

Masoud Behzadinasab

Curriculum Vitae

School of Engineering, Brown University

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Research Description

My research interests include **computational mechanics**, **fracture mechanics**, **fluid-structure interaction**, **structural mechanics**, **data-driven mechanics**, and **machine learning**. My research involves developing accurate, efficient, and robust predictive models for simulating the behavior of materials, solid structures, and fluid flows in extreme conditions involving high-Reynolds-number flows, large inelastic solid deformations, fracture, and fragmentation (e.g. blast events). My eventual goal is oriented towards **building a predictive computational platform for the design of resilient, sustainable, and smart materials, structures, buildings, and vehicles**. In doing so, I consider the best of different numerical techniques as the ingredients of my computational framework, i.e., **a combination of robust physics-based simulations with artificial intelligence**. I use and develop emerging research areas in computational mechanics, specifically meshfree methods (e.g. peridynamics), isogeometric (and finite element) analysis, and machine learning tools (e.g. Neural Networks), in high-performance computing settings to tackle a variety of engineering problems.

Current Employment

Jan 2020 – Present **Postdoctoral Research Associate**, *Brown University*.
School of Engineering, Mechanics of Solids Group;
Research on developing a robust computational framework for simulation of extreme events involving large deformation, fracture, and fragmentation (e.g. air-blast-structure interaction);
Advisor: Prof. Yuri Bazilevs.

Education

Sep 2015 – Dec 2019 **Doctor of Philosophy (Ph.D.)**, *The University of Texas at Austin (UT Austin)*.
Major: Engineering Mechanics; Program GPA: 3.96/4;
Dissertation: Peridynamic modeling of large deformation and ductile fracture
(<https://dx.doi.org/10.26153/tsw/8161>);
Committee: Prof. John Foster (chair), Prof. Krishnaswa Ravi-Chandar, Prof. Chad Landis, Prof. Stelios Kyriakides, Prof. Rui Huang, Prof. Mukul Sharma.

Sep 2017 – Dec 2018 **Portfolio in Scientific Computation**, *UT Austin*.
Department of Statistics and Data Sciences.

Sep 2013 – Aug 2015 **Master of Science in Engineering (M.S.E.)**, *UT Austin*.
Major: Mechanical Engineering (Thermal Fluid Systems); Program GPA: 3.96/4;
Thesis: Development and application of a parallel chemical compositional reservoir simulator;
Advisors: Prof. Kamy Sepehrnoori, Prof. Ofodike Ezekoye.

Sep 2009 – Jun 2013 **Bachelor of Science (B.Sc.)**, *Sharif University of Technology*, Tehran, Iran.
Major: Mechanical Engineering; Program GPA: 18.25/20 (3.90/4);
Thesis: A novel experimental design of a solar water desalination system;
Advisor: Prof. Mohammad Behshad Shafii.

Research Experience

Postdoctoral Research Associate

Brown University

School of Engineering

Advisor: Prof. Yuri Bazilevs

2020 – Present

- Immersed coupling of IGA and peridynamics for simulation of air- and water-blast fluid-structure interaction
- Development of a unified, stable and accurate meshfree framework for correspondence-based peridynamics
- Large deformation, fracture, and fragmentation analysis of thin-walled shell structures
- A machine learning approach to multiscale constitutive modeling involving plasticity and damage
- Topology optimization of materials under impact using neural networks
- Failure analysis of laminated composites subjected to low velocity impact
- Developing efficient strategies for addressing the high computational cost of peridynamics

Graduate Research Assistant

The University of Texas at Austin

Department of Aerospace Engineering and Engineering Mechanics

2015 – 2019

Advisor: Prof. John Foster

- Development of a predictive peridynamic framework for simulation of large deformation and ductile fracture
- Stability analysis of the existing peridynamic finite deformation theory
- Blind prediction of deformation and failure in additively manufactured metal (Sandia Fracture Challenge 3)
- Building an automated framework for model calibration
- Uncertainty quantification in predicting ductile fracture
- Mesoscale simulation of wave propagation in granular media by including inter- and intra-particle phenomena

Petroleum Engineering & Machine Learning Intern

Bazean Co., Houston, TX

Summer 2019

Project: An automated data-driven framework for prediction of oil production in horizontal wells

Research Associate Intern

Advanced Cooling Technologies, Inc., Lancaster, PA

Fall 2017, Summer 2018, Spring 2019

Mentor: Dr. Srujan Rokkam

Project: Fracture characterization of engineering alloys in corrosive environments

Recipient of an internal award for key contributions to the NAVAIR Phase II STTR project

Graduate Research Assistant

The University of Texas at Austin

Department of Petroleum and Geosystems Engineering

2014 – 2015

Advisor: Prof. Kamy Sepehrnoori

Project: Development of a parallel chemical flooding reservoir simulator for large-scale applications

Undergraduate Research Assistant

Sharif Energy Research Institute, Tehran, Iran

Summer 2012

Advisor: Prof. Behshad Shafii

Project: Experimental investigation of a novel solar desalination system

Scholastic Honors

- Selected to be a member of the inaugural class of Thomas J. R. Hughes Fellows (USNC/TAM) 2021
- Winner of the Best Student Poster Competition on Computational Mechanics (ASME-AMD), IMECE 2019
- The University of Texas at Austin Graduate Continuing Fellowship 2018 – 2019
- Ranked 2nd among 310,000+ participants in the Iranian Nationwide University Entrance Exam 2009
- Travel awards for ICTAM 2020+1 (NSF + IUTAM), WFM 2020 (USACM), USNCCM 2019 (USACM), PACAM 2019 (AAM), SIAM-CSE 2019 (SIAM + UT GS), SIAM TX-LA 2018 (SIAM), MFPM 2018 (USACM), WCCM 2018 (WCCM + UT GS), APS-SCCM 2017 (SCCM + UT GEC) 2017 – Present
- Poster award winner, UT Austin Graduate And Industry Networking Event 2018
- SIAWE Scholarship (awarding talented Iranian students in US) for two consecutive years 2014 and 2015
- The University of Texas incoming graduate student full scholarship 2013
- Exempted from MSc entrance exam as an exceptionally talent, Sharif University of Technology 2012
- First Rank Member of Iranian National Elites Foundation 2009 – 2013
- Dean's honorary award by the President of Sharif University of Technology 2009
- Honorary Award by the Iranian Ministry of Science, Research and Technology 2009
- Semi-finalist in the Iranian National Chemistry Olympiads 2007

Teaching Experience

Co-Instructor

*Brown University
School of Engineering*

- ENGN 2911V: Advanced Topics in Computational Mechanics: Isogeometric Analysis, Meshfree Methods, and FSI (with Prof. Yuri Bazilevs) Fall 2021

Graduate Teaching Assistant

*The University of Texas at Austin
Walker Department of Mechanical Engineering*

- ME 330: Fluid Mechanics Fall 2013 and Spring 2014

Mentorship

Brown University

- Weican Li (PhD student): Reduced integration for FEM, IGA, and peridynamics Fall 2021 – Spring 2022
- Shaunak Shende (PhD student): Immersed coupling of IGA-PD for analysis of underwater vehicles and structures under blast loading conditions Summer 2021 – Spring 2022
- Mert Alaydin (PhD student): Numerical simulation of damage and delamination growth in composite shell structures subjected to impact loading Winter 2021 – Spring 2022

UT Austin

- Barun Das (MS–PhD student): A blind-prediction approach to Sandia Fracture Challenge 2020 (a puncture test) using the peridynamic theory Fall 2019 – Spring 2022

Publications

- Link to my Google Scholar profile: <https://scholar.google.com/citations?user=MJSWA7QAAAAJ>

Preprints

3. Alaydin, M., **Behzadinasab, M.**, Bazilevs, Y. (2022). Isogeometric Analysis of Multilayer Composite Shell Structures: Plasticity, Damage, Delamination and Impact Modeling *Submitted to International Journal of Solids and Structures*.
2. Bazilevs, Y., **Behzadinasab, M.**, Foster, J.T. (2022). Simulating Concrete Failure Using the Microplane (M7) Constitutive Model and Correspondence-Based Peridynamics: Validation and Extension to Fracture and Fragmentation *Manuscript in preparation for submission to Journal of Applied Mechanics*.
1. Li, W., Moutsanidis, G., **Behzadinasab, M.**, Bazilevs, Y. (2022). Nonlinear One-Point Integration Methods for Reduced Integration in FEM and IGA. *Manuscript in preparation for submission to Computer Methods in Applied Mechanics and Engineering*.

Journal Papers

13. **Behzadinasab, M.**, Alaydin, M., Trask, N., Bazilevs, Y. (2022). A General-Purpose, Inelastic, Rotation-Free Kirchhoff-Love Shell Formulation for Peridynamics. *Computer Methods in Applied Mechanics and Engineering*. 389:114422. <https://www.sciencedirect.com/science/article/pii/S0045782521006678>.
12. **Behzadinasab, M.**, Hillman, M., Bazilevs, Y. (2021). IGA-PD Penalty-Based Coupling for Immersed Air-Blast Fluid-Structure Interaction: A Simple and Effective Solution for Fracture and Fragmentation. *Journal of Mechanics*. 37:680–692. <https://academic.oup.com/jom/article/doi/10.1093/jom/ufab033/6479818>.
11. **Behzadinasab, M.**, Moutsanidis, G., Trask, N., Foster, J.T., Bazilevs, Y. (2021). Coupling of IGA and Peridynamics for Air-Blast Fluid-Structure Interaction Using an Immersed Approach. *Forces in Mechanics*. 4:100045. <https://doi.org/10.1016/j.finmec.2021.100045>.

10. **Behzadinasab, M.**, Trask, N., Bazilevs, Y. (2021). A Unified, Stable and Accurate Meshfree Framework for Peridynamic Correspondence Modeling–Part I: Core Methods. *Journal of Peridynamics and Nonlocal Modeling*. 3(1):24–45. <https://doi.org/10.1007/s42102-020-00040-z>.
9. **Behzadinasab, M.**, Foster, J.T., Bazilevs, Y. (2021). A Unified, Stable, and Accurate Meshfree Framework for Peridynamic Correspondence Modeling–Part II: Wave Propagation and Enforcement of Stress Boundary Conditions. *Journal of Peridynamics and Nonlocal Modeling*. 3(1):46–66. <https://doi.org/10.1007/s42102-020-00039-6>.
8. **Behzadinasab, M.**, Foster, J.T. (2020). Revisiting the Third Sandia Fracture Challenge: A Bond-Associated, Semi-Lagrangian Peridynamic Approach to Modeling Large Deformation and Ductile Fracture. *International Journal of Fracture*. 224:261–267. <https://doi.org/10.1007/s10704-020-00455-1>.
7. **Behzadinasab, M.**, Foster, J.T. (2020). A Semi-Lagrangian Constitutive Correspondence Framework for Peridynamics. *Journal of the Mechanics and Physics of Solids*. 137:103862. <https://doi.org/10.1016/j.jmps.2019.103862>.
6. **Behzadinasab, M.**, Foster, J.T. (2020). On the Stability of the Generalized, Finite Deformation Correspondence Model of Peridynamics. *International Journal of Solids and Structures*. 182:64–76. <https://doi.org/10.1016/j.ijsolstr.2019.07.030>.
5. Kamensky, D., **Behzadinasab, M.**, Foster, J.T., Bazilevs, Y. (2019). Peridynamic Modeling of Frictional Contact. *Journal of Peridynamics and Nonlocal Modeling*. 1(2):107–121. <https://doi.org/10.1007/s42102-019-00012-y>.
4. **Behzadinasab, M.**, Foster, J.T. (2019). The Third Sandia Fracture Challenge: Peridynamic Blind Prediction of Ductile Fracture Characterization in Additively Manufactured Metal. *International Journal of Fracture*. 218:97–109. <https://doi.org/10.1007/s10704-019-00363-z>.
3. Kramer, S.L.B., Boyce, B.L., **Behzadinasab, M.**, Foster, J.T., *et al.* (2019). The Third Sandia Fracture Challenge: Predictions of Ductile Fracture in Additively Manufactured Metal. *International Journal of Fracture*. 218:5–61. <https://doi.org/10.1007/s10704-019-00361-1>.
2. **Behzadinasab, M.**, Vogler, T.J., Foster, J.T., Peterson, A.M., Rahman, R. (2018). Peridynamics Modeling of a Shock Wave Perturbation Decay Experiment in Granular Materials with Intra-Granular Fracture. *Journal of Dynamic Behavior of Materials*. 4(4):529–542. <https://doi.org/10.1007/s40870-018-0174-2>.
1. **Behzadinasab, M.**, Grein, E.A., Sepehrnoori, K. (2017). Development of a Parallel Chemical Flooding Reservoir Simulator. *International Journal of Oil, Gas and Coal Technology*. 16(2):111–129. <https://doi.org/10.1504/IJOGCT.2017.086353>.

Conference Papers

1. **Behzadinasab, M.**, Vogler, T.J., Foster, J.T. (2018). Modeling Perturbed Shock Wave Decay in Granular Materials with Intra-Granular Fracture. In: *20th APS Conference on Shock Compression of Condensed Matter*. 1979(1):070005. <https://doi.org/10.1063/1.5044814>.

Technical Reports

2. Rokkam, S., **Behzadinasab, M.**, Gunzburger, M., and Shanbag, S. (2019). *Development of Novel Peridynamics Framework for Corrosion Fatigue Damage Prediction*. NAVAIR Phase II.5 STTR Interim Final Report (NAVAIR Contract No. N68335-15-C-0032). Advanced Cooling Technologies, Inc.
1. Vogler, T.J., **Behzadinasab, M.**, Rahman, R., Foster, J.T. (2016). *Perturbation Decay Experiments on Granular Materials*. Technical Report No. SAND2016-2537C. Sandia National Laboratories.

Technical Presentations

Oral Presentations

19. “Peridynamics for Simulation of Fracture Mechanics Problems.” USACM TTA Early-Career Colloquium – Large Scale Structural Systems and Optimal Design. A Virtual Event. April 2022. **Invited talk.**
18. “Air-Blast-Structure Interaction Simulation Using an Immersed Isogeometric-Peridynamic Model.” ASME’s International Mechanical Engineering Congress & Exposition (IMECE 2021). A Virtual Event. November 2021. **Invited talk.**

17. “A General-Purpose, Inelastic, Rotation-Free Shell Formulation for Peridynamics.” XVI International Conference on Computational Plasticity. Fundamentals and Applications (COMPLAS 2021). Barcelona, Spain (A Virtual Event). September 2021. **Invited talk.**
16. “A Peridynamic Framework for Simulating Ductile Fracture.” The 25th International Congress of Theoretical and Applied Mechanics (ICTAM 2020+1) . Milan, Italy (A Virtual Event). August 2021. **Invited talk.**
15. “An Immersed Isogeometrics-Peridynamics Approach for Fluid-Structure Interaction Modeling.” The 16th U.S. National Congress on Computational Mechanics (USNCCM16). Chicago, Illinois (A Virtual Event). July 2021. **Invited talk.**
14. “Fluid-Structure Interaction Modeling Using a Coupled Isogeometric-peridynamic Approach.” The Engineering Mechanics Institute Conference 2021 (EMI / PMC 2021). New York City, New York (A Virtual Event). May 2021. **Invited talk.**
13. “Peridynamic Modeling of Large Deformation and Ductile Fracture: A Bond-Associated, Semi-Lagrangian, Correspondence Approach.” ASME’s International Mechanical Engineering Congress & Exposition (IMECE 2019). Salt Lake City, Utah. November 2019.
12. “A Semi-Lagrangian, Constitutive Correspondence Peridynamic Framework for Large Deformation Modeling.” The 19th International Conference on New Trends in Fatigue and Fracture (NT2F19). Tucson, Arizona. October 2019.
11. “A Semi-Lagrangian, Constitutive Correspondence Model for Peridynamics.” The 15th U.S. National Congress on Computational Mechanics (USNCCM15). Austin, Texas. August 2019.
10. “Dynamic Ductile Fracture Characterization with Peridynamics: A Sandia Fracture Challenge Study.” The Fourteenth Pan American Conference on Applied Mechanics (PACAM XVI). Ann Arbor, Michigan. May 2019.
9. “A Stabilized Hypoelastic Constitutive Correspondence Model for Peridynamics.” 2019 Minerals, Metals & Materials Society Annual Meeting & Exhibition (TMS 2019). San Antonio, Texas. March 2019.
8. “On the Stability of the Generalized, Ordinary, Finite Deformation Constitutive Correspondence Model of Peridynamics.” ASME’s International Mechanical Engineering Congress & Exposition (IMECE 2018). Pittsburgh, Pennsylvania, November 2018.
7. “Peridynamic Modeling of Dynamic Fracture in Metallic Materials.” USACM Thematic Conference on Meshfree and Particle Methods: Applications and Theory (MFPM 2018). Santa Fe, New Mexico. September 2018.
6. “Dynamic Fracture Modeling of Ductile Materials with Peridynamics.” The 13th World Congress on Computational Mechanics / 2nd Pan American Congress on Computational Mechanics (WCCM 2018). New York, New York. July 2018.
5. “Ductile Fracture Modeling with Peridynamics” The 18th US National Congress of Theoretical and Applied Mechanics (USNC/TAM 2018). Chicago, Illinois. June 2018.
4. “A Peridynamic Study of Predicting Ductile Fracture in Additively Manufactured Metal.” The 1st Annual Meeting of SIAM Texas-Louisiana Section. Baton Rouge, Louisiana. October 2018. **Invited talk.**
3. “Modeling Ductile Fracture with Peridynamics”. MURI webinar on peridynamic models of fracture mechanics. A Virtual Event. December 2017. **Invited talk.**
2. “Modeling Perturbed Shock Wave Decay in Granular Materials with Intra-Granular Fracture.” The 20th Biennial Conference of the APS Topical Group on Shock Compression of Condensed Matter (SCCM 2017). St. Louis, Missouri. July 2017.
1. “Large-Scale Granular Material Simulations using Peridigm.” MURI workshop on material failure prediction through peridynamics. Tucson, Arizona. February 2017.

Posters

8. “Peridynamic Modeling of Large Deformation and Ductile Fracture.” Workshop on Experimental and Computational Fracture Mechanics 2020 (WFM2020). Baton Rouge, Louisiana. February 2020. **Invited poster.**
7. “A Peridynamic Framework for Simulation of Large Deformation and Ductile Fracture.” ASME’s International Mechanical Engineering Congress & Exposition (IMECE 2019). Salt Lake City, Utah. November 2019. **(Best student poster award on Computational Mechanics).**

6. "A Stabilized, Hypoelastic Constitutive Correspondence Framework for Peridynamics." SIAM Conference on Computational Science and Engineering 2019 (SIAM-CSE19). Spokane, Washington. February 2019.
5. "Sandia Fracture Challenge 2017: Peridynamic Blind Prediction of Dynamic Crack Growth in Ductile Materials." USACM Thematic Conference on Meshfree and Particle Methods: Applications and Theory (MFPM 2018). Santa Fe, New Mexico. September 2018.
4. "Sandia Fracture Challenge 2017: Peridynamics Blind Prediction of Dynamic Crack Growth." The 13th World Congress on Computational Mechanics / 2nd Pan American Congress on Computational Mechanics (WCCM 2018). New York, New York. July 2018.
3. "Prediction of Dynamic Fracture Growth in Metallic Alloys with Peridynamics." Graduate And Industry Networking 2018. The University of Texas at Austin. Austin, Texas. January 2018.
2. "Peridynamics Modeling of Perturbation Decay Experiments in Granular Materials with Intra-Granular Fracture." The 20th Biennial Conference of the APS Topical Group on Shock Compression of Condensed Matter. St. Louis, Missouri. July 2017.
1. "Fracture and Frictional Effects in Granular Materials under Pressure." Graduate And Industry Networking 2017. The University of Texas at Austin. Austin, Texas. January 2017.

Professional Activities and Services

Technical Program Committees

- Lead organizer, mini-symposium on Contemporary Meshfree Methods in Computational Mechanics, the 19th U.S. National Congress on Theoretical and Applied Mechanics (USNC/TAM 2022), Austin, TX, 2022

Journal Reviews

- International Journal of Solids and Structures
- International Journal of Fracture
- Computer Methods in Applied Mechanics and Engineering
- Computational Mechanics
- Engineering Fracture Mechanics
- International Journal for Numerical Methods in Engineering
- International Journal for Multiscale Computational Engineering
- Computational Geosciences
- Journal of Natural Gas Science and Engineering
- Mathematical Problems in Engineering
- Materials
- Fluids

Conference Reviews

- The ARMA 53rd US Rock Mechanics/Geomechanics Symposium, New York City, 2019

Memberships

- U.S. Association for Computational Mechanics (USACM)
- Engineering Mechanics Institute (EMI)
- American Society of Mechanical Engineers (ASME)
- American Society of Civil Engineers (ASCE)

Software

- Active contributor to Peridigm - open source computational peridynamics code