Brian Doran Giffin, Ph.D.

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EDUCATION

University of California, Davis — Davis, CA
Doctor of Philosophy in Computational Solid Mechanics; GPA: 4.00 — *2015 – 2018*
- **Minor**: Applied Mathematics
- **Advisor**: Professor Mark Rashid
- **Dissertation**: Partitioned Polytopal Finite-Element Methods for Nonlinear Solid Mechanics

University of California, Davis — Davis, CA
Master of Science in Structural Engineering & Mechanics; GPA: 4.00 — *2013 – 2014*
- **M.S. Project**: Applied Poromechanics for Hydraulic Fracture Simulation

University of California, Davis — Davis, CA
Bachelor of Science in Civil Engineering; GPA: 3.98 - Summa Cum Laude — *2009 – 2013*
- **Department Citation**: Awarded by the Department of Civil & Environmental Engineering to two recipients each year, in recognition of outstanding academic achievement.

PROFESSIONAL EXPERIENCE

Oklahoma State University (OSU) — Stillwater, OK
Assistant Professor in the Department of Civil & Environmental Engineering — *2024 – Present*

Lawrence Livermore National Laboratory (LLNL) — Livermore, CA
Computational Mechanics Methods Developer — *2018 – 2023*
- **Senior software developer of DYNA3D/ParaDyn**: a parallel, non-linear, explicit, large deformation solid and structural finite element code in Fortran, sharing the same original code base as LS-DYNA.
- **Lead developer of BCLink**: a boundary condition remapping library in C++, for loose FSI coupling between structural and CFD analyses.
- **Lead developer of SML**: a large deformation constitutive model library in C++, for use by both explicit and implicit thermo-mechanical HPC analysis codes.

McClone Construction — Shingle Springs, CA
Technical Lead — *2019 - 2020*
- Software developer of FormPro: an in-house structural concrete formwork analysis tool. Assessed client needs, met regularly with stakeholders and other developers, managed code architecture considerations. Implemented core structural analysis software library in C#. Prototyped GUI and load/shear/bending/deflection graphing functionality using Mono. Developed and conducted rigorous unit testing using NUnit. Improved performance of FormPro's visualization using .NET.

Sandia National Laboratories — Albuquerque, NM
Graduate Technical Intern — *Summer 2014 & 2015*
- Developed and implemented an agglomerated polyhedral element capability within the SIERRA Solid Mechanics simulation code.

Sandia National Laboratories — Albuquerque, NM
Undergraduate Technical Intern — *Summer 2013*
- Worked with Dr. Joseph Bishop in Sandia's engineering sciences division to conduct verification testing of the Reproducing Kernal Particle Method (RKPM) in the SIERRA Solid Mechanics simulation code.

Structure Maintenance and Investigations - Caltrans — Sacramento, CA
Undergraduate Student Intern — *2012-2013*
- Assisted in the field inspection of bridges located throughout the central valley of California. Reviewed as-built corrections and adjusted CAD-based structural plan documents. Performed load rating analyses on California bridges.

Publications and Scholarly Activities

Peer-reviewed Journal Articles (published):

1. Giffin, B. D. and Zoller, M. (2024). "A layered solid finite element formulation with interlaminar enhanced displacements for the modeling of laminated composite structures." *International Journal for Numerical Methods in Engineering.* 125(23):e7581. https://doi.org/10.1002/nme.7581.

2. Giffin, B. D. and Zywicz, E. (2023). "A smeared crack modeling framework accommodating multi-directional fracture at finite strains." *International Journal of Fracture.* 239, 87-109. https://doi.org/10.1007/s10704-022-00665-9.

Peer-reviewed Journal Articles (in preparation):

1. Giffin, B. D. and Salmani, M. (in preparation). "Hyper-dimensional contact gap methods: theory and numerical discretization." *Computational Mechanics.*

2. Giffin, B. D. (in preparation). "Bit-reversible time integrations for dissipative dynamic systems." *International Journal for Numerical Methods in Engineering.*

3. Poudel, H,. and Giffin, B. D. (in preparation). "Physics-based modeling and fragility analysis of transmission towers under tornado-induced wind and debris impact loading." *Journal of Wind Engineering and Industrial Aerodynamics.*

Conference Papers:

1. Giffin, B. D. (2024). "Hyper-dimensional gap finite elements for the enforcement of interfacial constraints." *16th World Congress on Computational Mechanics.* 10.23967/wccm.2024.109.

2. Kenawy, M. and Giffin, B. D. (2024). "Model-Based Uncertainty in Predicting Damage to Near-Fault Reinforced Concrete Structures." *18th World Congress on Earthquake Engineering.* https://www.mahakenawy.com/_files/ugd/e274d3_b4dfd379f6d34758b4e578b1085460cf.pdf.

Dissertation and Reports:

1. Castonguay, S., Giffin, B., Hathaway, R., Zoller, M. (2023). "Shared Material Library User Documentation - Version 23.0." *Lawrence Livermore National Laboratory.* LLNL-SM-854936.

2. Giffin, B. D. (2022). "BCLink User Documentation" *Lawrence Livermore National Laboratory.* LLNL-TR-840326. https://doi.org/10.2172/1889533.

3. Giffin, B. D. (2020). "Shell Element Material Model Verification Problems for DYNA3D: Part II." *Lawrence Livermore National Laboratory.* LLNL-TR-814964. https://doi.org/10.2172/1668518.

4. Giffin, B D. (2019). "Shell Element Material Model Verification Problems for DYNA3D." *Lawrence Livermore National Laboratory.* LLNL-TR-792469. https://doi.org/10.2172/1569660.

5. Giffin, B. D. (2019). "Verification Problems for Parameterized Load Curves in DYNA3D." *Lawrence Livermore National Laboratory.* LLNL-TR-765860. https://doi.org/10.2172/1499983.

6. Giffin, B. D. (2018). "Partitioned Polytopal Finite-Element Methods for Nonlinear Solid Mechanics." Ph.D. Dissertation. *University of California, Davis.* https://www.proquest.com/docview/2091485390?sourcetype=Dissertations%20&%20Theses.

7. Giffin, Brian D. (2015). "Verification Tests for Sierra/SM's Reproducing Kernal Particle Method." *Sandia National Laboratories.* SAND2017-12869. https://doi.org/10.2172/1411850.

8. Giffin, B. D. (2014). "Applied Poromechanics for Hydraulic Fracture Simulation." M.S. Project Report. *University of California, Davis.*

Conference Presentations and Posters:

1. Giffin, B. D. (2025). "Exactly bit-reversible computational methods for memory-efficient adjoint sensitivity analysis of dissipative dynamic systems." Oral presentation (presenter), *18th U.S. National Congress on Computational Mechanics*, July 20-24, Chicago, IL.

2. Giffin, B. D. (2025). "Hyper-dimensional gap finite elements for the enforcement of frictionless contact constraints." Oral presentation (presenter), *8th International Conference on Computational Contact Mechanics*, July 2-4, Munich, Germany.

3. Poudel, H. and Giffin, B. D. (2025). "Fragility Analysis of Transmission Towers through Physics-Based Modeling of Tornado-Induced Wind and Debris Impact Loads." Oral presentation (co-author), *NHERI Computational Symposium*, Feburary 5-7, Los Angeles, CA.

4. Giffin, B. D. (2024). "Hyper-dimensional gap finite elements for the enforcement of interfacial constraints." Oral presentation (presenter), *16th World Congress on Computational Mechanics*, July 21-26, Vancouver, BC.

5. Zoller, M. and Giffin, B. D. (2024). "A layered solid finite element formulation with interlaminar enhanced displacements for the modeling of laminated composite structures." Oral presentation (co-author), *16th World Congress on Computational Mechanics*, July 21-26, Vancouver, BC.

6. Kenawy, M. and Giffin, B. D. (2024). "Model-Based Uncertainty in Predicting Damage to Near-Fault Reinforced Concrete Structures." Oral presentation (co-author), *18th World Congress on Earthquake Engineering*, June 30 - July 5, Milan, Italy.

7. Giffin, B. D. (2022). "Elasto-Plastic Hourglass Control for Physically Stabilized Non-Linear Finite Elements with Reduced Integration." Oral presentation (presenter), *Engineering Mechanics Institute Conference*, May 31-June 3, Baltimore, MD.

8. Giffin, B. D. (2021). "A Smeared Crack Modeling Framework Accommodating Multi-directional Fracture at Finite Strains." Oral presentation (presenter), *Engineering Mechanics Institute Conference*, May 25-28, virtual event.

9. Giffin, B. D. (2019). "A stable, efficient, locking free hexahedral element for problems in non-linear dynamics." Oral presentation (presenter), *Engineering Mechanics Institute Conference*, June 18-21, Pasadena, CA.

10. Giffin, B. D. and Rashid, M. (2017). "An Improved Partitioned Element Method for Constructing Higher-Order Shape Functions on Arbitrary Polyhedra." Oral presentation (presenter), *14th U.S. National Congress on Computational Mechanics*, July 17-20, Montreal, Canada.

11. Bishop, J. E., Giffin, B. D., and Pott, J. (2013). "Verification of a Convergent Meshless Method in Sierra Solid Mechanics." Poster presentation (presenter), *Sandia Intern Symposium*, August 6, Albuquerque, NM.

ACADEMIC AND PROFESSIONAL LEADERSHIP

- **Chi Epsilon**
  Active member   *2024 – present*

- **American Society of Civil Engineers (ASCE)**
  Active member   *2012 – present*

- **Computational Mechanics (*journal*)**
  Peer reviewer   *2024*

- **Earthquake Engineering Research Institute**   12th National Conference on Earthquake Engineering
  Peer reviewer for technical conference papers   *2022*

- **National Student Steel Bridge Competition (NSSBC)**   ASCE Mid-Pacific Student Conference
  Regional Competition Judge   *2022*

- **Computational Mechanics Working Group (CMWG)** — UC Davis
  Co-founder, President — *2016 – 2018*
  - Organized a community of graduate students at UC Davis to meet and discuss research related interests in the field of computational mechanics. Invited speakers from LLNL and LBNL to come share their current projects and interests with the group.

- **National Student Steel Bridge Team at UC Davis** — UC Davis
  Project Manager — *2012 – 2013*
  - Led a team of 20 undergraduate engineering students in the design and fabrication of a 20ft steel bridge as part of the National Student Steel Bridge Competition (NSSBC). Claimed 2nd place overall at the Mid-Pacific regional competition; ranked 3rd place overall at the national competition.

- **American Society of Civil Engineers (ASCE) Student Chapter** — UC Davis
  Events and Activities Coordinator — *2012 – 2013*

Honors and Awards

- **NHERI Primary Travel Award** — 2024
  NHERI Natural Hazards Research Summit

- **Graduate Studies Travel Award** — 2017
  University of California, Davis - Graduate Studies

- **Academic Achievement Award** — 2013
  American Society of Civil Engineers (ASCE) Sacramento Section

- **Civil & Environmental Engineering Departmental Citation Award** — 2013
  UC Davis Department of Civil & Environmental Engineering

- **3rd Place Overall - National Student Steel Bridge Competition** — 2013
  National Student Steel Bridge Competition (NSSBC)

- **SEAOCC Student Scholarship** — 2012
  Structural Engineers Association of Central California (SEAOCC)

- **Outstanding Student Award** — 2012
  American Society of Civil Engineers (ASCE) Sacramento Section

Research Experience

- **Research and development of novel methods for inverse and optimization problems** — OSU
  Academic research project — *2024 – present*
  - Developed a novel approach to accelerate the computation of adjoint sensitivity calculations for the solution of large-scale inverse and optimization problems applied to dissipative dynamic systems.
  - Implemented and demonstrated efficacy of the developed approach in a self-authored open source software project (REMAT).
  - Presented findings at USNCCM (journal article in preparation).

- **Research and development of novel methods in computational contact mechanics** — OSU
  Academic research project — *2024 – present*
  - Developed a novel mathematical theory for the treatment of contacting interfaces, similar to a volume-based contact discretization method.
  - Implemented and demonstrated efficacy of the developed approach in a self-authored open source software project.
  - Presented findings at 2 international conferences, and documented methodology in 1 conference paper (journal article in preparation).

- **Research and development of novel finite element methods** — LLNL
  Various ParaDyn-related projects — *2018 – 2023*
  - Developed and a implemented a novel solid element formulation for improved bending performance, specialized for use in explicit dynamics simulations (presented at EMI).
  - Formulated a laminated solid element for use in the modeling of laminated composites (publication in IJNME).
  - Developed an improved (naturally stable) formulation of the 10-node composite tetrahedron element for rapid analysis needs.
  - Devised a novel elasto-plastic hourglass stabilization method for finite elements with reduced integration (presented at EMI).

- **Research and development of novel constitutive modeling approaches** — LLNL
  Various ParaDyn-related projects — *2018 – 2023*
  - Formulated and implemented a large deformation material modeling framework accommodating multi-directional failure (publication in IJF).
  - Formulated and implemented a novel logarithmic strain-based temperature-dependent, hybrid visco-plastic/visco-elastic material model.

- **Incremental kinematic algorithms for large deformation analyses** — UC Davis
  Graduate research — *2016 – 2018*
  - Investigated the accuracy of alternative incremental kinematic algorithms used by hypo-elastic constitutive models. Formulated an improved algorithm for efficiently evaluating matrix functions used in high-accuracy kinematic algorithms.

- **Partitioned polytopal finite-element methods for nonlinear solid mechanics** — UC Davis
  Ph.D. Dissertation — *2015 – 2018*
  - Developed a high-order arbitrary polyhedral element method for improved accuracy in the modeling of thin geometries.
  - Implemented a novel finite deformation polyhedral finite element method in a self-authored Fortran-based research code, and demonstrated notable improvements in mesh quality and solution accuracy.

- **Agglomerated polyhedral finite elements** — Sandia National Labs
  Summer research project — *2014 – 2015*
  - Developed and implemented a method for aggregating tetrahedral elements into arbitrary polyhedral elements, utilizing existing domain decomposition methods via METIS. Implemented an agglomerated polyhedral element capability within the SIERRA Solid Mechanics simulation platform. The element formulation was largely based upon the "partitioned element method" (the subject of my dissertation), and capable of handling polyhedra generated from arbitrary aggregations of tetrahedra. The method was demonstrated to provide improved accuracy in large deformation elasto-plastic impact problems.

- **Poromechanical simulation methods for hydraulic fracture** — UC Davis
  M.S. Project — *2014*
  - Collaborated with Lawrence Livermore National Laboratory's Computational Geosciences Group, investigating the use of continuum damage models for simulating hydraulically driven fracture. The project culminated in the implementation of a coupled poromechanics physics solver within the GEOS finite element code.

Teaching and Mentoring Experience

- **Oklahoma State University** — Stillwater, OK
  Course Instructor: ENSC 2143 - Strength of Materials — *Fall 2025*
  - Undergraduate-level course: co-organized and taught an undergraduate engineering course of 200 students; managed a team of 5 teaching assistants; prepared course lecture notes, homework assignments, exams, and supplementary educational materials.

- **Oklahoma State University** — Stillwater, OK
  Course Instructor: CIVE 5010 - Finite Element Analysis of Solids and Structures — *Spring 2025*
  - Graduate-level course: prepared original course lecture notes, homework assignments, exams, and supplementary educational materials.

- **Oklahoma State University** — Stillwater, OK
  Course Instructor: CIVE 5403 - Advanced Strength of Materials — *Fall 2024*
  - Graduate-level course: prepared original course lecture notes, homework assignments, exams, and supplementary educational materials.

- **Oklahoma State University** — Stillwater, OK
  Course Instructor: CIVE 5423 - Matrix Analysis of Structures — *Spring 2024*
  - Graduate-level course: prepared original course lecture notes, homework assignments, exams, and supplementary educational materials.

- **National Student Steel Bridge Team at Oklahoma State University** — OSU
  Faculty Advisor — *2024 – present*
  - Provided consultation to undergraduate students regarding design, project management, and participation in the NSSBC.

- **College of Engineering Mentor Collective** — UC Davis
  Academic Mentor — *2020 – 2021*
  - Mentored first year undergraduate students at UC Davis, providing academic and career guidance during the 2020-21 academic year.

- **University of California, Davis** — Davis, CA
  Substitute Lecturer — *2017*
  - Served as a substitute lecturer for the *Mechanics of Materials* undergraduate course on behalf of Professor Bassam Younis, and Professor Sabbie Miller.

- **University of California, Davis** — Davis, CA
  Course Instructor: ENG 35 - Engineering Statics — *Fall 2015*
  - Independently organized and taught an undergraduate engineering course of 118 students. Managed a team of 5 teaching assistants and 2 graders. Prepared original course lecture notes, homework assignments, exams, and supplementary educational materials.

- **National Student Steel Bridge Team at UC Davis** — UC Davis
  Graduate Advisor — *2014 – 2018*
  - Provided consultation to undergraduate students regarding design and fabrication processes. Helped the team to claim 1st place overall at the national competition (2014).
  - Recorded a series of videos demonstrating design principles in AutoCAD and SAP2000, intended for students participating in the National Student Steel Bridge Competition (NSSBC). (https://www.youtube.com/@briangiffin6640)

- ○ Developed a collection of VBA-based automated structural design and optimization tools utilizing the AutoCAD and SAP2000 APIs, intended for students participating in the National Student Steel Bridge Competition (NSSBC). (https://github.com/bdgiffin/SBDesignTools)

- **University of California, Davis** — Davis, CA
  Teaching Assistant — *2013 – 2018*
  - ○ Assisted lecturing, hosted laboratory sessions, held office hours, and graded assignments for the following courses: *Introduction to Civil Engineering, Mechanics of Materials, Finite Element Procedures in Applied Mechanics*

OPEN-SOURCE RESEARCH AND EDUCATIONAL SOFTWARE PROJECTS

- **REversible Physics and MATerial Model Library (REMAT)**
  https://github.com/bdgiffin/remat — *2024 – present*
  - ○ Proof-of-concept reversible physics library predicated on the use of fixed-precision numerics and integer arithmetic operations to ensure that all computations are exactly bit-reversible. REMAT is designed to accelerate the computation of adjoint sensitivities for the solution of large-scale optimization and inverse problems by eliminating the need for solution checkpointing during the backpropagation phase to compute the adjoint variables by reverse time-integration.

- **Structural Wind-borne Impact Risk assessment Library (SWIRL)**
  https://github.com/bdgiffin/SWIRL — *2024 – present*
  - ○ Physics-based fluid-structure-debris modeling framework, developed to investigate and quantify the extent to which wind-borne debris impact contributes to structural damage and collapse. Accompanying documentation aims to facilitate broader adoption, collaboration, and integration with existing NHERI SimCenter computational infrastructure.

- **Interactive Earthquake Simulator - Cohesive Zone Model (CZM) library**
  https://github.com/bdgiffin/CZM — *2020 – present*
  - ○ Independently developed an educational, open-source, earthquake simulator. Users first "paint" a structure on a pixelated 2D canvas (a la Minecraft), and then subject their design to a dynamically simulated earthquake (using recorded motions taken from the PEER Ground Motion Database). Brittle damage and failure is modeled using cohesive zone elements, incorporating real-time simulation and rendering via OpenGL.

- **Interactive Multi-Physics Analysis in Real-Time (IMPART)**
  https://github.com/bdgiffin/IMPART — *2020 – present*
  - ○ Independently developed an educational, open-source, 2D thermo-mechanical physics engine, incorporating real-time simulation and rendering via OpenGL. Users can interactively control the analysis to investigate the effects of: large deformations, heat transfer and thermal expansion, dynamic impact, frictional contact, gravitational and buoyant forces, bulk viscosity, and element erosion.

- **NSSBC Bridge Designer**
  https://github.com/bdgiffin/BridgeDesigner — *2017 – present*
  - ○ Developed a MATLAB-based 3D structural analysis and optimization tool, intended for students participating in the National Student Steel Bridge Competition (NSSBC). Students can import and export designs to/from AutoCAD, run linear elastic analyses, buckling analyses, evaluate design efficiency, and improve designs using a gradient-based optimization approach to select (discrete) member section sizes.

MEDIA APPEARANCES

- **OSU - CIVE "Get to know your faculty" series** — 2024
  https://ceat.okstate.edu/cive/get-to-know-your-faculty.html
- **News 9 in Oklahoma City** — 2024
  https://www.news9.com/story/6648202d80caabd8822f1a79/osu-researchers-gather-storm-damage-data

Licenses and Certifications

- **Engineer in Training** 2023
  California Board for Professional Engineers, Land Surveyors, and Geologists *Certificate # EIT 178316*

Knowledge, Skills, and Research Interests

- **Technical Expertise and Research Interests**: Computational solid mechanics, large deformation kinematics, finite elements and novel discretization methods, nonlinear transient (explicit) dynamics, contact mechanics, reversible computing, inverse problems, numerical modeling of fracture, poromechanics, impact mechanics, constitutive model development, structural analysis, design optimization, natural hazards engineering

- **Programming Languages**: C++, C#, Fortran, Matlab, Python, VBA, .NET

- **Software Development**: High performance computing (HPC), GPGPU, Git, CVS, Agile methodologies, Unix, shell scripting, LaTeX, GNU Make, CMake, GUI, OpenGL, OpenACC, OpenMP, GitLab CI/CD, unit testing, V&V, Eclipse, Visual Studio, Mono, TotalView, Sphinx, Emscripten

- **Engineering Software**: AutoCAD, MicroStation, SAP2000, DYNA3D/ParaDyn, SIERRA Solid Mechanics, Abaqus, ANSYS, SolidWorks, Cubit, ParaView, Ensight, VisIt