Harkirat Singh

CONTACT INFORMATION

Solid Mechanics
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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*

TECHNICAL SKILLS

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

Programming languages: MATLAB, Python, Fortran, C.

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

PHD THESIS

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

- Coupled segregation dynamics with rheology of dense granular mixtures by developing a novel continuum scale model that enabled scientific explorations at large length scales
- Developed finite deformation elasto-plastic framework which facilitated simulating the segregation-flow dynamics under different physical and loading conditions
- Implemented the numerical framework using Abaqus user element (UEL)
- Used Abaqus python scripting to automate several pre/post- processing operations

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

- Formulated grain level interactions to perform particle simulations which enabled extraction of high fidelity information at small length scales to assess the continuum model
- Studied diverse boundary-driven and gravity-driven flows using LAMMPS
- Developed coarse-graining methods to map microscopic-macroscopic information

Pressure sensitive shear zones in hydrogel suspensions (May' 22 - Present)
Collaborators: Zohreh Farmani and Joshua Diksman, Wageningen University. Nazanin Ghods, TU Graz

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

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.

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

Journal Publications

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

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

Pressure sensitive non-local behaviour in hydrogel suspension, with Zohreh Farmani, Nazanin Ghods, David Henann and Joshua Diksman. *In Preparation*

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]

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

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
Computational Mechanics
Fracture Mechanics
Non-Linear Vibration
Solid Mechanics
Plasiticity
Stress Waves in Solids
Aeroelasticity

Reference

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