

Jeremy L Thompson

Research Software Engineer

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Education

- 2016–2021 **PhD**, *University of Colorado Boulder*
Applied Mathematics
- 2012–2010 **MSc**, *University of Washington*
Applied Mathematics
- 2005–2009 **BS**, *United States Air Force Academy*
Mathematics

Experience

- 2021–current **Research Associate**, *University of Colorado Boulder PSAAP Center*
Research Software Engineer
- Lead developer for low level performance portable library - github.com/CEED/libCEED
 - Solid mechanics and fluid dynamics mini-applications for PETSc with libCEED in C and Rust - gitlab.com/micromorph/Ratel, github.com/jeremylt/meles-rs
 - Mentoring graduate students in software development and academic research practices
- 2017–2021 **Graduate Research Assistant**, *University of Colorado Boulder*
HPC Algorithms and Software Researcher
- Developing libCEED - C99 minimal dependency library with CPU/GPU performance portability; optimized AVX, CUDA, & HIP backends; C/C++, Fortran77, Rust, Julia, & Python interfaces
 - Researching efficient implementations of high order finite elements for exascale hardware
 - Architect/developer for extensible analysis toolkit - github.com/jeremylt/LFAToolkit.jl
- 2012–2016 **Assistant Professor**, *United States Air Force Academy*
Math Department Faculty
- Taught Calc I, Calc II, Calc III, Differential Equations, Engineering Mathematics, Discrete Mathematics
 - Awarded Outstanding Academy Educator, Outstanding Course Director, Outstanding New Instructor
- 2014–2014 **Visiting Scientist**, *Lawrence Livermore National Laboratory*
Summer Visiting Faculty
- Improved wind data projections for optimizing power grid production balancing
 - Implemented smoothing filters, FFT, Gaussian smoothing, and non-local means
- 2009–2012 **Advanced Weapon Systems Analyst**, *United States Air Force*
B-52 Testing and Analysis
- Executed testing and analysis for B-52 nuclear Air Launched Cruise Missile
 - Restored USSTRATCOM confidence in USAF accuracy and reliability forecasts
 - Awarded Air Combat Command Junior Military Scientist of the Year

Technical Skills

Rust, C, C++, CUDA, Fortran, Python, Julia
Make, Git, Doxygen, Sphinx, Prove, JUnit, GitHub Actions, Travis CI

Honors and Awards

- 2020, 2021 **Annual freeCodeCamp Top Contributor Award**, *freeCodeCamp*
- Jun 2018 **Helping Hands Volunteer Award**, *Moving to End Sexual Assault*
- 2015–2016 **Brigadier General Daniel W Litwhiler Award for the Outstanding Course Director in Mathematical Sciences**, *United States Air Force Academy Department of Mathematical Sciences*
- 2013–2014 **Outstanding Academy Educator**, *United States Air Force Academy Department of Mathematical Sciences*
- Spring 2013 **Outstanding New Instructor**, *United States Air Force Academy Department of Mathematical Sciences*
- 2011 **Scientist of the Year, Junior Military Category**, *United States Air Force Air Combat Command*
- May 2010 **Honor Graduate, Phase II**, *Operations Research Systems Analysis Military Application Course*
- Feb 2010 **Honor Graduate, Phase I**, *Operations Research Systems Analysis Military Application Course*
- Aug 2008 **Award for Excellence in Student Exposition and Research**, *American Mathematical Society*

Publications

- [1] Tzanio Kolev, Paul Fischer, Misun Min, Jack Dongarra, Jed Brown, Veselin Dobrev, Tim Warburton, Stanimire Tomov, Mark S Shephard, Ahmad Abdelfattah, Valeria Barra, Natalie Beams, Jean-Sylvain Camier, Noel Chalmers, Yohann Dudouit, Ali Karakus, Ian Karlin, Stefan Kerkemeier, Yu-Hsiang Lan, David Medina, Elia Merzari, Aleksandr Obabko, Will Pazner, Thilina Rathnayake, Cameron W Smith, Lukas Spies, Kasia Swirydowicz, Jeremy Thompson, Ananias Tomboulides, and Vladimir Tomov. Efficient exascale discretizations: High-order finite element methods. *The International Journal of High Performance Computing Applications*, 0(0):10943420211020803, 0.
- [2] Jeremy L Thompson. An emperical evaluation of denoising techniques for streaming data. Technical Report LLNL-TR-659435, Lawrence Livermore National Laboratory, August 2014.
- [3] Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Paul Fisher, Tzanio Kolev, Thilina Ratnayaka, Mark Shepard, Jeremy Thompson, and Vladimir Tomov. Ecp milestone report initial ceed api. Technical Report WBS 2.2.6.06, Milestone CEED-MS10, Lawrence Livermore National Laboratory, December 2017.
- [4] Jeremy L Thompson, Kurt Herzinger, and Trae Holcomb. The frobenius number of balanced numerical semigroups. *Semigroup Forum*, 94:632–649, 2017.
- [5] Jed Brown, Veselin Dobrev, Som Dutta, Paul Fisher, Kazem Kamran, Tzanio Kolev, Davin Medina, Misun Min, Thilina Ratnayaka, Mark Shepard, Cameron Smith, and Jeremy Thompson. Ecp milestone report propose high-order mesh/data format. Technical Report WBS 2.2.6.06, Milestone CEED-MS18, Lawrence Livermore National Laboratory, June 2018.

- [6] Stanimire Tomov, Pedro Bello-Maldonado, Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Jack Dongarra, Paul Fisher, Azzam Haidar, Tzanio Kolev, Elia Merzari, Misun Min, Aleks Obabko, Scott Parker, Thilina Ratnayaka, and Jeremy Thompson. Ecp milestone report performance tuning of ceed software and first wave apps. Technical Report WBS 2.2.6.06, Milestone CEED-MS20, Lawrence Livermore National Laboratory, September 2018.
- [7] Jed Brown, Admad Abdelfatah, Valera Barra, Veselin Dobrev, Yohan Doudouit, Paul Fisher, Tzanio Kolev, David Medina, Misun Min, Thilina Ratnayaka, Cameron Smith, Jeremy Thompson, Stanimire Tomov, Vladimir Tomov, and Tim Warburton. Ecp milestone report public release of ceed 2.0. Technical Report WBS 2.2.6.06, Milestone CEED-MS25, Lawrence Livermore National Laboratory, April 2019.
- [8] Mark Shepard, Valera Barra, Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Yohan Doudouit, Paul Fisher, Tzanio Kolev, David Medina, Misun Min, Cameron Smith, Morteza H. Siboni, Jeremy Thompson, and Tim Warburton. Ecp milestone report improved support for parallel adaptive simulation in ceed. Technical Report WBS 2.2.6.06, Milestone CEED-MS29, Lawrence Livermore National Laboratory, July 2019.
- [9] Stanimire Tomov, Ahmad Abdelfattah, Valera Barra, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Yohan Doudouit, Paul Fisher, Ali Karakus, Stefan Kerkemier, Tzanio Kolev, YuHsiang Lan, Misun Min, Aleks Obabko, Scott Parker, Thilina Ratnayaka, Jeremy Thompson, Ananias Tomboulides, Vladimir Tomov, and Tim Warburton. Ecp milestone report performance tuning of ceed software and 1st and 2nd wave apps. Technical Report WBS 2.2.6.06, Milestone CEED-MS32, Lawrence Livermore National Laboratory, October 2019.
- [10] Arash Mehraban, Jed Brown, Valeria Barra, Henry Tufo, Jeremy Thompson, and Richard Regueiro. Efficient residual and matrix-free jacobian evaluation for three-dimensional tri-quadratic hexahedral finite elements with nearly-incompressible neo-hookean hyperelasticity applied to soft materials on unstructured meshes in parallel, with PETSc and libCEED. In *Proceedings of the 2020 International Mechanical Engineering Congress and Exposition*, July 2020.
- [11] Rachel Eaton, Kurt Herzinger, Ian Pierce, and Jeremy Thompson. Numerical semigroups and the game of sylver coinage. *The American Mathematical Monthly*, 127(8):706–715, 2020.
- [12] Tzanio Kolev, Paul Fisher, Ahmad Abdelfattah, Shreyas Ananthan, Valera Barra, Natalie Beams, Ryan Bleile, Jed Brown, Robert Carson, Jean-Sylvain Camier, Matthew Churchfield, Veselin Dobrev, Jack Bongarra, Yohan Doudouit, Ali Karakus, Stefan Kerkemier, YuHsiang Lan, David Medina, Elia Merzari, Misun Min, Scott Parker, Thilina Ratnayaka, Cameron Smith, Michael Sprague, Thomas Stitt, Jeremy Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, Arturo Vargas, Tim Warburton, and Kenneth Weiss. Ecp milestone report improve performance and capabilities of ceed-enabled ecp applications on summit/sierra. Technical Report WBS 2.2.6.06, Milestone CEED-MS34, Lawrence Livermore National Laboratory, March 2020.
- [13] Tzanio Kolev, Paul Fisher, Ahmad Abdelfattah, Valera Barra, Natalie Beams, Jed Brown, Robert Carson, Jean-Sylvain Camier, Noel Chalmers, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, Stefan Kerkemier, YuHsiang Lan, Elia Merzari, Misun Min, Will Pazner,

Thilina Ratnayaka, Mark S. Shephard, Morteza H. Siboni, Cameron W. Smith, Jeremy L. Thompson, Stanimire Tomov, and Tim Warburton. Ecp milestone report high-order algorithmic developments and optimizations for large-scale gpu-accelerated simulations. Technical Report WBS 2.2.6.06, Milestone CEED-MS36, Lawrence Livermore National Laboratory, September 2020.

- [14] Valeria Barra, Jed Brown, Jeremy Thompson, and Yohann Dudouit. High-performance operator evaluations with ease of use: libCEED's Python interface. In Meghann Agarwal, Chris Calloway, Dillon Niederhut, and David Shupe, editors, *Proceedings of the 19th Python in Science Conference*, pages 75–80, July 2020.
- [15] Jed Brown, Ahmad Abdelfattah, Valeria Barra, Natalie Beams, Jean-Sylvain Camier, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, Tzanio Kolev, David Medina, Will Pazner, Thilina Ratnayaka, Jeremy Thompson, and Stan Tomov. libceed: Fast algebra for high-order element-based discretizations. *Journal of Open Source Software*, 6(63):2945, 2021.
- [16] Tzanio Kolev, Paul Fischer, Misun Min, Jack Dongarra, Jed Brown, Veselin Dobrev, Tim Warburton, Stanimire Tomov, Mark Shephard, Ahmad Abdelfattah, Valeria Barra, Natalie Beams, Jean-Sylvain Camier, Noel Chalmers, Yohann Dudouit, Ali Karakus, Ian Karlin, Stefan Kerkemeier, Yu-Hsiang Lan, and Vladimir Tomov. Efficient exascale discretizations: High-order finite element methods. *The International Journal of High Performance Computing Applications*, 06 2021.
- [17] Tzanio Kolev, Paul Fisher, Ahmad Abdelfattah, Valera Barra, Natalie Beams, Jed Brown, Robert Carson Jean-Sylvain Camier, Noel Chalmers, Veselin Dobrev, Stefan Kerkemier, YuHsiang Lan, Elia Merzari, Misun Min, Malachi Phillips, Thilina Ratnayaka, Kris Rowe, Jeremy Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, and Tim Warburton. Ecp milestone report support ceed-enabled ecp applications in their preparation for aurora/frontier. Technical Report WBS 2.2.6.06, Milestone CEED-MS35, Lawrence Livermore National Laboratory, March 2021.
- [18] Arash Mehraban, Jeremy Thompson, Jed Brown, Richard Regueiro, Valeria Barra, and Henry Tufo. Simulating compressible and nearly-incompressible linear elasticity using an efficient parallel scalable matrix-free high-order finite element method. In *14th WCCM-ECCOMAS Congress 2020*, volume 1400, 2021.

Presentations

- Mar 2021 **Preconditioning High-Order Finite Elements with P-Multigrid and BDDC**
SIAM CSE 2021. Held Virtually.
- Aug 2020 **libCEED Tutorial**
CEED Project Annual Meeting. Held Virtually.
- Jul 2020 **libCEED: A Case Study in the Hidden Benefits of the Bridge Pattern**
Practice & Experience in Advanced Research Computing Conference Series 2020. Portland, Oregon.
- Jan 2020 **Preconditioning with BDDC and FDM for High Order Finite Elements with libCEED**
Joint Mathematics Meetings. Denver, Colorado.
- Sep 2019 **Matrix Free Multigrid with libCEED - Challenges and Applications**
SIAM Northern States Meeting, University of Wyoming, Laramie, Wyoming.

- Sep 2019 **libCEED Finite Element Library - Development Updates and Examples**
UCAR Multicore Workshop 2019. Boulder, Colorado.
- Jun 2019 **Matrix Free P-Multigrid with libCEED and PETSc**
Invited Talk, Argonne National Laboratory. Argonne National Laboratory, Lemont, Illinois.
- Feb 2019 **Optimizing Performance for Portable Generic Finite Element Interfaces**
SIAM-SCE 2019. Spokane, Washington.
- Sept 2018 **Performance and Portability with the libCEED Finite Element Library**
UCAR Multicore Workshop 2018. Boulder, Colorado.
- Aug 2018 **Designing Generic Finite Elements Interfaces**
Mathfest 2018. Denver, Colorado.
- Jul 2018 **Performance and Portability for Generic Finite Elements Interfaces**
International Conference on Spectral and High Order Methods. Imperial Collage, London, United Kingdom.
- Mar 2018 **Performance and Portability fro Generic Finite Elements Interfaces**
SIAM Front Range Applied Mathematics Student Conference. University of Colorado Denver, Denver, Colorado.
- Apr 2015 **Designing Projects for Engineering Mathematics Students**
MAA Rocky Mountain Section Meeting. Colorado College, Colorado Springs, Colorado.
- Apr 2015 **Balanced Numerical Semigroups and Their Frobenius Numbers**
MAA Rocky Mountain Section Meeting. Colorado College, Colorado Springs, Colorado.
- Aug 2014 **The Frobenius Number of Balanced Numerical Semigroups**
Mathfest 2014. Portland, Oregon.
- Jul 2014 **On the Selection of Incremental Denoising Techniques, for Streaming Data**
Technical Presentation. Lawrence Livermore National Laboratory, California.
- Mar 2014 **The Frobenius Number of Balanced Numerical Semigroups**
Department of Mathematical Sciences Colloquium. United States Air Force Academy, Colorado
- Jan 2012 **Mixed Data Type Exponential Smoothing for Reliability Prediction**
53rd With Operations Analyst Forum. Eglin Air Force Base, Florida.
- Dec 2011 **Mixed Data Type Exponential Smoothing for Reliability Prediction**
Applied Mathematics Masters Symposium. University of Washington, Seattle, Washington.
- Apr 2009 **Intersecting Relative Ideals and Duals of Numerical Semigroups**
Service Academy Student Math Conference. United States Coast Guard Academy, new London, Connecticut.
- Feb 2009 **Intersecting Relative Ideals and Duals of Numerical Semigroups**
Pikes Peak Regional Undergraduate Mathematics Conference. Colorado Springs, Colorado.
- Aug 2008 **Numerical Semigroups and Wilf's Conjecture**
Pi Mu Epsilon National Meeting at MathFest 2008. Madison, Wisconsin.