

# Michael H. Gardner

## Research Interests

Rock Mechanics ♦ Slope Stability ♦ Fluid-Solid Interaction ♦ Natural Hazards ♦ Open Source Software ♦ High Performance Computing ♦ Multiscale Simulations ♦ Discrete Element Method ♦ Lattice Boltzmann Method ♦ Uncertainty Quantification ♦ Remote Sensing

## Academic Positions

- 2020 – present **Assistant Professor**, *Department of Geological Sciences and Engineering*, University of Nevada, Reno.  
2018 – 2019 **Postdoctoral Scholar**, *NHERI SimCenter*, University of California, Berkeley.

## Education

- 2018 **Ph.D., Civil and Environmental Engineering**, *University of California, Berkeley*.  
Title: *Development of a Coupled 3-D DEM-LBM Model for Simulation of Dynamic Rock-Fluid Interaction*  
Minors: Numerical Mathematics, Mechanics  
Advisor: Professor Nicholas Sitar
- 2012 **M.S., Civil and Environmental Engineering**, *University of California, Berkeley*.
- 2010 **B.S., Civil and Environmental Engineering**, *University of California, Berkeley*.  
*High Honors*

## Professional Licenses

- 2014 - Present **Licensed Professional Engineer**, *California*.

## Honors and Awards

- 2022 **Finalist**, LaMay Award for Excellence in Teaching, College of Science.  
University of Nevada, Reno
- 2018 **Best Paper**.  
52nd US Rock Mechanics/Geomechanics Symposium
- 2018 **Presidential Management Fellow**.  
A highly selective leadership development program (~7% acceptance rate)
- 2012 **Outstanding Graduate Student Instructor Award**.  
Awarded for outstanding work in teaching course on groundwater and seepage (CE 173)
- 2008 – 2010 **Regents' and Chancellor's Scholarship**.  
Most prestigious scholarship offered by UC Berkeley to entering undergraduates

## Publications

### Thesis

- [1] **M. Gardner**, *Development of a Coupled 3-D DEM-LBM Model for Simulation of Dynamic Rock-Fluid Interaction*. PhD thesis, University of California, Berkeley, 2018

### Journal Articles

- [2] **M. Gardner**, "Toward a Complete Kinematic Description of Hydraulic Plucking of Fractured Rock," *ASCE Journal of Hydraulic Engineering*, Revise for editor only, In review, 2022
- [3] **M. Gardner**, E. Nichols, N. Stark, A. Lemnitzer, and D. Frost, "Multispectral Imaging for Identification of High-Water Marks in Post-Disaster Flood Reconnaissance," *ASCE Natural Hazards Review*, Revise for editor only, In review, 2022
- [4] S. Feehan, S. McCoy, J. Scheingross, and **M. Gardner**, "The influence of variability in lift, drag, protrusion, friction angle, and particle and fluid density on incipient sediment motion," *JGR: Earth Surface*, In review, 2022

- [5] **M. Gardner** and N. Sitar, "Modeling of Dynamic Rock–Fluid Interaction Using Coupled 3-D Discrete Element and Lattice Boltzmann Methods," *Rock Mechanics and Rock Engineering*, Invited paper, 2019
- [6] **M. Gardner** and N. Sitar, "Coupled three-dimensional discrete element-lattice Boltzmann methods for fluid-solid interaction with polyhedral particles," *International Journal for Numerical and Analytical Methods in Geomechanics*, 2019
- [7] **M. Gardner**, J. Kolb, and N. Sitar, "Parallel and scalable block system generation," *Computers and Geotechnics*, vol. 89, pp. 168 – 178, 2017. DOI: <https://doi.org/10.1016/j.compgeo.2017.05.001>
- [8] F. Zheng, Y.-Y. Jiao, **M. Gardner**, and N. Sitar, "A fast direct search algorithm for contact detection of convex polygonal or polyhedral particles," *Computers and Geotechnics*, vol. 87, pp. 76 – 85, 2017. DOI: <https://doi.org/10.1016/j.compgeo.2017.02.001>

#### Conference Papers (Refereed)

- [9] Y. Keissar, I. Brown, N. Sitar, and **M. Gardner**, "DEM Modeling of 3-D Kinematics in Rock Slope Failure," in *ARMA*, (Houston, Texas), April 18 - 19 (2023, In Review)
- [10] A. Lemnitzer, N. Stark, **M. Gardner**, E. Nichols, J. Mueller, and N. Brilli, "Geotechnical and Geo-environmental damage and its impact on critical infrastructure during the 2021 Western European Floods," in *9th International Congress on Environmental Geotechnics*, (Chania, Crete), June 23 - 27 (2023, In Review)
- [11] N. Stark, A. Lemnitzer, K. W. Franke, **M. Gardner**, J. Hubler, B. Lingwall, E. Nichols, B. Quinn, C. Thom, K. Markert, and D. Harman, "The role of gravel shoals on scour and erosion in the Yellowstone River during the 2022 flood event - initial observations," in *11th International Conference on Scour and Erosion (ICSE 11)*, (Copenhagen, Denmark), September 17 - 21 (2023, In Review)
- [12] E. Nichols, A. Lemnitzer, N. Stark, **M. Gardner**, and J. Mueller, "Impact of 2021 Western European Flooding on Geo-Structures," in *9th ASCE Forensic Engineering Congress*, (Denver, CO), November 4 - 9 (2022)
- [13] **M. Gardner**, "Modeling the Mechanics of Rock Scour in Unlined Dam Spillways," in *ASCE GeoCongress*, (Charlotte, North Carolina, USA), March 20 - 23 (2022)
- [14] A. Lemnitzer, N. Stark, J. Mueller, E. Nichols, **M. Gardner**, G. Anoyatis, H. Schuettrumpf, , J. Stamm, M. George, M. van Marle, A. Mavritsakis, L. Leunge, and K. van Ginkel, "Initial geo-structural performance observations of critical infrastructure components during the 2021 Western European Floods," in *ICONHIC*, (Athens, Greece), July 5 - 7 (2022)
- [15] **M. Gardner** and N. Sitar, "Modeling Rock Scour Using Coupled 3D Discrete Element and Lattice Boltzmann Methods," in *ASCE International Conference on Scour (ICSE10)*, (Virtual), October 18 - 21 (2021)
- [16] **M. Gardner** and N. Sitar, "Modeling of Rock Scour using Coupled 3-D Discrete Element and Lattice Boltzmann Methods," in *Proceedings of the 52nd US Rock Mechanics/Geomechanics Symposium*, (Seattle, Washington), American Rock Mechanics Association, 2018

#### Technical Reports

- [17] A. Lemnitzer and K. Franke, "Geotechnical Reconnaissance of the 2022 Yellowstone Floods," techreport, Geotechnical Extreme Events Reconnaissance Association, In press, 2022. (**Contributing Author**)
- [18] A. Lemnitzer and N. Stark, "Geotechnical Reconnaissance of the 2021 Western European Floods," techreport, Geotechnical Extreme Events Reconnaissance Association, 2022. (**Contributing Author**)
- [19] G. G. Deierlein and e. Adam Zsarnóczyay, "State of the Art in Computational Simulation for Natural Hazards Engineering," tech. rep., Feb. 2021. (**Corresponding Author in Chapters 3 & 5**)
- [20] G. G. Deierlein and A. Zsarnóczyay, "State-of-Art in Computational Simulation for Natural Hazards Engineering," tech. rep., Feb. 2019. (**Contributing Author in Sections 1.2, 1.3 & 1.4**)
- [21] **M. Gardner** and N. Sitar, "Coupled 3-D DEM-LBM Model for Simulation of Dynamic Rock-Fluid Interaction," tech. rep., University of California, Berkeley, 2018. DOI: <https://doi.org/10.13140/RG.2.2.21301.73441>
- [22] J. Bray, J. Cohen-Waeber, T. Dawson, T. Kishida, and N. Sitar, "Geotechnical Engineering Reconnaissance of the August 24, 2014 M6 South Napa Earthquake," techreport, Geotechnical Extreme Events Reconnaissance Association, 2014. (**Contributing Author in Sections 5 & 6**)

## Published Software

- [23] F. McKenna, S. ri Yi, A. B. Satish, A. Zsarnoczay, **M. Gardner**, and W. Elhaddad, "The Quantified Uncertainty with Optimization for the Finite Element Method (quoFEM) application: Version 3.2.0," Oct. 2022. <https://doi.org/10.5281/zenodo.7131444>
- [24] F. McKenna, K. Zhong, **M. Gardner**, A. Zsarnoczay, C. Wang, and W. Elhaddad, "NHERI-SimCenter Earthquake Engineering with Uncertainty Quantification (EE-UQ) Application," Oct. 2022. <https://doi.org/10.5281/zenodo.7131474>
- [25] F. McKenna, P. Mackenzie-Helnwein, W. Elhaddad, **M. Gardner**, J. Wan, and D. K. Kwon, "NHERI-SimCenter Wind Engineering with Uncertainty Quantification (WE-UQ) Application," July 2019. <http://doi.org/10.5281/zenodo.3274228>
- [26] **M. Gardner**, "NHERI-SimCenter smelt (Stochastic, Modular, and Extensible Library for Time histories)," May 2019. <https://doi.org/10.5281/zenodo.2697657>
- [27] F. McKenna, A. Zsarnoczay, C. Wang, W. Elhaddad, and **M. Gardner**, "NHERI-SimCenter Performance-Based Engineering (PBE) Application," Apr. 2019. <https://doi.org/10.5281/zenodo.2619736>
- [28] B. Simpson, F. McKenna, and **M. Gardner**, "NHERI-SimCenter Braced Frame Modeling (BFM) Application," Sept. 2018. <https://doi.org/10.5281/zenodo.1438554>
- [29] **M. Gardner**, J. Kolb, and N. Sitar, "SparkRocks," Nov. 2016. <https://doi.org/10.5281/zenodo.166103>

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## Presentations

### Seminar Presentations (Invited)

- **Michael Gardner**, "Kinematics of hydraulic plucking in fractured rock," in *Seminar Series (Host: Anne Lemnitzer)*, (University of California, Irvine, CA, United States of America), November 4, 2022
- **Michael Gardner**, "Modeling dynamic fluid-solid interaction in turbulent flow during rock scour," in *USGS Engineering Brownbag (Host: Ben Mason)*, (United States Geological Engineering, Golden, CO, United States of America), June 9, 2022
- **Michael Gardner**, "Modeling dynamic fluid-solid interaction in turbulent flow during rock scour," in *Graduate Seminar (Host: Michael Shields)*, (Johns Hopkins University, Baltimore, MD, United States of America), February 3, 2022
- A. Lemnitzer, E. Nichols, **Michael Gardner**, A. Mavritsakis, and M. van Marle, "GEER reconnaissance mission to Germany, Belgium and the Netherlands," in *Lunch Lecture (Host: Magreet van Marle)*, (Deltares, Delft, Netherlands), November 11, 2021
- **Michael Gardner**, "Modeling dynamic rock-fluid interaction applied to hydraulic plucking in dam spillways," in *AEG Great Basin Chapter Meeting (Host: Merrily Graham)*, (AEG Great Basin Chapter, Reno, NV, United States of America), October 14, 2021
- **Michael Gardner**, "Modeling dynamic rock-fluid interaction," in *Distinguished Lecturer Series (Host: Ye Zhang)*, (University of Wyoming, Laramie, WY, United States of America), April 12, 2021
- **Michael Gardner**, "Modeling dynamic rock-fluid interaction," in *Lunchtime Talk (Host: Kirk Ellison)*, (Arup, San Francisco, CA, United States of America), April 10, 2020
- **Michael Gardner**, "Large-scale C++ programming and parallelisation frameworks," in *1st Workshop on Large-Scale DEM-LBM (Host: Krishna Kumar)*, (University of Cambridge, Cambridge, United Kingdom), June 23 (2017)
- **Michael Gardner**, "Numerical modelling of rock-fluid interaction," in *Geotechnical Seminar (Host: Stefano Uti)*, (Newcastle University, Newcastle upon Tyne, United Kingdom), June 21 (2017)
- **Michael Gardner**, "Numerical modeling of fractured rock," in *Association of Environmental and Engineering Geologists Student Night (Host: Julien Cohen-Waeber)*, April 11 (2017)

### Conference Presentations

- **M. Gardner**, N. Stark, A. Lemnitzer, N. Brilli, E. Nichols, M. Grilliot, J. Zdebski, J. Mueller, and M. George, "Geotechnical and geophysical investigations of river-infrastructure interaction in response to the 2021 Ahr Valley flood," in *American Geophysical Union Fall Meeting*, (Chicago, Illinois, USA), December 12 - 16 (2022)

- J. Toller, **M. Gardner**, and K. Keegan, "Using the Lattice Boltzmann Method to Determine the Intrinsic Permeability of Polar Firn," in *American Geophysical Union Fall Meeting*, (Chicago, Illinois, USA), December 12 - 16 (2022)
- S. Feehan, S. McCoy, J. Scheingross, and **M. Gardner**, "Exploring the Controls on Riverbed Grain Size Distributions," in *American Geophysical Union Fall Meeting*, (Chicago, Illinois, USA), December 12 - 16 (2022)
- N. Stark, A. Lemnitzer, and **M. Gardner**, "Geotechnical and geophysical investigations of river-infrastructure interaction in response to the 2021 Ahr Valley flood," in *1st KAHR Science Conference*, (Virtual), June 29 - 30 (2022)
- **M. Gardner**, "Modeling the Mechanics of Rock Scour in Unlined Dam Spillways," in *ASCE GeoCongress*, (Charlotte, North Carolina, USA), March 20 - 23 (2022)
- **M. Gardner**, Y. Keissar, P. Wood, I. Brown, and N. Sitar, "Three-Dimensional Kinematics and Scaling Effects in Rock Slope Failure," in *American Geophysical Union Fall Meeting*, (New Orleans, LA, United States), December 13 - 17 (2021)
- J. Toller, **M. Gardner**, K. Keegan, S. Day, and Y. Chung, "The Importance of Image Thresholding in Computing Permeability of Firn using Micro-CT Images and the Lattice Boltzmann Method," in *American Geophysical Union Fall Meeting*, (New Orleans, LA, United States), December 13 - 17 (2021)
- J. Scheingross, W. Cao, J. DesOrmeau, **M. Gardner**, S. Gordon, C. D. Masi, P. Sheevam, and J. Toller, "Progress on DEI initiatives within the University of Nevada Reno (UNR) geosciences community," in *American Geophysical Union Fall Meeting*, (New Orleans, LA, United States), December 13 - 17 (2021)
- **M. Gardner**, "Modeling the Mechanics of Rock Scour in Unlined Dam Spillways," in *International Conference of Numerical Analysis and Applied Mathematics*, (Rhodes, Greece), September 20 - 26 (2021)
- **M. Gardner** and N. Sitar, "Modeling Rock Scour Using Coupled 3D Discrete Element and Lattice Boltzmann Methods," in *ASCE International Conference on Scour (ICSE10)*, (Virtual), October 18 - 21 (2021)
- **M. Gardner**, "Surrogate Model Development for Rock Slope Failures using quoFEM," in *PEER Annual Meeting*, (Berkeley, CA, United States), January 16 - 17 (2020)
- **M. Gardner** and N. Sitar, "Coupled Three-Dimensional Discrete Element-Lattice Boltzmann Methods for Fluid-Solid Interaction with Polyhedral Particles," in *Engineering Mechanics Institute Conference*, (Pasadena, California), June 18 - June 21 (2019)
- W. Elhaddad, F. McKenna, **M. Gardner**, A. Zsarnóczy, M. Schoettler, C. Wang, S. Govindjee, and G. Deierlein, "A Computational Framework for Regional Earthquake Loss Estimation," in *Engineering Mechanics Institute Conference*, (Pasadena, California), June 18 - June 21 (2019)
- **M. Gardner** and N. Sitar, "Modeling Rock Scour using Coupled Discrete Element and Lattice Boltzmann Methods," in *Engineering Mechanics Institute Conference*, (Boston, Massachusetts), May 29 - June 1 (2018)
- **Michael Gardner**, "Numerical modeling of rock-fluid interaction," in *1st Annual Geotechnical Research Symposium*, (University of California, Berkeley, United States of America), February 1 (2018)

## Grants & Funding

### Active Research Grants

- 2022 – 2025 **Collaborative Research: Multi-Block System Response to Hydraulic Loads in Rock Scour**, National Science Foundation, Principal Investigator, co-PI David Harbor (Washington & Lee University), \$419,486 (UNR portion), 3 years.
- 2022 – 2023 **RAPID: Collaborative Research: Geotechnical and geoenvironmental properties of the Ahr and Erft Rivers, Germany, and their role in structural damage during the 2021 Western European Floods**, National Science Foundation, Principal Investigator, co-PIs Nina Stark (Virginia Tech) and Anne Lemnitzer (UCI), \$77,558 (UNR portion, including supplement), 1 year.
- 2021 – 2024 **Mafic magmatic enclaves as tracer of protracted mixing and hybridization**, National Science Foundation, Co-Principal Investigator, PI Philip Ruprecht (UNR), \$320,350, 3 years.

### Completed Research Grants

- June 2020 – Dec. 2020 **Natural Hazards Engineering Research Infrastructure: Computational Modeling and Simulation Center (subaward)**, National Science Foundation, Expand modularity of SimCenter quoFEM application, \$9,358.20, 6 months.

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## Research Mentoring

### Graduate Students

- Spring 2023 – **Jakob Scheel**, *Ph.D. Geology, University of Nevada, Reno.*  
present Project: Mafic magmatic enclaves as tracer of protracted mixing and hybridization (co-advised with Philipp Ruprecht)
- Fall 2021 – **Mohsen Tahkhtravan**, *Ph.D. Geological Engineering, University of Nevada, Reno.*  
present Project: Multi-Block System Response to Hydraulic Loads
- Spring 2021 – **Justin Toller**, *Ph.D. Geology, University of Nevada, Reno.*  
present Project: The impact of glacial firn microstructure on ice age-gas age difference (co-advised with Kaitlin Keegan)
- Spring 2019 – **Yuval Keissar**, *Ph.D. Civil Engineering, University of California, Berkeley.*  
present Project: Predictive models for dynamic analysis of rock slope response (co-advised with Nicholas Sitar)
- Fall 2019 – **Ingrid Suter**, *M.S. Geological Engineering, University of Nevada, Reno.*
- Spring 2022 Project: Mapping bed forces to granular flow properties (co-advised with Scott McCoy)

### Undergraduate Students

- Summer 2022 – **Kevin Ostfeld**, *B.S. Geological Engineering, University of Nevada, Reno.*  
present Project: Multispectral Imaging for Identifying Erosional and Depositional Patterns During Extreme Flooding
- Summer 2019 **Haley Hostetter**, *B.S. Civil Engineering, Southern Illinois University,*  
NSF Research Experiences for Undergraduates Intern at the NHERI SimCenter.  
Project: A Stochastic Ground Motion Simulation Model Developed for Shallow Crustal Earthquakes Evaluated in a Subduction Zone Setting

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## Teaching Experience

Legend: ‡: course designed or substantially renovated

### Instruction

- Spring 2022 – ‡**Geological Engineering Slope Stability (GE 483)**,  
present *Department of Geological Sciences and Engineering, University of Nevada, Reno.*
- Spring 2021 – ‡**Numerical Methods for Geomaterials (GE 745)**,  
present *Department of Geological Sciences and Engineering, University of Nevada, Reno.*
- Fall 2020 – ‡**Geological Engineering Data Analysis (GE 385)**,  
present *Department of Geological Sciences and Engineering, University of Nevada, Reno.*
- Summer 2015 **Engineering Geomatics (CE 174) [course TA]**,  
*Department of Civil and Environmental Engineering, University of California, Berkeley.*
- Spring 2014 **Advanced GeoEngineering Testing and Design (CE 273) [course TA]**,  
*Department of Civil and Environmental Engineering, University of California, Berkeley.*
- Fall 2011 & **Groundwater and Seepage (CE 173) [course TA]**,  
Fall 2013 *Department of Civil and Environmental Engineering, University of California, Berkeley.*

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## Service

- 2022 – **Review Panelist and Ad Hoc Reviewer**, *National Science Foundation.*  
Present
- Summer 2021 – **Faculty Advisor**, *Association of Environmental and Engineering Geologists, UNR Student Chapter.*  
– Present
- Summer 2020 – **Committee Member**, *Diversity, Equity, and Inclusion Committee, University of Nevada, Reno.*  
– present
- Academic Year 2021 **Annual Evaluation Committee**, *Department of Geological Sciences and Engineering, University of Nevada, Reno.*
- Academic Year 2020 **Faculty Search Committee**, *Department of Geological Sciences and Engineering, University of Nevada, Reno.*
- 2016 – present **Journal referee.**  
o Computers and Geotechnics, Rock Mechanics and Rock Engineering, International Journal for Numerical and Analytical Methods in Geomechanics, Acta Geotechnica, Geofluids, Journal of Rock Mechanics and Geotechnical Engineering

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## Work Experience

Spring 2010 - **Engineer**, *Geotechnics Group, Arup*, San Francisco, CA.  
Fall 2013

Summer 2009 **Geotechnical Intern**, *ENGEO Incorporated*, San Ramon, CA.

Summer 2007 **Engineering Intern**, *Zone 7 Water Agency*, Livermore, CA.

March 2003 - **Combat Engineer**, *United States Army*, Honorably discharged at rank of Specialist, E-4.  
March 2005 *Commendations:*

- Two Army Commendation Medals
- National Defense Medal
- Global War on Terrorism Expeditionary Medal
- Global War on Terrorism Campaign Medal
- Army Service Ribbon

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## Professional Memberships

- American Society of Civil Engineers (ASCE)
- American Geophysical Union (AGU)
- Association of Environmental and Engineering Geologists (AEG)
- U.S. Society of Dams (USSD)
- International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)
- Geotechnical Extreme Events Reconnaissance Association (GEER)
- United States University Council on Geotechnical Education and Research (USUCGER)

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## Language Skills

- English: fluent (speaking, reading, writing)
- Afrikaans: native (speaking, reading, writing)