## Prasad Ranganath Sonar, Ph.D. (IIT Kanpur, Solid Mechanics and Design)


**Contact information**

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**About me**

I am a Mechanical Engineer specializing in Solid Mechanics and Mechanical Design. I am working as a scientist at CSIR-CFTRI, Mysuru, India. Previously, I held a post-doctoral position at Tokyo University of Agriculture and Technology and Osaka University from December 2020 to January 2024.

My research interests encompass challenges in granular materials, including flows, crater formation, agglomeration and attrition of granular aggregates, grain-structure interactions, and fluid mechanics-related phenomena.

In my future research, I will primarily focus on agriculture and food processing applications. Additionally, I am interested in understanding complex fluids like slurry flows and viscous bubbly flows.

**Education**

Ph.D., Mechanical Engineering, November 2019,
Indian Institute of Technology Kanpur, Kanpur, UP, India.
Thesis: *Granular flows over rigid inclined bases that are either spring-supported or externally vibrated.* Advisors: Prof. Ishan Sharma & Prof. Jayant Singh

M.E., Design Engineering, May 2012,
Birla Institute of Technology and Sciences, Pilani, RJ, India.
Thesis: *Design of Robotic Exoskeleton for Rehabilitation Engineering.*
Advisor: Prof. B. K. Rout

B.Tech., Mechanical Engineering, May 2009,
Vishwakarma Institute of Technology, Pune, MH, India.

Diploma, Mechanical Engineering, May 2006,
K. K. Wagh Polytechnic, Nashik, MH, India.

**Professional Experience**

Tokyo University of Agriculture and Technology, Tokyo, Japan.
Post-doctoral researcher, Duration: June 2023 - January 2025.

Osaka University, Osaka, Japan.
Post-doctoral researcher, Duration: December 2020 - June 2023.

Indian Institute of Technology Kanpur, Kanpur, UP, India.
Project associate, Duration: February-November, 2020.

Ansys Fluent India Pvt. Ltd., Hinjewadi, Pune, MH, India.
Trainee Engineer, Duration: July-December, 2009.

RESEARCH

Since June 2023, I have been researching high-speed liquid micro-jets and their applications at Tokyo University of Agriculture and Technology. My work includes conducting impact-induced liquid jet formation experiments using a bubble-contained gel, with a focus on increasing jet velocity. Additionally, I am involved in two research projects: one investigating stresses induced in human tissue simulants by jet penetration for needle-free injections, and the other optimizing nozzle-injection system parameters for viscous-jet printing. I also mentor research students and write research grants.

In 2022-23, as a post-doctoral researcher at Osaka University, I studied air-jet impacts on granular surfaces, focusing on crater morphology in rocket landing scenarios on minor planets or asteroids. I proposed a universal scaling for crater morphology, showing that a simple scaling parameter based on air-jet conditions is sufficient when the nozzle is far from the landing site. However, as the nozzle gets closer, grain size information becomes crucial, with the governing length scale shifting from the nozzle-to-surface distance to the grain diameter.

From 2020 to 2022, I also studied the fluidization of fine cohesive powders using vertical vibrations. I discovered a unique wave-propagation phenomenon in vibrated cohesive powders and examined the formation and attrition of rotating granular aggregates, as well as the fracturing of solid agglomerates before reaching the fluidized state. This research has applications in the pharmaceutical, agricultural, and food processing industries.

During my Ph.D., I studied granular flows using discrete element (DE) simulations, experiments, and kinetic theory. I discovered that the mass flow rate of granular material could be enhanced and controlled by inducing base vibrations. Additionally, I contributed to developing an Extended Strain Path Method to determine the forces on a plough by using kinematic information from the deformed surface, obtained through approximate simulations.

JOURNAL PUBLISHED

**Prasad Sonar**, Ashish Bhateja, Ishan Sharma, Granular flow over inclined vibrated bases, *Physical Rev. Fluids, 9(12), 124304, 2024*, Quartile: Q2

**Prasad Sonar** and Hiroaki Katsuragi, Universal scaling for turbulent air-jet impact on granular surfaces *J. Fluid Mech., vol. 998, A29, 2024*, Quartile: Q1

**Prasad Sonar** and Hiroaki Katsuragi, Fracturing-induced fluidization of vibrated fine-powder column, *Pow. Tech., 421, 118405, 2023*, Quartile: Q2

**Prasad Sonar** and Hiroaki Katsuragi, Decompaction-wave propagation in a vibrated fine powder bed, *Phys. Rev. E, 106, 014905, 2022.*, Quartile: Q1

**Prasad Sonar**, Sachin Modi, Ishan Sharma, Estimating forces during ploughing of a granular bed, *J. Fluid Mech. 875, 376-410, 2019*, Quartile: Q1

To be submitted

**Prasad Sonar**, Hiroya Watanabe, Yoshiyuki Tagawa, Impact-induced liquid jet formation using a bubble-contained PVA-gel *(to be submitted in J. Fluid Mech.)*.

**Prasad Sonar**, Yuto Yokoyama, Kohei Yamagata and Yoshiyuki Tagawa, Stress analysis in human tissue simulant upon penetrating high-speed water jet *(to be submitted in IEEE Transactions on Biomedical Engineering)*.

**Prasad Sonar**, Hiroya Watanabe and Yoshiyuki Tagawa, Parametric optimization of viscous jets. *(In preparation)*.

Peer-reviewed Proceedings

**Prasad Sonar**, Ishan Sharma, Jayant K. Singh, Granular flow down a flexible inclined plane, *Powders & Grains-2017*, EPJ Web of Conferences, Vol. 140, p. 03074, EDP Sciences, Montpelier, France, July 2017.

**Prasad Sonar**, Rout B.K., *Proceedings of 3rd Asian Conference on Mechanics of Functional Materials and Structures*, IIT Delhi, India, 676 -679, December 2012.

Conferences

**Prasad Sonar**, Hiroya Watanabe, Yoshiyuki Tagawa, *Soft Matter, Fluids, Interfaces*, Quy Nhon, Vietnam, June 2024.

**Prasad Sonar**, Hiroaki Katsuragi, *The 7th International Soft Matter Conference (ISMC2023)*, Osaka, Japan, September 2023.

**Prasad Sonar**, Hiroaki Katsuragi, *The 15th Asia Pacific Physics Conference (APPC-2022)*, Online conference, Osaka, Japan, August 2022.

**Prasad Sonar**, Hiroaki Katsuragi, *The 8th Asian Particle Technology Symposium (APT-2021)*, Osaka, Japan, October 2021.

**Prasad Sonar** & Ishan Sharma, *3rd IMA conference on Dense granular flows-2019*, Cambridge, UK, July 2019.

**Prasad Sonar**, Ashish Bhateja, Ishan Sharma, Jayant K. Singh, *Gorden Research Conferences: Granular Matter*, Easton, NY, USA, July 2016.

**Prasad Sonar**, Ashish Bhateja, Ishan Sharma, Jayant K. Singh, *Complex Fluids-2016*, IIIT Hyderabad, AP, India, December 2016.

**Prasad Sonar**, Ashish Bhateja, Ishan Sharma, Jayant K. Singh, *Complex Fluids-2016*, National Chemical Laboratory, Pune, MH, India, January 2016.

**Prasad Sonar**, Ishan Sharma, Jayant K. Singh, *European Solid Mechanics Conference*, Madrid, Spain, July 2015.

**Prasad Sonar**, Ashish Bhateja, Ishan Sharma, Jayant K. Singh, *Complex Fluids-2014*, JNCASR, Bangalore, KT, India, December 2014.

**Prasad Sonar**, Rout B.K., *8th IAMI Biennial conference, NCMI*, AIIMS, New Delhi, India, February 2012.

SYMPOSIUMS/ WORKSHOPS

**Prasad Sonar** (Participated), *International Symposium on Snow Avalanches & Mitigation Strategies*, Organised by Snow and Avalanche Study Establishment (SASE), DRDO in Chandigarh, CH, India, July 2019.

**Prasad Sonar**, Ishan Sharma, *IUTAM*, IIT Kanpur, UP, India. December 2018.

**Prasad Sonar**, Ishan Sharma, Jayant K. Singh, *Helix: Fluids-structure interactions*, Mersellie, France, June 2015.

COURSES

Introduction to Solid Mechanics, Applied Dynamics and Vibrations, Theory of Elasticity, Introduction to Finite Element Methods, Granular Materials, Fracture mechanics, Numerical Methods in Engineering, Engineering mathematics.

TA/TUTOR WORK

Dynamics, Advanced Mechanics of Solids, Design of Machine Elements, Theory of Mechanisms and Machines, Applied Dynamics and Vibrations, Granular Materials.

REFERENCES

Prof. Ishan Sharma, Indian Institute of Technology Kanpur, ishans@iitk.ac.in.

Prof. Hiroaki Katsuragi, Osaka University, katsuragi@ess.sci.osaka-u.ac.jp.

Prof. Yoshiyuki Tagawa, Tokyo University of Agriculture and Technology, tagawayo@cc.tuat.ac.jp.

Prof. B. K. Rout, BITS Pilani, rout@pilani.bits-pilani.ac.in.