Maximilian H. Bremer

CONTACT INFORMATION

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EDUCATION

University of Texas at Austin,
Oden Institute for Computational Engineering and Sciences

Ph.D. Computational Science, Engineering, and Mathematics. August 2020.
M.Sc., Computational Science, Engineering, and Mathematics, May 2018.
Thesis: Task-Based Parallelism for Hurricane Storm Surge
Advisor: Clint Dawson

University of Cambridge,

M.A.St., Part III Pure Mathematics, June 2015.
Emphasis: Partial Differential Equations / Analysis

The University of Texas at Austin

B.Sc., Aerospace Engineering, May 2014, GPA: 3.98/4.00.
B.Sc., Applied Mathematics, May 2014, GPA: 3.98/4.00.

RESEARCH EXPERIENCE

Keywords

Task-based parallelism • High performance computing • Discontinuous Galerkin finite elements • Shallow water equations • Hurricane storm surge

Lawrence Berkeley National Lab Fall 2020–present
Computer Architecture Group *Supervised by:* Cy Chan and John Shalf

‡ Co-designed accelerator for graph algorithms. Designed and modeled a 4x speed-up for community detection algorithms: Markov Clustering and Infomap community detection.
‡ Developed optimistic parallel discrete event simulation back-end for the Structural Simulation Toolkit (SST); observed an up to 2.76x speed-up due to reduced synchronization costs

The University of Texas at Austin Fall 2015–Fall 2020
Computational Hydraulics Group *Supervised by:* Clint Dawson

‡ Compared and analyzed performance of flat (non-blocking) MPI versus an HPX-based parallelization on Knights Landing and Skylake architectures on Stampede2.
‡ Performed roofline analyses and implemented vectorization strategies that accelerated the code by 2.9x.
‡ Refactored in-house discontinuous Galerkin storm surge code to improve productivity. Introduced software engineering best practices, e.g. continuous integration and unit testing.

Lawrence Berkeley National Lab Summer 2019
Computer Architecture Group *Supervised by:* Cy Chan

‡ Designed timestepping strategies that adaptively refine and coarsen timesteps to ensure that cells optimally satisfy the CFL condition.
‡ Leveraged existing speculative parallel discrete event simulation techniques to efficiently parallelize the code.

Lawrence Berkeley National Lab Summer 2016
Computer Architecture Group *Supervised by:* Cy Chan

‡ Explored load balancing strategies for asynchronously run hurricane storm surge simulations.
‡ Developed and validated a discrete event simulator of the application code for rapid prototyping of load balancing strategies.

Publications

Journal Articles

4. **M.B.**, John Bachan, Cy Chan, Clint Dawson, "Performance Analysis of Speculative Parallel Adaptive Local Timestepping for Conservation Laws", *ACM Transactions on Modeling and Computer Simulation*, September 2022, doi:10.1145/3545996.
3. **M.B.**, John Bachan, Cy Chan, Clint Dawson, "Adaptive Total Variation Stable Local Timestepping for Conservation Laws", *Journal of Computational Physics*, August 2022, doi:10.1016/j.jcp.2022.111176.
2. Chao Zhang, **M.B.**, Cy Chan, John Shalf, Xiaochen Guo, "ASA: Accelerating Sparse Accumulation in Column-wise SpGEMM", *ACM Transactions on Architecture and Code Optimization*, May 2022, doi:10.1145/3543068.
1. **M.B.**, Kazbek Kazhyken, Hartmut Kaiser, Craig Michoski, Clint Dawson, "Performance Comparison of HPX Versus Traditional Parallelization Strategies for the Discontinuous Galerkin Method", *Journal of Scientific Computing*, May 2019, doi:10.1007/s10915-019-00960-z.

Conference Papers

5. Md Abdul Motaleb Faysal, **M.B.**, Cy Chan, John Shalf, Shaikh M. Arifuzzaman, "Fast Parallel Index Construction for Efficient K-truss-based Local Community Detection in Large Graphs", *International Conference on Parallel Processing (ICPP)*, Salt Lake City, UT, ACM, Accepted, 10 pages.
4. Md Abdul Motaleb Faysal, **M.B.**, Shaikh M. Arifuzzaman, Doru Popovici, John Shalf, Cy Chan, "Fast Community Detection in Graphs with Infomap Method using Accelerated Sparse Accumulation", *International Workshop on Accelerators and Hybrid Emerging Systems (AsHES)*, St. Petersburg, FL, ACM, In Press, 10 pages.
3. Md Abdul Motaleb Faysal, Shaikh M. Arifuzzaman, Cy Chan, **M.B.**, Doru Popovici, John Shalf, "HyPC-Map: A Hybrid Parallel Community Detection Algorithm Using Information-Theoretic Approach", *IEEE High Performance Extreme Computing Conference (HPEC)*, Boston, MA, IEEE, September 21, 2021, 8 pages.
2. **M.B.**, John Bachan, Cy Chan, Clint Dawson, "Speculative Parallel Execution for Local Timestepping", *2021 ACM SIGSIM Conference on Principles of Advanced Discrete Simulation (SIGSIM-PADS'21)*, Virtual Event USA, ACM, June 1, 2021, 11 pages.
1. **M.B.**, John Bachan, Cy Chan, "Semi-Static and Dynamic Load Balancing for Asynchronous Hurricane Storm Surge Simulations", *2018 IEEE/ACM Parallel Applications Workshop, Alternatives To MPI (PAW-ATM)*, Dallas, TX, IEEE, November 16, 2018, 13 pages.

Presentations/Talks

16. **M.B.**, Thomas Unfer, Clint Dawson,"Scalable Adaptive Local Timestepping with Parallel Discrete Event Simulation", *U.S. National Congress on Computational Mechanics*, July 25, 2023.
15. **M.B.**,"Simulating the Impact of Dynamic Rerouting on Metropolitan-Scale Traffic Systems", *ACM SIGSIM Conference on Principles of Advanced Discrete Simulation*, June 23, 2023.
14. **M.B.**, Nirmalendu Patra, Tan Nguyen, Cy Chan, and Dilip Vasudevan,"Accelerating Open-Source Hardware Simulation Using Optimistic Parallel Discrete Event Simulation", *Open-Source Computer Architecture Research (OSCAR) ISCA Workshop*, June 18, 2023.
13. **M.B.**, Cy Chan, John Bachan, Clint Dawson,"Adaptive Local Timestepping and its Parallelization", *SIAM Conference on Parallel Processing for Scientific Computing (PP20)*, February 15, 2020.
12. **M.B.**, Cy Chan, John Bachan, Clint Dawson,"Adaptive Local Timestepping for Shallow Water Flows", 18^{th} *International Workshop on Multi-scale (Un)-structured Mesh Numerical Modeling for Coastal, Shelf, and Global Ocean Dynamics (IMUM)*, September 26, 2019.
11. Clint Dawson, **M.B.**,"Vectorization of Discontinuous Galerkin Schemes for Shallow Water Flows", *U.S. National Congress on Computational Mechanics*, July 31, 2019.
10. **M.B.**,"Simulation of Shallow Water Flows Using HPX", *DOE CSGF Program Review*, July 15, 2019.
9. **M.B.**, Hartmut Kaiser, Clint Dawson,"Asynchronous Finite Element Simulation of Coastal Inundation", *SIAM Conference on Computational Science and Engineering (CSE19)*, February 28, 2019.
8. **M.B.**, John Bachan, Cy Chan,"Semi-Static and Dynamic Load Balancing for Asynchronous Hur-

ricane Storm Surge Simulations", *2018 IEEE/ACM Parallel Applications Workshop, Alternatives To MPI (PAW-ATM)*, November 16, 2018.

7. **M.B.**, Kazbek Kazhyken, Hartmut Kaiser, Craig Michoski, Clint Dawson,"Task-based Parallelism for Finite-Element Models of Shallow Water Flows", *World Congress in Computational Mechanics*, July 24, 2018.
6. **M.B.**,"Computational Modeling of Hurricane Storm Surge", *Harrington Annual Research Symposium*, April 10, 2018.
5. **M.B.**, Zach Byerly, Hartmut Kaiser, Craig Michoski, Clint Dawson,"Performance Comparison of HPX versus Traditional Parallelization Models for Finite-Element Models of Environmental Flows", *American Meteorological Society Annual Meeting*, January 10, 2018.
4. **M.B.**,"Wrangling Concurrency with HPX", *ICES Seminar–Student Forum*, December 8, 2017.
3. **M.B.**, Craig Michoski, Zach Byerly, Hartmut Kaiser, Clint Dawson,"Optimizing Discontinuous Galerkin Finite Element Kernels on Knights Landing Chips", *Texas Applied Mathematics and Engineering Symposium*, September 22, 2017.
2. **M.B.**, John Bachan, Cy Chan,"Asynchronous Load Balancing for Hurricane Storm Surge Simulations", *LBL Computing Sciences Seminar*, February 16, 2017.
1. **M.B.**, Clint Dawson, Zach Byerly, Hartmut Kaiser, Craig Michoski, Andreas Schäfer,"Application of High Performance ParallelX (HPX) for High Performance Computing of Hurricane Storm Surge", *American Meteorological Society Annual Meeting*, January 25, 2017.

Honors and Awards

Honors and Awards

Certificate of Recognition for BLPA Leadership (2022)
Department of Energy Computational Science Graduate Fellowship (2015)
Donald D. Harrington Fellowship (2015)
Cockrell School of Engineering Outstanding Scholar/Leader Award (2014)
Graham F. Carey Scholarship in Computational Science (2013)

Computer Skills

Languages

‡ C++, Python, Bash Scripting, FORTRAN, MatLab, LaTeX

Software Development

DGSWEM-v2 `https://github.com/UT-CHG/dgswemv2`

‡ Discontinuous Galerkin (DG) finite element code for the simulation of coastal flows.
‡ Provides MPI+OpenMP and HPX parallelization back-ends.
‡ License: MIT

Areas of Exposure

‡ *Packages*: MPI, OpenMP
‡ *Libraries*: SST, Devastator, HPX, Blaze, UPC++
‡ *Software Engineering*: git, make, cmake, CircleCI, Docker

Academic Service

Conferences/Seminars Organized

‡ PC Member, *International Conference on Parallel Processing*, Algorithm Track — August 2022
‡ Co-organizer, *SIAM CSE Minisymposium* — March 2021
‡ Co-organizer, *ICES Seminar–Babuška Forum* — Fall 2018–Spring 2019
‡ Co-organizer, *Texas Applied Mathematics and Engineering Symposium* — September 2017

Societal Membership

‡ Berkeley Lab Postdoc Association, Board Member — March 2021–Present
‡ CSEM Student Representative — Fall 2018–Spring 2019
‡ Society for Industrial and Applied Mathematics (SIAM)

Reviewer/Journal

‡ ACM Transactions on Architecture and Code Optimization

‡ Computer Methods in Applied Mechanics and Engineering
‡ Journal of Computational Physics