

# Maximilian H. Bremer

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## CONTACT INFORMATION

201 East 24th St, Stop C0200  
Austin, TX 78712-1229 USA

Cell: (214) 862-7370  
E-mail: [max@oden.utexas.edu](mailto:max@oden.utexas.edu)

## EDUCATION

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

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

### 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

### The University of Texas at Austin

*Computational Hydraulics Group*

Fall 2015–present

*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.

## PUBLICATIONS

### *Journal Articles*

2. **M.B.**, John Bachan, Cy Chan, Clint Dawson, “Adaptive Total Variation Stable Local Timestepping for Conservation Laws”, *Submitted to SIAM Journal on Scientific Computing*, 2020.
1. **M.B.**, Kazbek Kazhyken, Hartmut Kaiser, Craig Michoski, Clint Dawson, “Performance Comparison of HPX Versus Traditional Parallelization Strategies for the Discontinuous Galerkin Method”, *J. Sci. Comput.*, May 2019, doi:10.1007/s10915-019-00960-z.

### Conference Papers

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, Texas, 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 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

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:* HPX, Eigen, Blaze, UPC++
- ‡ *Software Engineering:* git, make, cmake, CircleCI, Docker

ACADEMIC  
SERVICE

*Conferences/Seminars Organized*

- ‡ Co-organizer, *ICES Seminar–Babuška Forum* Fall 2018–Spring 2019
- ‡ Co-organizer, *Texas Applied Mathematics and Engineering Symposium* September 2017

*Societal Membership*

- ‡ CSEM Student Representative Fall 2018–Spring 2019
- ‡ Society for Industrial and Applied Mathematics (SIAM)

*Reviewer, Journal Articles*

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