# Dongfang Zhao

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## EDUCATION

**Ph.D. Mechanical Engineering** Aug. 2024
*University of Utah* Salt Lake City, Utah

- Specialization: Structural materials; Finite-element analysis; Fracture mechanics
- Dissertation: *Effect of Hierarchical Structure on Multi-scale Mechanical Response of Open-cell Aluminum Foams*

**M.S. Mechanical & Materials Engineering** Mar. 2017
*University of Denver* Denver, CO

- Specialization: Monte Carlo simulation; Thermal conductivity; Contact mechanics
- Dissertation: *Computational Study of the Effect of Interparticle Contact in Conductive Properties of Random Particulate Systems* digitalcommons.du.edu/etd/1245

**B.E. Polymer Materials Science & Engineering** Jun. 2014
*Beijing University of Chemical Technology* Beijing, China

## TECHNICAL SKILLS

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|---|---|
| **Programming** | C/C++, Python, Matlab, MPI, OpenMP, Object Oriented Programming, Git |
| **Simulation Tools** | ABAQUS, Uintah, ANSYS, SOLIDWORKS, FRANC3D, Tetgen, SciFen |
| **General** | Linux bash, DREAM.3D, Paraview, Visit, ImageJ, LaTeX, MacOS, Microsoft Office |

## RESEARCH EXPERIENCE

**University of Utah Multiscale Mechanics & Materials Laboratory** Sep. 2016 – Present
*Graduate Research Assistant (Advisor: Dr. Ashley Spear)* Salt Lake City, UT

– ***Research activities***

- Investigated coupled effects of grain size and surface condition on bulk compressive response of open-cell aluminum foam, providing manufacturer with valuable guidance to improve the strength of foam and accelerating performance-based design in open-cell metal foam
- Assessed the validity of crack-nucleation criteria for predicting fracture locations and failure modes in as-manufactured aluminum Duocel® foams
- Investigated the effect of foam hierarchical features on global mechanical response using a design of experiment approach; Performed Pearson correlation analysis to determine rank order of hierarchical structures on foam performance, thereby optimizing the design of foam
- Compared the computational efficiency, model accuracy, and numerical convergence between Finite Element Method (FEM) and Material Point Method (MPM) incorporating crystal plasticity in simulating large-strain (up to 70%) deformation of open-cell metal foam

– ***Skills acquired***

- Collaborated with implementation and verification of crystal-plasticity constitutive models in Abaqus/Explicit user subroutine (VUMAT) and material-point-method solver, Uintah
- Improved the computational efficiency (up to 50%) in Uintah-MPM by paralleling and modifying the grid basis functions in convected-particle tetrahedron interpolation
- Extensively used an open-source software DREAM.3D to process High Energy X-ray Diffraction Microscopy data, reconstruct 3D microstructures, and export data for subsequent simulation
- Proficiently post-process, analyze simulation results, and develop visualization tools using Abaqus/Python and Paraview/HDF5

**University of Denver Department of Mechanical & Materials Engineering** Jan. 2015 – Aug. 2016
*Graduate Research Assistant (Advisor: Dr. Yun-Bo Yi)* Denver, CO

– ***Research activities***

- Computational studied thermal conductivity in heterogeneous particulate composites and correlated their effective conductivity with various particle attributes (e.g., morphology, material composition, frictional contact)

– ***Skills acquired***

- Developed a dynamic collision algorithm using C++ to generate particulate material system
- Performed finite element analysis of heat conduction using Abaqus/Explicit
- Modeled interfacial contact mechanics with Coulomb friction and contact resistance via Abaqus/Explicit

## PUBLICATIONS

- **D. Zhao**, J. He, E. Marsden, A.D. Spear. Investigating microscale failure mechanisms in open-cell metal foam by coupling high-fidelity numerical modeling with experimental observations. (In Preparation)
- **D. Zhao**, K.E. Matheson, B.R. Phung, S. Petruzza, M.W. Czabaj, A.D. Spear. Investigating the effect of grain structure on compressive response of open-cell metal foam using high-fidelity crystal-plasticity modeling. *Materials Science and Engineering: A.* 2021.
doi.org/10.1016/j.msea.2021.140847
- **D. Zhao**, Y. Zhang, Y. Yi. Computational modeling of thermal conductivity of random particulate composites with contact resistance. *International Journal for Multiscale Computational Engineering.* 2021.
doi.org/10.1615/IntJMultCompEng.2021038979
- A.D. Spear, M. Czabaj, P. Newell, K. DeMille, B.R. Phung, **D. Zhao**, et al. The Third Sandia Fracture Challenge: From Theory to Practice in a Classroom Setting. *International Journal of Fracture.* 2019.
doi.org/10.1007/s10704-019-00366-w

## CONFERENCE PRESENTATIONS

- **D. Zhao**, K. Matheson, Q. Johnson, B. Phung, S. Petruzza, M. Czabaj, A.D. Spear, "Investigating the effect of grain structure on compressive response of open-cell metal foam using high-fidelity crystal-plasticity modeling", *USNCCM16*, virtual, July 2021.
- **D. Zhao**, K.E. Matheson, B.R. Phung, M.W. Czabaj, A.D. Spear, "A crystal plasticity modeling framework to study the effect of grain size on mechanical response of open-cell aluminum foam", *TMS 2020 Annual Meeting & Exhibition*, San Diego, California, February 2020.
- **D. Zhao**, J. Tucker, A.D. Spear, "High-fidelity numerical simulation of open-cell aluminum foams using crystal plasticity modeling", *11th International Conference on Porous Metals and Metallic Foams (MetFoam)*, Dearborn, Michigan, August 2019.
- **D. Zhao**, J. Plumb, B.R. Phung, K. Matheson, J. Guilkey, A.D. Spear, "3D crystal-plastic particle-in-cell simulation of open-cell metal foam", *13th World Congress on Computational Mechanics*, New York, July 2018.
- **D. Zhao**, J. Plumb, A.D. Spear, "Characterization and role of interfaces in stochastic open-cell metal foams", *Materials Research Society (MRS) Fall Meeting*, Boston, Massachusetts, November 2017. (student poster)

## RELEVANT COURSEWORK

Engineering Material Science
Continuum Mechanics
Advanced Mechanics of Materials
Advanced Finite Element Method
Advanced Engineering Mathematics
Advanced Numerical Methods
Fracture and Fatigue
Mechanics of Composite Materials
Parallel High Performance Computing

## OTHER PROJECTS

### 3rd Sandia Fracture Challenge Participant

- Calibrated material model parameters based on experimental data
- Generated adaptive refined elements in the notched tensile specimen produced via additive manufacturing of stainless steel 316L powder