

SANDIP MANDAL

Assistant Professor

Chemical Engineering Department, IIT (ISM) Dhanbad, Jharkhand 826004, IN
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PERSONAL DETAILS

Date of Birth: May 10, 1988

PROFESSIONAL SUMMARY

Assistant Professor and researcher specializing in bulk solid handling and granular materials, with expertise in Discrete Element Method (DEM) simulations, experimental investigations, and computational modeling. Conducts research on the mechanics and flow behavior of granular materials, with particular focus on granular rheology, particle segregation, Janssen effects, and shape-driven flow phenomena.

RESEARCH INTERESTS

- Granular Mechanics
- Fluid Mechanics
- Complex fluids
- Rheology

EDUCATION

- 07/2009 to 04/2018 **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
- 07/2005 to 05/2009 **B.Tech.: Chemical Engineering**
Heritage Institute of Technology - Kolkata

WORK HISTORY

- 12/2021 to Current **Assistant Professor**
Indian Institute of Technology Dhanbad – India
- Investigating the rheology of non-spherical grains, employing Discrete Element Method (DEM) simulations and experiments
 - Investigating Janssen effects in granular media, utilizing experiments and DEM simulations
- 05/2021 to 07/2021 **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 DEM simulations
- 09/2018 to 04/2021 **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

01/2018 to 04/2018 **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

07/2009 to 12/2017 **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

TEACHING EXPERIENCE

- Instructor for the course "Chemical Process Calculations," Winter 2024-25, 2025-26
- Instructor for the course "Introduction to Granular Mechanics," Winter 2023-24, Monsoon 2025-26
- Instructor for the course "Fluid Mechanics," Monsoon 2025-26
- Instructor for the laboratory "Heat Transfer," Winter 2021-22, Winter 2024-25
- Instructor for the course "Fluid Particle Mechanics," Monsoon 2022-23, 2023-24, 2024-25
- Instructor for the laboratory "Fluid Particle Mechanics," Monsoon 2022-23, 2023-24, 2024-25
- Instructor for the course "Transport Phenomena," Winter 2021-22, 2022-23

- Instructor for the course "Research Methodology," Winter 2021-22, 2022-23, 2023-24

PUBLICATIONS

- S. Mandal, Silo Discharge of Non-spherical Grains: From Spheroids to Faceted, *Ind. Eng. Chem. Res.* 65, 9731-9737 (2026).
- 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 non-spherical granular materials, COMPFLU24, IIT Hyderabad, December 16-18, 2024.
- 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

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

SERVICE

Referee, Eur. Phys. J. E & Phys. Fluids