# Jeremy L Thompson

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*Research Professor, Software Engineer*

English (native), German (A2-B1)

## Education

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

## Experience

2025 - **Research Assistant Professor**, *CS Department, University of Colorado Boulder*

2021 - 2025 **Research Software Engineer**, *CS Department, University of Colorado Boulder*
- Architect for solid mechanics library with PETSc and libCEED - gitlab.com/micromorph/Ratel
- Lead developer for performance portable finite element 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 best practices
- Quality focused; focus on tests, maintainability, and documentation while expanding functionality
- Research software innovations; developed GPU matrix-free Material Point Method software
- Taught: Numerical Computation

2017 - 2021 **Graduate Research Assistant**, *Applied Math Department, University of Colorado Boulder*
- libCEED core developer - C99 library with CPU/GPU performance portability; AVX, CUDA, HIP, & SYCL impl; C/C++, Fortran, Rust, Julia, & Python interfaces - github.com/CEED/libCEED
- Architect/developer for FEM precondioner analysis toolkit - github.com/jeremylt/LFAToolkit.jl
- Developed efficient implementations of high order finite elements for new exascale hardware
- Researched Local Fourier Analysis for parameter tuning with sharp convergence estimates of preconditioners for arbitrary order FEM based operators, including p-multigrid and BDDC

2014 - 2016 **Assistant Professor**, *Math Department, United States Air Force Academy*

2012 - 2014 **Instructor**, *Math Department, United States Air Force Academy*
- Math majors coordinator; ensured 50+ students in majors on track, organized majors events
- Research mentor; advised students for independent research in math and operations projects
- Faculty club advisor, Cadet Honor Guard and Freethinkers club; mentored student leaders, coordinated club travel and budget, supervised chemical and explosive safety programs
- Taught: Calc I/II/III, Differential Equations, Engineering Mathematics, Discrete Mathematics

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 aircraft nuclear weapon test results for annual planning report
- Overhauled annual ALCM accuracy and reliability forecasts; restored USSTRATCOM confidence

2023 - **Community Organizer, Moderator**, *Colorado BattleTech, Catalyst Game Labs*
- Ensure a safe and welcoming environment for introducing new players to miniatures hobbies
- Organize statewide events and moderate community spaces for CGL and Colorado BattleTech
- Editor/developer for fan game projects, outworlds-wastes.jeremylt.org, skirmishers.jeremylt.org

## Honors and Awards

2020 - 2025 **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**, *USAFA Department of Mathematical Sciences*
2014 **Outstanding Academy Educator**, *USAFA Department of Mathematical Sciences*
2013 **Outstanding New Instructor**, *USAFA 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

Nov 2025 **Performant Matrix-Free MPM with Ratel and libCEED**
Guest Lecture. Innovative Computing Laboratory, University of Tennessee, Knoxville.

Oct 2025 **Concepts of Numerical Computation in libCEED and PETSc**
Guest Lecture. San Diego State University.

Aug 2025 **Performant MPM Basis Operations for GPU Architecture**
MPM Workshop. University of Colorado Boulder.

July 2025 **Matrix-Free MPM on High-Order Meshes with Ratel and libCEED**
International Conference on Spectral and High Order Methods. McGill Uni, Montreal, Canada.

May 2025 **Ratel Feature Overview**
Micromorph PSAAP Center Annual Review Meeting.

May 2025 **Ratel - New Foundations of Computational Mechanics for the Exascale Era**
CS Department Colloquium. University of Colorado Boulder.

Oct 2024 **Ratel Implicit Material Point Method**
Micromorph PSAAP Center Annual Review Meeting.

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 2020. Portland, Oregon.

Jan 2020 **Preconditioning with BDDC and FDM for High Order FEM 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, United Kingdom.

Mar 2018 **Performance and Portability fro Generic Finite Elements Interfaces**
SIAM Front Range Applied Mathematics Student Conference. University of Colorado Denver.

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.

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

ORCID: orcid.org/0000-0003-2980-0899
ResearchGate: researchgate.net/profile/Jeremy-Thompson
Google Scholar: scholar.google.com/citations?user=UCKh6wcAAAAJ

### Peer Reviewed Journals

[1] Jeremy L Thompson, Kurt Herzinger, and Trae Holcomb. The frobenius number of balanced numerical semigroups. *Semigroup Forum*, 94:632–649, 2017.

[2] 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.

[3] 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.

[4] 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.

[5] 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.

[6] 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.

## Conference Papers


[7] Arash Mehraban, Jed Brown, Valeria Barra, Henry Tufo, Jeremy Thompson, and Richard Regueiro. Efficient residual and matrix-free jacobian evaluation for three-dimensional triquadratic hexahedral finite elements with nearly-incompressible neo-hookean hyperelasticity applied to soft materials on unstructured meshes in parallel, with PETSc and libCEED. In *Procedings of the 2020 International Mechanical Engineering Congress and Exposition*, July 2020.

[8] 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.

[9] Arash Mehraban, Jed Brown, Henry Tufo, Jeremy Thompson, Rezgar Shakeri, and Richard Regueiro. Efficient parallel scalable matrix-free 3d high-order finite element simulation of neo-hookean compressible hyperelasticity at finite strain. volume Volume 12: Mechanics of Solids, Structures, and Fluids; Micro- and Nano- Systems Engineering and Packaging of *ASME International Mechanical Engineering Congress and Exposition*, page V012T12A027, 11 2021.

[10] 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.


## Technical Reports


[11] Jeremy L Thompson. An emperical evaluation of denoising techniques for streaming data. Technical Report LLNL-TR-659435, Lawrence Livermore National Laboratory, August 2014.

[12] 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.

[13] 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.

[14] 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.

[15] 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.

[16] 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.

[17] 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.

[18] 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 capabilityes of ceed-enabled ecp applications on summit/sierra. Technical Report WBS 2.2.6.06, Milestone CEED-MS34, Lawrence Livermore National Laboratory, March 2020.

[19] 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.

[20] 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.

[21] 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.

[22] 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.

[23] 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.

### Preprints

[24] Jed Brown, Valeria Barra, Natalie Beams, Leila Ghaffari, Matthew Knepley, William Moses, Rezgar Shakeri, Karen Stengel, Jeremy L. Thompson, and Junchao Zhang. Performance portable solid mechanics via matrix-free $p$-multigrid. 2022.

[25] Zachary R. Atkins, Jed Brown, Rezgar Shakeri, and Jeremy L. Thompson. Matrix-free finite element methods with arbitrary quadrature point locations. 2025.

### Software

[26] Ahmad Abdelfattah, Valeria Barra, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, Sebastian Grimberg, Tzanio Kolev, David Medina, Will Pazner, Thilina Ratnayaka, Rezgar Shakeri, Jeremy L Thompson, Stanimire Tomov, and James Wright III. libCEED user manual, November 2023.

[27] Jeremy L Thompson, Adeleke O Bankole, and Jed Brown. LFAToolkit.jl, March 2024.

[28] Zachary R Atkins, Jed Brown, Fabio Di Gioacchino, Leila Ghaffari, Rezgar Shakeri, Ren Stengel, and Jeremy L Thompson. Ratel user manual, April 2025.