

# Harkirat Singh

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CONTACT INFORMATION	Solid Mechanics Brown University Barus and Holley, 184 Hope street Providence, RI 02906.	Homepage: <a href="http://www.harkirat-singh.com">www.harkirat-singh.com</a> Email: <a href="mailto:harkirat_singh@brown.edu">harkirat_singh@brown.edu</a>
RESEARCH INTERESTS	Computational Mechanics	
EDUCATION	<b>Brown University</b> <i>Ph.D.</i> in Solid Mechanics <i>MS</i> in Solid Mechanics	2018 - present 2018
	<b>Indian Institute of Technology (IIT), Kanpur</b> <i>Bachelor's and Master's (Dual degree)</i> in Mechanical Engineering	2016
RESEARCH EXPERIENCE	<b>Graduate Student Researcher</b> Advisor: Prof. David Henann Solid Mechanics, <i>Brown University</i>	2018 - present
	<b>Research Assistant</b> Advisor: Prof. Venkatesan Department of Aerospace, <i>IIT Kanpur</i>	2016-17
	<b>Research Assistant</b> Advisor: Prof. Pankaj Wahi Mechanics & Applied Mathematics Group, <i>IIT Kanpur</i>	2015-16
TECHNICAL SKILLS	<i>Computational:</i> Finite element analysis, Structural analysis, Numerical methods, Molecular dynamics. <i>Programming languages:</i> MATLAB, Python, Fortran, C. <i>Softwares:</i> Abaqus, LAMMPS, Mathematica, Ovito, Maple.	
PHD THESIS	<b>Constitutive modeling of size segregation-flow in dense granular materials</b> (May' 18 - Present) <ul style="list-style-type: none"><li>Formulated constitutive equations for segregation dynamics in bidisperse granular mixtures</li><li>Coupled the model for segregation dynamics with rheological constitutive equations for dense granular mixtures by developing a novel continuum-scale model that enables predictive modeling at large length scales</li><li>Generalized the coupled model in a finite-deformation, elasto-plastic framework which facilitates simulating the segregation/flow dynamics under different loading conditions</li><li>Implemented the coupled continuum framework in the commercial finite-element code Abaqus using a user element (UEL) subroutine</li><li>Used Python scripting in Abaqus to automate several pre/post-processing operations</li></ul> <b>Discrete element method (DEM) modeling of dense granular mixtures</b> (May' 18 - Present) <ul style="list-style-type: none"><li>Performed large-scale particle-level simulations which enabled extraction of high fidelity information at small length scales to inform and assess the development of the coupled continuum model for size segregation and flow</li><li>Studied diverse boundary-driven and gravity-driven flows using LAMMPS</li><li>Developed coarse-graining methods to map grain-scale information to continuum-scale</li></ul> <b>Pressure sensitive shear zones in hydrogel suspensions</b> (May' 22 - Present) <i>Collaborators:</i> Zohreh Farmani and Joshua Dikman, Wageningen University. Nazanin Ghods, TU Graz <ul style="list-style-type: none"><li>Used nonlocal continuum modeling to study shear localization in dense hydrogel suspensions in a boundary-driven flow geometry</li><li>Implemented nonlocal granular rheology model using Abaqus UEL subroutine</li><li>Tested model performance against MRI-PIV experimental measurements and DEM simulations</li></ul>	

MASTERS THESIS	<b>Modeling the dynamics of the string vibrating against a rigid obstacle</b> (May '15 - Jul '16) <ul style="list-style-type: none"> <li>Derived the equations of motion for the system using extended Hamilton's principle</li> <li>Performed reduced order modeling using Galerkin projection method</li> <li>Performed stability analysis of equations with periodic coefficients using Floquet theory</li> </ul>	
SELECTED PROJECTS	<b>Torsional properties of beams with arbitrary cross section</b> (Sep'16 - April'17) <ul style="list-style-type: none"> <li>Studied the discrepancy in torsional frequency of I-beams between FEM and analytical solutions</li> <li>Developed series solutions estimating the torsional rigidity of beams with arbitrary cross-section</li> </ul>	
	<b>Exam schedule optimization</b> (Jan'15 - May'15) <ul style="list-style-type: none"> <li>Formulated a well posed linear programming problem with an objective to optimize the exam schedule given number of days, preference of students with other soft and hard constraints.</li> </ul>	
CONFERENCES	Society of Engineering Science (SES) Annual Meeting, Texas, US. <i>Talk.</i> 2022 Gordan Reserch Conference, Granular Matter, Stonehill college, US. <i>Poster.</i> [ <a href="#">Poster</a> ] 2022 American Physics Society (APS) March Meeting, Chicago, US. <i>Talk.</i> [ <a href="#">Link</a> ] 2022 Society of Engineering Science (SES) Annual Meeting. <i>Virtual.</i> [ <a href="#">Poster</a> ] 2021 9th European Nonlinear Dynamics Conference, Budapest, Hungary. <i>Talk.</i> [ <a href="#">Paper</a> ] 2017 International Congress of Theoretical and Applied Mechanics , Montreal, Canada. [ <a href="#">Poster</a> ] 2016 International Conference on Structural Nonlinear Dynamics and Diagnosis, Marrakesh, Morocco. <i>Talk.</i> [ <a href="#">Paper</a> ] 2016 International Conference on Advances in Dynamics, Vibrations and Control, NIT Durgapur, India. <i>Talk.</i> [ <a href="#">Paper</a> ] 2016	
JOURNAL PUBLICATIONS	<i>Continuum modeling of shear-strain-rate-gradient-driven size-segregation in dense, bidisperse granular flows</i> , with Daren liu and David Henann. <i>In Preparation.</i> [ <a href="#">arxiv</a> ] <i>Continuum modeling of pressure-gradient-driven size-segregation in dense, bidisperse granular flows</i> , with Daren liu and David Henann. <i>In Preparation.</i> <i>Finite element implementation of segregation dynamics coupled with nonlocal granular rheology</i> , with Shihong Li and David Henann. <i>In Preparation</i> <i>Pressure sensitive non-local behaviour in hydrogel suspension</i> , with Zohreh Farmani, Nazanin Ghods, David Henann and Joshua Diksmen. <i>In Preparation</i> Harkirat Singh and Pankaj Wahi. <i>Non-planar vibrations of a string in the presence of a boundary obstacle.</i> Journal of Sound and Vibration, 389, 326-349.[ <a href="#">PDF</a> ] Harkirat Singh and Pankaj Wahi. <i>Role of curvatures in determining the characteristics of a string vibrating against a doubly curved obstacle.</i> Journal of Sound and Vibration, 402, 1-13. [ <a href="#">PDF</a> ]	
AWARDS / HONORS	Poster award at SES conference 2021 President Fellowship at Brown University 2017-20 4 year Doctoral fellowship at UBC ( <i>*not pursued</i> ) 2017 Cambridge India Ramanujan Scholarship ( <i>*not pursued</i> ) 2017	
TEACHING EXPERIENCE	Teaching assistant for Advanced Solid Mechanics (ENGN 1750) (Sep '20 - Dec '20) Teaching assistant for Mechanics of Solids and Structures (ENGN 0310) (Sep '19 - Dec '19)	
RELEVANT COURSES	Continuum Mechanics Computational Mechanics Fracture Mechanics Non-Linear Vibration	Solid Mechanics Plasticity Stress Waves in Solids Aeroelasticity
REFERENCE	<b>David Henann</b> Email: david.henann@brown.edu Professor, Solid Mechanics, Brown University <b>Pradeep Guduru</b> Email: pradeep.guduru@brown.edu Professor, Solid Mechanics, Brown University	