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
Ph.D. in Solid Mechanics — 2018 - present
MS in Solid Mechanics — 2018

Indian Institute of Technology (IIT), Kanpur
Bachelor's and Master's (Dual degree) in Mechanical Engineering — 2016

RESEARCH EXPERIENCE

Graduate Student Researcher — 2018 - present
Advisor: Prof. David Henann
Solid Mechanics, *Brown University*

Research Assistant — 2016-17
Advisor: Prof. Venkatesan
Department of Aerospace, *IIT Kanpur*

Research Assistant — 2015-16
Advisor: Prof. Pankaj Wahi
Mechanics & Applied Mathematics Group, *IIT Kanpur*

AWARDS / HONORS

- Poster award at SES conference — 2021
- President Fellowship at Brown University — 2017-20
- 4 year Doctoral fellowship at UBC (**not pursued*) — 2017
- Cambridge India Ramanujan Scholarship (**not pursued*) — 2017

WORKING PAPERS

Pressure sensitive non-local behaviour in hydrogel suspension, with Zohreh Farmani and Nazanin Ghods

A predictive continuum model for coupled size segregation and flow in dense granular materials, with Daren liu and David Henann.

Finite element implementation of segregation dynamics coupled with nonlocal granular rheology , with Shihong Li and David Henann

JOURNAL PUBLICATIONS

Harkirat Singh and Pankaj Wahi. *Non-planar vibrations of a string in the presence of a boundary obstacle*. Journal of Sound and Vibration, 389, 326-349.[PDF]

Harkirat Singh and Pankaj Wahi. *Role of curvatures in determining the characteristics of a string vibrating against a doubly curved obstacle*. Journal of Sound and Vibration, 402, 1-13. [PDF]

CONFERENCES

- Society of Engineering Science (SES) Annual Meeting, Texas, US. *Talk*. — 2022
- Gordan Reserch Conference, Granular Matter, Stonehill college, US. *Poster*. [Poster] — 2022
- American Physics Society (APS) March Meeting, Chicago, US. *Talk*. [Link] — 2022
- Society of Engineering Science (SES) Annual Meeting. *Virtual*. [Poster] — 2021
- 9th European Nonlinear Dynamics Conference, Budapest, Hungary. *Talk*. [Paper] — 2017
- International Congress of Theoretical and Applied Mechanics , Montreal, Canada. [Poster] — 2016
- International Conference on Structural Nonlinear Dynamics and Diagnosis, Marrakesh, Morocco. *Talk*. [Paper] — 2016
- International Conference on Advances in Dynamics, Vibrations and Control, NIT Durgapur, India. *Talk*. [Paper] — 2016

PhD Thesis

Pressure sensitive shear zones in hydrogel suspensions (May' 22 - Present)

Collaborators: Zohreh Farmani and Joshua Diksman, Wageningen University. Nazanin Ghods, TU Graz

- Implemented nonlocal granular rheology model using Abaqus UEL subroutine
- Studied the shear localization in hydrogel suspensions in a boundary-driven flow geometry
- Model performance is tested against MRI-PIV measurements and DEM simulations

Discrete element method (DEM) modeling for dense granular mixtures (May' 18 - Present)

- Formulated grain level interactions to perform particle simulations
- Numerical integrations are performed using Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) to study diverse boundary-driven and gravity-driven flows
- Developed coarse-graining methods to map microscopic-macroscopic information

Constitutive modeling for size segregation and flow in granular materials (May' 18 - Present)

- Developed continuum scale model that predicts segregation and flow simultaneously
- Developed finite deformation elasto-plastic framework coupled with segregation dynamics
- Numerical framework is implemented using Abaqus user element (UEL)
- Model is tested against DEM simulations in diverse flow configurations

Masters Thesis

Modeling the dynamics of the string vibrating against a rigid obstacle (May '15 - Jul '16)

- Derived the equations of motion for the system using extended Hamilton's principle
- Performed reduced order modeling using Galerkin projection method
- Perfomed stability anaylsis of equations with periodic coefficients using Floquet theory

Selected Projects

Torsional properties of beams with arbitrary cross section (Sep'16 - April'17)

- 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)

- 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.

Technical Skills

Computational: Finite element analysis, Structural analysis, Numerical methods, Molecular dynamics.

Programming languages: MATLAB, Python, Fortran, C.

Softwares: Abaqus, LAMMPS, Mathematica, Ovito, Maple.

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 '16)

Relevant Courses

Continuum Mechanics	Solid Mechanics
Computational Mechanics	Plasiticity
Fracture Mechanics	Stress Waves in Solids
Non-Linear Vibration	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
Daniel Harris Email: daniel_harris3@brown.edu
Professor, Fluid Mechanics, Brown University