset". In: ECOOP. New York, NY, USA: Association for Computing Machinery, June 2024. URL: https://arxiv.org/pdf/2405.17590.

[Su+24] Yian Su, Mike Rainey, Nick Wanninger, Nadharm Dhiantravan, Jasper Liang, Umut Acar, Peter Dinda, and Simone Campanoni. "Compiling Loop-Based Nested Parallelism for Irregular Workloads". In: *The 29th ACM International Conference on Architectural Support for Programming Languages and Operating Systems*. Vol. 22. ASPLOS '24 ASPLOS. ACM. New York, NY, USA, 2024. URL: http://mike-rainey.site/papers/HELIX_ASPLOS_2024.pdf.

[Wes+24a] Sam Westrick, Matthew Fluet, Mike Rainey, and Umut A. Acar. "Automatic Parallelism Management". In: vol. 8. POPL. New York, NY, USA: Association for Computing Machinery, Jan. 2024. DOI: 10.1145/3632880. URL: https://doi.org/10.1145/3632880.

[Wes+24b] Sam Westrick, Pengyu Liu, Byeongjee Kang, Colin McDonald, Mike Rainey, Mingkuan Xu, Jatin Arora, Yongshan Ding, and Umut A. Acar. "GraFeyn: Efficient Parallel Sparse Simulation of Quantum Circuits". In: *Proceedings of the IEEE International Conference on Quantum Computing and Engineering* (Montréal, Canada, Sept. 15–20, 2024). 2024. URL: https://www.cs.cmu.edu/~swestric/24/qce24-grafeyn.pdf.

[Wes+22] Sam Westrick, Mike Rainey, Daniel Anderson, and Guy E. Blelloch. "Parallel Block-Delayed Sequences". In: *Proceedings of the 27th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming*. PPoPP '22. Seoul, Republic of Korea: Association for Computing Machinery, 2022, pp. 61–75. ISBN: 9781450392044. DOI: 10.1145/3503221.3508434. URL: https://doi.org/10.1145/3503221.3508434.

[Kop+21] Chaitanya Koparkar, Mike Rainey, Michael Vollmer, Milind Kulkarni, and Ryan R. Newton. "Efficient Tree-Traversals: Reconciling Parallelism and Dense Data Representations". In: vol. 5. ICFP. New York, NY, USA: Association for Computing Machinery, Aug. 2021. DOI: 10.1145/3473596. URL: https://doi.org/10.1145/3473596.

[Rai+21] Mike Rainey, Kyle Hale, Ryan R. Newton, Nikos Hardavellas, Simone Campanoni, Peter Dinda, and Umut A. Acar. "Task Parallel Assembly Language for Uncompromising Parallelism". In: *Proceedings of the 42nd ACM SIGPLAN Conference on Programming Language Design and Implementation*. PLDI '21. New York, NY, USA: ACM, June 2021. URL: http://mike-rainey.site/papers/tpal-long.pdf.

[Aca+19] Umut A. Acar, Vitaly Aksenov, Arthur Charguéraud, and Mike Rainey. "Provably and Practically Efficient Granularity Control". In: *Proceedings of the 24th Symposium on Principles and Practice of Parallel Programming*. PPoPP '19. Washington, District of Columbia: ACM, 2019, pp. 214–228. ISBN: 978-1-4503-6225-2. URL: http://mike-rainey.site/papers/oracle-ppop19-long.pdf.

[Vol+19] Michael Vollmer, Chaitanya Koparkar, Mike Rainey, Laith Sakka, Milind Kulkarni, and Ryan R. Newton. "LoCal: A Language for Programs Operating on Serialized Data". In: *40th ACM SIGPLAN Conference on Programming Language Design and Implementation*. PLDI '19. ACM. 2019. URL: http://mike-rainey.site/papers/lo-cal19.pdf.

[Aca+18] Umut A Acar, Arthur Charguéraud, Adrien Guatto, Mike Rainey, and Filip Sieczkowski. "Heartbeat Scheduling: Provable Efficiency for Nested Parallelism". In: *39th ACM SIGPLAN Conference on Programming Language Design and Implementation*. PLDI '18. ACM. 2018. URL: http://mike-rainey.site/papers/heartbeat.pdf.

[ABR17] Umut A Acar, Naama Ben-David, and Mike Rainey. "Contention in Structured Concurrency: Provably Efficient Dynamic NonZero Indicators for Nested Parallel Computation". In: *22nd ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming*. PPoPP '17. ACM. 2017. URL: http://mike-rainey.site/papers/dynsnzi.pdf.

[Aca+16] Umut A Acar, Arthur Charguéraud, Mike Rainey, and Filip Sieczkowski. "Dag-Calculus: A Calculus for Parallel Computation". In: *The 26th ACM SIGPLAN International Conference on Functional Programming*. ICFP '16. ACM. 2016. URL: http://mike-rainey.site/papers/dag-calculus.pdf.

[ACR15] Umut A Acar, Arthur Charguéraud, and Mike Rainey. "A Work-efficient Algorithm for Parallel Unordered Depth-first Search". In: *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*. SC '15. ACM, 2015, 67:1–67:12. URL: http://mike-rainey.site/papers/pdfs_sc15.pdf.

[ACR14] Umut A Acar, Arthur Charguéraud, and Mike Rainey. "Theory and Practice of Chunked Sequences". In: *The 22nd Annual European Symposium on Algorithms*. ESA '14. Springer, 2014, pp. 25–36. URL: http://mike-rainey.site/papers/chunked_seq.pdf.

[ACR13] Umut A Acar, Arthur Charguéraud, and Mike Rainey. "Scheduling Parallel Programs by Work Stealing with Private Deques". In: *18th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming*. Vol. 48. PPoPP '13 8. ACM. 2013, pp. 219–228. URL: http://mike-rainey.site/papers/full.pdf.

[Ber+13] Lars Bergstrom, Matthew Fluet, Mike Rainey, John Reppy, Stephen Rosen, and Adam Shaw. "Data-only Flattening for Nested Data Parallelism". In: *18th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming*. Vol. 48. PPoPP '13 8. ACM. 2013, pp. 81–92. URL: http://mike-rainey.site/papers/ppopp13-flat.pdf.

[ACR11] Umut A Acar, Arthur Charguéraud, and Mike Rainey. "Oracle Scheduling: Controlling Granularity in Implicitly Parallel Languages". In: *Proceedings of the 2011 ACM international conference on Object oriented programming systems languages and applications*. Vol. 46. OOPSLA '11 10. ACM. 2011, pp. 499–518. URL: http://mike-rainey.site/papers/oracle_scheduling.pdf.

[Ber+10] Lars Bergstrom, Mike Rainey, John Reppy, Adam Shaw, and Matthew Fluet. "Lazy Tree Splitting". In: *The 20th ACM SIGPLAN International Conference on Functional Programming*. Vol. 45. ICFP '10 9. ACM. 2010, pp. 93–104. URL: http://mike-rainey.site/papers/icfp10-lts.pdf.

[FRR08] Matthew Fluet, Mike Rainey, and John Reppy. "A Scheduling Framework for General-purpose Parallel Languages". In: *The 13th ACM SIGPLAN International Conference on Functional Programming*. Vol. 43. ICFP '08 9. ACM. 2008, pp. 241–252. URL: http://mike-rainey.site/papers/icfp08-sched.pdf.

[Flu+08] Matthew Fluet, Mike Rainey, John Reppy, and Adam Shaw. "Implicitly-threaded Parallelism in Manticore". In: *The 13th ACM SIGPLAN International Conference on Functional Programming*. Vol. 43. ICFP '08 9. ACM. 2008, pp. 119–130. URL: http://mike-rainey.site/papers/icfp08-implicit.pdf.

[Wis+05] David S. Wise, Craig Citro, Joshua Hursey, Fang Liu, and Michael Rainey. "A Paradigm for Parallel Matrix Algorithms: Scalable Cholesky". In: *In Euro-Par 2005 – Parallel Processing*. 2005. URL: http://dx.doi.org/10.1007/11549468_76.

Workshops

[Rai23] Mike Rainey. *The best multicore refactoring you've never heard of*. Tech. rep. 2023. URL: http://mike-rainey.site/papers/pardefunc.pdf.

[CR17] Arthur Charguéraud and Mike Rainey. *Efficient Representations for Large Dynamic Sequences in ML*. ML Family Workshop. Sept. 2017. URL: https://hal.inria.fr/hal-01669407/file/chunkseq_ml.pdf.

[ACR12] Umut A Acar, Arthur Charguéraud, and Mike Rainey. *Efficient Primitives for Creating and Scheduling Parallel Computations*. Appears in the short-paper track. Jan. 2012. URL: http://mike-rainey.site/papers/damp2012_primitives.pdf.

[BRR08] Matthias Blume, Michael Rainey, and John Reppy. *Calling Variadic Functions from a Strongly-typed Language*. ACM, 2008. URL: http://mike-rainey.site/papers/ml-varargs.pdf.

[Flu+07] Matthew Fluet, Mike Rainey, John Reppy, Adam Shaw, and Yingqi Xiao. *Manticore: A Heterogeneous Parallel Language*. ACM, 2007.

Journals

[ACR16b] Umut A Acar, Arthur Charguéraud, and Mike Rainey. "Oracle-Guided Scheduling for Controlling Granularity in Implicitly Parallel Languages". In: Cambridge University Press, 2016. URL: http://mike-rainey.site/papers/jfp-oracle-guided.pdf.

[Ber+12] Lars Bergstrom, Matthew Fluet, Mike Rainey, John Reppy, and Adam Shaw. "Lazy Tree Splitting". In: vol. 22. 4-5. Cambridge University Press, 2012, pp. 382–438. URL: http://mike-rainey.site/papers/jfp-lts-submitted.pdf.

[Flu+10] Matthew Fluet, Mike Rainey, John Reppy, and Adam Shaw. "Implicitly Threaded Parallelism in Manticore". In: vol. 20. 5-6. Cambridge University Press, 2010, pp. 537–576.

Technical reports

[RAS26] Mike Rainey, Umut Acar, and Muhammed Sezer. "SPIRE: Structure-Preserving Interpretable Retrieval of Evidence". In: (Apr. 2026). DOI: 10.5281/zenodo.19441410. URL: https://zenodo.org/records/19441410.

[ACR17] Umut A. Acar, Arthur Charguéraud, and Mike Rainey. *Parallel Work Inflation, Memory Effects, and their Empirical Analysis*. Tech. rep. 2017. arXiv: 1709.03767. URL: http://arxiv.org/abs/1709.03767.

Software artifacts

Manticore, *Parallel dialect of Standard ML*, This artifact consists of a parallel, functional programming language aimed at general-purpose applications running on multi-core processors. I contributed code to the compiler and runtime system, with particular focus on load balancing for parallel workloads and on code generation
http://manticore.cs.uchicago.edu/

Chunkedseq, *Chunked sequence data structure*, This project features a C++ template library which implements ordered, in-memory containers that are based on the B-tree-like data structure I coauthored with Umut Acar and Arthur Charguéraud [ACR14]
http://mike-rainey.site/chunkedseq/chunkedseq.html

PASL, *Parallel Algorithm Scheduling Library*, I coauthored this library with Umut Acar and Arthur Charguéraud
http://deepsea.inria.fr/pasl/

SML/NJ, *Standard ML of New Jersey*, I worked on the back end of the compiler. My main projects covered code generation for the x86_64 and support for foreign-function calls
http://smlnj.org/

PDFS, *Parallel DFS*, This project features a C++ implementation of the fast DFS-like graph-traversal algorithm from the SC'15 paper [ACR15]
http://mike-rainey.site/pdfs/pdfs.html

Professional service

Program committee member

2019 **ICFP**, *ACM SIGPLAN International Conference on Functional Programming*
`https://icfp19.sigplan.org/`

2018 **FHPC**, *ACM SIGPLAN Workshop on Functional High-Performance Computing*, Co-organized with Kei Davis (`https://ccsweb.lanl.gov/~kei/`)
`https://icfp18.sigplan.org/track/FHPC-2018-papers`

2018 **IPDPS**, *International Parallel and Distributed Processing Symposium*
`http://www.ipdps.org/`

2016 **FHPC**, *ACM SIGPLAN Workshop on Functional High-Performance Computing*
`http://conf.researchr.org/home/FHPC-2016`

2015 **ICFP**, *ACM SIGPLAN International Conference on Functional Programming*
`http://icfpconference.org/icfp2015/`

2014 **ECOOP**, *European Conference on Object-Oriented Programming*, Artifact-evaluation-committee member
`http://ecoop14.it.uu.se/index.php`

2013 **FHPC**, *ACM SIGPLAN Workshop on Functional High-Performance Computing*
`https://sites.google.com/site/fhpcworkshops/fhpc-2013`

Reviewer

ICFP, *ACM SIGPLAN International Conference on Functional Programming*

PLDI, *ACM SIGPLAN Programming Language Design and Implementation*

PPoPP, *ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming*

POPL, *ACM SIGPLAN Symposium on Principles of Programming Languages*

SPAA, *ACM Symposium on Parallelism in Algorithms and Architectures*

TOPLAS, *ACM Transactions on Programming Languages and Systems*

JFP, *Journal of Functional Programming*

ESOP, *European Joint Conferences on Theory and Practice of Software*

Euro-Par, *International Conference on Parallel Programming*

Teaching

Course materials

2014 **PASL book and minicourse**

In 2014, Umut Acar and I authored course materials on multicore computing. We were motivated by a gap between the teaching of theory and practice of parallel computing that we believe existed in the undergraduate algorithms course at Carnegie Mellon University, where Acar teaches. We were also motivated by the desire to hone an automatic granularity-control technique that we developed as part of our research collaboration [ACR16b; ACR11]. We used the course materials to teach a two-week, NSF-funded, undergraduate course at the University of Puerto Rico PASL Workshop (`https://sites.google.com/site/paslpr14/home`). Later, in 2014, we introduced updated materials into the undergraduate algorithms course at Carnegie Mellon University. I served as guest lecturer in 2014 and 2015, and since then, this material has been reused several times in the course. The course materials are available on the course website (`http://www.cs.cmu.edu/~15210/pasl.html`).

Teaching assistantships

2009 **Implementation of Computer Languages - II**, *University of Chicago*, Spring

2007 **CSPP Networks**, *University of Chicago*, Winter

2006 **Introduction to Computer Systems**, *University of Chicago*, Spring

2006 **CSPP Unix Systems Programming**, *University of Chicago*, Fall

Selected talks

2019 **Provably and Practically Efficient Granularity Control**, *PPoPP*
video at `https://youtu.be/uItZHGL6aaQ`; slides at `http://mike-rainey.site/papers/oracle_ppopp_talk.pdf`

2018 **Heartbeat Scheduling: Provable Efficiency for Nested Parallelism**, *PLDI*
video at `https://youtu.be/re-syeFf8bA`; slides at `http://mike-rainey.site/papers/heartbeat_talk.pdf`

2016 **A Work-efficient Algorithm for Parallel Unordered Depth-first Search**, *Supercomputing*
video at `https://youtu.be/Nr2s1-fds3w`; slides at `http://mike-rainey.site/papers/sc15-pdfs-talk.pdf`

2013 **Scheduling Parallel Programs by Work Stealing with Private Deques**, *PPoPP*
slides at `http://mike-rainey.site/papers/ppopp2013.pdf`

2013 **Higher-level Implicit Parallelism with PASL**, *LAME Workshop*
slides at `http://mike-rainey.site/papers/lame2013.pdf`

2011 **Fork-join Model and Work stealing**, *MPI-SWS weekly seminar*
slides at `http://mike-rainey.site/papers/reading_group_slides.pdf`