Sandip Mandal

Assistant Professor

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Research Interests

- Granular Mechanics
- Fluid Mechanics
- Complex fluids
- Rheology

Work History

2021-05 - 2021-07

Post-doctoral Researcher

Sorbonne University, France

- Investigated the influence of adhesion in the rheology and segregation of granular mixtures flowing down a rough inclined plane, using Discrete Element Method (DEM) simulations.

2018-09 - 2021-04

Post-doctoral Researcher

Laboratory IUSTI, Aix-Marseille University, CNRS, France

- Studied shear banding instability in cohesive granular media
- Proposed a continuum model to explain the observations
- Examined the rheology of cohesive granular media flowing down a rough inclined plane, using DEM simulations
- Discovered an effective adhesion, comprising inter-particle adhesion, elasticity, and dissipation to control the flow
- Proposed scaling relations to describe the rheology.

2018-01 - 2018-04

Research Associate

Indian Institute Of Technology Bombay, India

- Studied the role of inter-particle friction in controlling the size- and shape-difference-driven granular segregation.

2009-07 - 2017-12

Graduate Researcher

Indian Institute Of Technology Bombay, India

- Investigated the rheology and micro-structure of dumbbell-shaped particles flowing down a rough inclined plane and in a simple shear cell, using DEM simulations
- Proposed scaling relations to describe the rheology
- Examined the rheology of prolate spheroidal grains of different aspect ratios flowing in a quasi-two-dimensional rotating cylinder

experimentally and compared the results with the predictions of a continuum model
- Discovered a disorder-to-order transition in granular flows in inclined channels, caused by increasing particle-wall friction
- Proposed scaling laws to describe the results
- Explored the rheology and segregation of granular mixtures of spheres and dumbbells flowing down a rough inclined plane, using DEM simulations
- Showed that a percolation mechanism based on the difference in the geometric mean diameter of the species controls the intensity of segregation
- Studied the kinematics of granular surface flows on a conical heap experimentally
- Developed a simple model, which predicted well the layer thickness profile in the streamwise direction of the flow.

Education

2005-07 - 2009-05

B.Tech.: Chemical Engineering

Heritage Institute of Technology - Kolkata

2009-07 - 2018-05

M.Tech.+Ph.D. Dual Degree: Chemical Engineering

Indian Institute of Technology Bombay - Mumbai

- Thesis Title: Rheology and Segregation of Nonspherical Granular Materials
- Advisor: Prof. Devang V. Khakhar

Awards

- Institute Award for Excellence in Ph.D. thesis work, IIT Bombay 2019
- RG Manudhane Ph.D. excellence Award, Department of Chemical Engineering, IIT Bombay 2019

Publications

- S. Mandal, M. Nicolas, and O. Pouliquen, Rheology of cohesive granular media: Shear banding, hysteresis, and non-local effects, Phys. Rev. X 11, 021017 (2021).
- S. Mandal, M. Nicolas, and O. Pouliquen, Insights into the rheology of cohesive granular media, Proc. Natl. Acad. Sci. 117, 8366-8373 (2020).
- S. Mandal and D. V. Khakhar, Granular surface flow on an asymmetric conical heap, J. Fluid Mech. 865, 41-59 (2019).
- S. Mandal and D. V. Khakhar, Dense granular flow of mixtures of spheres and dumbbells down a rough inclined plane: Segregation and rheology, Phys. Fluids 31, 023304 (2019). Selected as Editor's pick
- S. Mandal and D. V. Khakhar, A study of the rheology and micro-structure of dumbbells in shear geometries, Phys. Fluids 30, 013303

(2018).

- S. Mandal and D. V. Khakhar, Sidewall-friction-driven ordering transition in granular channel flows: Implications for granular rheology, Phys. Rev. E. 96, 050901(R) (2017).
- S. Mandal and D. V. Khakhar, An experimental study of the flow of nonspherical grains in a rotating cylinder, AIChE J. 63, 4307-4315 (2017).
- S. Mandal and D. V. Khakhar, A study of the rheology of planar granular flow of dumbbells using discrete element method simulations, Phys. Fluids 28, 103301 (2016). Selected as Editor's pick

Conferences

- Rheology of complex granular flows, SOFT MATTER YOUNG INVESTIGATORS MEET 2023, Uttarakhand, June 14-17, 2023.
- Rheology of cohesive granular media, COMPFLU22, IIT Kharagpur, December 19-21, 2022.
- Insights into the rheology of cohesive granular media, The Annual European Rheology Conference, Cyberspace, April 13-15, 2021.
- Packings and dense flows for a controlled-cohesion granular material, 3rd IMA Conference on Dense Granular Flows, Cambridge, July 01-04, 2019.
- DEM simulation of flow of dumbbells on a rough inclined plane, 68th Annual Meeting of American Physical Society - Division of Fluid Dynamics, Boston, November 22-24, 2015.
- An experimental study of dense granular surface flow of nonspherical grains in a rotating cylinder, 7th World Congress on Particle Technology, Beijing, May19-22, 2014.
- DEM simulations of two-dimensional flow of dumbbells on a rough inclined surface, 7th World Congress on Particle Technology, Beijing, May19-22, 2014.
- DEM simulations of two-dimensional flow of dumbbells on a rough inclined surface, Research Scholars' Symposium, 2014, Department of Chemical Engineering, Indian Institute of Technology Bombay, Mumbai, February 15, 2014

Teaching Experience

- Instructor for the course "Introduction to Granular Mechanics," Winter 2023-24
- Instructor for the course "Fluid Particle Mechanics," Monsoon 2022-23, 2023-24
- Instructor for the laboratory "Fluid Particle Mechanics," Monsoon 2022-23, 2023-24
- Instructor for the course "Transport Phenomena," Winter 2021-22, 2022-23
- Instructor for the course "Research Methodology," Winter 2021-22, 2022-23, 2023-24

- Instructor for the laboratory "Heat Transfer," Monsoon 2022-23

Service

Referee, Eur. Phys. J. E