

# Maximilian H. Bremer

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## 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**

*Computer Architecture Group*

Fall 2020–present

*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**

*Computational Hydraulics Group*

Fall 2015–Fall 2020

*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**

*Computer Architecture Group*

Summer 2019

*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**

*Computer Architecture Group*

Summer 2016

*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.

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 Spase 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

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 21)*, 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

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<sup>th</sup> 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 Hurricane 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 Sim-

ulations”, *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, L<sup>A</sup>T<sub>E</sub>X

### *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