

Harkirat Singh

CONTACT INFORMATION	Solid Mechanics Brown University Barus and Holley, 184 Hope street Providence, RI 02906.	Homepage: www.harkirat-singh.com Email: harkirat_singh@brown.edu
RESEARCH INTERESTS	Computational Mechanics	
EDUCATION	Brown University <i>Ph.D.</i> in Solid Mechanics <i>MS</i> in Solid Mechanics	2018 - present 2018
	Indian Institute of Technology (IIT), Kanpur <i>Bachelor's and Master's (Dual degree)</i> in Mechanical Engineering	2016
RESEARCH EXPERIENCE	Graduate Student Researcher Advisor: Prof. David Henann Solid Mechanics, <i>Brown University</i>	2018 - present
	Research Assistant Advisor: Prof. Venkatesan Department of Aerospace, <i>IIT Kanpur</i>	2016-17
	Research Assistant 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	Constitutive modeling of size segregation-flow in dense granular materials (May' 18 - Present) <ul style="list-style-type: none">Formulated constitutive equations for segregation dynamics in bidisperse granular mixturesCoupled 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 scalesGeneralized the coupled model in a finite-deformation, elasto-plastic framework which facilitates simulating the segregation/flow dynamics under different loading conditionsImplemented the coupled continuum framework in the commercial finite-element code Abaqus using a user element (UEL) subroutineUsed Python scripting in Abaqus to automate several pre/post-processing operations Discrete element method (DEM) modeling of dense granular mixtures (May' 18 - Present) <ul style="list-style-type: none">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 flowStudied diverse boundary-driven and gravity-driven flows using LAMMPSDeveloped coarse-graining methods to map grain-scale information to continuum-scale Pressure sensitive shear zones in hydrogel suspensions (May' 22 - Present) <i>Collaborators:</i> Zohreh Farmani and Joshua Dikman, Wageningen University. Nazanin Ghods, TU Graz <ul style="list-style-type: none">Used nonlocal continuum modeling to study shear localization in dense hydrogel suspensions in a boundary-driven flow geometryImplemented nonlocal granular rheology model using Abaqus UEL subroutineTested model performance against MRI-PIV experimental measurements and DEM simulations	

MASTERS THESIS	Modeling the dynamics of the string vibrating against a rigid obstacle (May '15 - Jul '16) <ul style="list-style-type: none"> Derived the equations of motion for the system using extended Hamilton's principle Performed reduced order modeling using Galerkin projection method Performed stability analysis of equations with periodic coefficients using Floquet theory 	
SELECTED PROJECTS	Torsional properties of beams with arbitrary cross section (Sep'16 - April'17) <ul style="list-style-type: none"> Studied the discrepancy in torsional frequency of I-beams between FEM and analytical solutions Developed series solutions estimating the torsional rigidity of beams with arbitrary cross-section 	
	Exam schedule optimization (Jan'15 - May'15) <ul style="list-style-type: none"> 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. 	
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> [Poster] 2022 American Physics Society (APS) March Meeting, Chicago, US. <i>Talk.</i> [Link] 2022 Society of Engineering Science (SES) Annual Meeting. <i>Virtual.</i> [Poster] 2021 9th European Nonlinear Dynamics Conference, Budapest, Hungary. <i>Talk.</i> [Paper] 2017 International Congress of Theoretical and Applied Mechanics , Montreal, Canada. [Poster] 2016 International Conference on Structural Nonlinear Dynamics and Diagnosis, Marrakesh, Morocco. <i>Talk.</i> [Paper] 2016 International Conference on Advances in Dynamics, Vibrations and Control, NIT Durgapur, India. <i>Talk.</i> [Paper] 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> <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.[PDF] 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. [PDF]	
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	David Henann Email: david.henann@brown.edu Professor, Solid Mechanics, Brown University Pradeep Guduru Email: pradeep.guduru@brown.edu Professor, Solid Mechanics, Brown University	