

Jeremy L Thompson

Research Software Engineer

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English (native), German (A2)

Education

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

Experience

- 2021 - **Research Software Engineer**, *University of Colorado Boulder PSAAP Center*
 - Architect for solid mechanics library with PETSc and libCEED - gitlab.com/micromorph/Ratel
 - Lead developer for performance portable HPC library - github.com/CEED/libCEED
 - Maintainer for fluid dynamics library with PETSc and libCEED - gitlab.com/phypid/HONEE
 - Mentor graduate students; teach software development and academic research practices
 - Quality focused; improve maintainability and documentation while expanding core functionality
 - Research software innovation; developed GPU matrix-free Material Point Method software
- 2023 - **Demo Team Agent**, *Catalyst Game Labs, Colorado BattleTech*
 - Ensuring safe and welcoming environment for introducing new players to miniatures hobbies
 - Organizing statewide events and moderating community spaces for Colorado BattleTech
 - Editor and developer for original fan campaign system - outworlds-wastes.jeremylt.org
- 2017 - 2021 **Graduate Research Assistant**, *University of Colorado Boulder*
 - libCEED core developer - C99 library with CPU/GPU performance portability; optimized AVX, CUDA, & HIP backends; C/C++, Fortran77, Rust, Julia, & Python interfaces
 - Architect/developer for FEM analysis toolkit - github.com/jeremylt/LFAToolkit.jl
 - Research efficient implementations of high order finite elements for new exascale hardware
 - Develop Local Fourier Analysis toolkit for sharp convergence estimates of preconditioners for arbitrary order finite element based operators, including p-multigrid and BDDC
- 2012 - 2016 **Assistant Professor**, *United States Air Force Academy*
 - Taught Calc I/II/III, Differential Equations, Engineering Mathematics, Discrete Mathematics
 - Math majors coordinator; ensure 50+ students in majors on track, organized majors events
 - Research mentor; advised students for independent research in math and operations research
 - Faculty club advisor, Cadet Honor Guard and Freethinkers club; mentor student leaders, coordinate club travel and budget, monitor chemical and explosive safety programs
- Summer 2014 **Visiting Scientist**, *Lawrence Livermore National Laboratory*
 - Improved wind forecasting data projections for optimizing power grid production balancing
 - Investigated and compared smoothing filters, FFT, Gaussian smoothing, and non-local means
- 2009 - 2012 **Advanced Weapon Systems Analyst**, *United States Air Force*
 - NUCWSEP tester and analyst; conducted live tests of B-52 Air Launched Cruise Missile
 - Aggregated and analyzed ACC nuclear weapon testing results for annual planning report
 - Overhauled annual accuracy and reliability forecasts; restored USSTRATCOM confidence

Honors and Awards

- 2020 - 2024 **Annual freeCodeCamp Top Contributor Award**, *freeCodeCamp*
- 2018 **Helping Hands Volunteer Award**, *Moving to End Sexual Assault*
- 2016 **Brigadier General Daniel W Litwhiler Award for Outstanding Course Director**, *USAF Department of Mathematical Sciences*
- 2014 **Outstanding Academy Educator**, *USAF Department of Mathematical Sciences*
- 2013 **Outstanding New Instructor**, *USAF Department of Mathematical Sciences*
- 2011 **Junior Military Scientist of the Year**, *USAF Air Combat Command*
- 2010 **Honor Graduate**, *Operations Research Systems Analysis Military Application Course*
- 2008 **Excellence in Student Exposition and Research**, *American Mathematical Society*

Presentations

- May 2024 **PETSc with libCEED - Performance Portable Matrix-Free Operators**
PETSc User Meeting. Universität zu Köln , Köln, Germany.
- Aug 2023 **Ratel: High Order Solid Mechanics with libCEED and PETSc**
International Conference on Spectral and High Order Methods. Yonsei University, Seoul, Korea.
- Sept 2022 **Open Source Development Best Practices in Ratel**
Micromorph PSAAP Center Annual Review Meeting.
- Apr 2022 **BDDC Preconditioned P-Multigrid for High-Order Finite Elements**
17th Copper Mountain Conference On Iterative and Multigrid Methods. Held Virtually.
- Feb 2022 **Productive Performance Portability: Building in Rust with PETSc and libCEED**
SIAM Parallel Processing 2021. Held Virtually.
- 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.

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, Alexs 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 Doudouit, Leila Ghaffari, Stefan Kerkemier, YuHsiang Lan, Elia Merzari, Misun Min, Will Pazner, Thilina Ratnayaka, Mark S. Shepard, 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 Doudouit. 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.
- [19] Tzanio Kolev, Paul Fisher, Ahmad Abdelfattah, Andeleke Bankole, Natalie Beams, Michael Brazell, Jed Brown, Jean-Sylvain Camier, Noel Chalmers, Matthew Churchfield, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, John HOLEMEN, Stefan Kerkemier, YuHsiang Lan, Yimin Lin, Damon McDougall, Elia Merzari, Misun Min, Ketan Mittal, Will Pazner, Malachi Phillips, Thilina Ratnayaka, Kris Rowe, Mark S. Shephard, Cameron W. Smith, Michael Sprague, Jeremy L. Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, Tim Warburton, and James Wright III. Ecp milestone report improve performance and capabilities of ceed-enabled ecp applications on frontier/aurora ea. Technical Report WBS 2.2.6.06, Milestone CEED-MS39, Lawrence Livermore National Laboratory, September 2022.
- [20] Tzanio Kolev, Paul Fisher, Ahmad Abdelfattah, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Robert Carson, Noel Chalmers, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, Aditya Y. Joshi, Stefan Kerkemier, YuHsiang Lan, Damon McDougall, David Medina, Misun Min, Abhishek Mishra, Will Pazner, Malachi Phillips, Thilina Ratnayaka, Mark S. Shephard, Morteza H. Siboni, Cameron W. Smith, Jeremy L. Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, and Tim Warburton. Ecp milestone report high-order algorithmic developments and optimizations for more robust exascale applications. Technical Report WBS 2.2.6.06, Milestone CEED-MS38, Lawrence Livermore National Laboratory, March 2022.
- [21] Tzanio Kolev, Paul Fisher, Ahmad Abdelfattah, Zach Atkins, Andeleke Bankole, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Noel Chalmers, Veselin Dobrev, John HOLEMEN, Kenneth Jansen, Stefan Kerkemier, YuHsiang Lan, Damon McDougall, Elia Merzari, Misun Min, Malachi Phillips, Thilina Ratnayaka, Kris Rowe, Mark S. Shephard, Cameron W.

Smith, Jeremy L. Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, Umesh Unnikrishnan, Arturo Vargas, Tim Warburton, and James Wright III. Ecp milestone report support ecp applications in their exascale challenge problem runs. Technical Report WBS 2.2.6.06, Milestone CEED-MS40, Lawrence Livermore National Laboratory, March 2023.

- [22] Jeremy L. Thompson, Jed Brown, and Yunhui He. Local fourier analysis of p-multigrid for high-order finite element operators. *SIAM Journal on Scientific Computing*, 45(3):S351–S370, 2023.
- [23] Rezgar Shakeri, Leila Ghaffari, Jeremy Thompson, and Jed Brown. Stable numerics for finite-strain elasticity. *International Journal for Numerical Methods in Engineering*, page e7563, 2024.