Abhinendra Singh

CONTACT INFORMATION

Department of Macromolecular Science and Engineering
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RESEARCH INTERESTS

Soft matter physics - Polymer Science - Non-equilibrium systems - Particle-based simulations - Structure-Property Relationship - Suspensions - Granular Materials - Network Science

EDUCATION

Ph.D. in Mechanical Engineering - University of Twente, The Netherlands — 07/2009 - 05/2014

Batchelor and Masters in Physics - Indian Institute of Technology (IIT), Kharagpur, India — 07/2004 - 04/2009

APPOINTMENTS

Assistant Professor -Department of Macromolecular Science & Engineering, Case Western Reserve University — 07/2022 - Present

Postdoctoral Researcher -University of Chicago — 07/2018 - 07/2022
Advisors: Heinrich M. Jaeger and Juan J. de Pablo

Research Associate - City College of New York — 07/2015 - 07/2018
Advisors: Jeffrey F. Morris and Morton M. Denn

AWARD AND RECOGNITIONS

The Maria Lastra Postdoctoral Excellence in Mentoring Award — 2021
Awarded for contribution as an exceptional mentor in the University of Chicago.

Society of Rheology Publication Award — 2020
Awarded by the Society of Rheology for "the best paper published in JOR during the two calendar years immediately preceding the year of the award." [JOR, **62***, 457 (2018)].*

Best Presentation by a young scientist — 2020
Awarded for the best presentation at Physics of dense suspensions virtual symposium.

Long-term Invited Visitor — 2018
Invited as a long-term visitor in KITP Program "Physics of Dense Suspensions".

PUBLICATIONS

* denotes corresponding author

[**23**] Wincox, K.G.; Grinevich, A.; Linscott, A.; **Singh, A.**; Morozova, .S. Properties of Crosslinked Poly-L-Lysine Hydrogels Across the Random Coil-Helix Transition, Accepted in *Macromolecular Chemistry and Physics* .

[**22**] **Singh, A.*** Hidden hierarchy in the rheology of dense suspensions, *MRS Communications*, 1-9 **(invited)**.

[**21**] **Singh, A.***; Saitoh, K. Scaling relations between viscosity and diffusivity in shear-thickening suspensions, *Soft Matter*, **2023**,19, 6631-6640

[**20**] Naald, M.v.; **Singh, A.***; Eid, T.; Tang, K., de Pablo, J.J.; Jaeger, H.M. Minimally Rigid Clusters in Dense Suspension Flow, under review in *Nature Physics*.

[**19**] Chen, C.; Naald, M.v.; **Singh, A.**; Jackson, G.L.; Jaeger H.M.; Rowan, S.; de Pablo, J.J. Leveraging the polymer glass transition to access thermally-switchable shear jamming suspensions, *ACS Central Science*, **2023**, 9, 4, 639–647.

[**18**] Nabizadeh, M.; **Singh, A.**; Jamali, S. Structure and dynamics of force clusters and networks in shear thickening suspensions, *Phys. Rev. Lett.*, **2022**, 129, 068001. Cover Image of the Issue.

Before Case Western

[**17**] **Singh, A.*** Shear thickening in dense suspension: A master-curve and "roll" of friction, *Science Talks*, **2022**, 100028.

[**16**] **Singh, A.***; Jackson, G.L.; Naald, M.v.; de Pablo, J.J.; Jaeger, H.M. Stress-activated Constraints in Dense Suspension Rheology, *Phys. Rev. Fluids*, **2022**, 7, 054302.

[**15**] Edens, L.E.; Alvarado, E.G.; **Singh, A.**; Morris, J.F.; Schenter, J.K.; Chun, J.; Clark, A.E. Shear Stress Dependence of Force Networks in 3D Dense Suspensions, *Soft Matter*, **2021** (32), 7476. Cover Image of the Issue.

[**14**] **Singh, A.***; Ness, C.; Seto, R.; de Pablo, J.J.; Jaeger H.M. Shear thickening and jamming of dense suspensions: the "roll" of friction, *Phys. Rev. Lett.*, **2020**, 124 (24), 248005.

[**13**] Li, J.; Jiang, X.; **Singh, A.**; Heinonen, O.G.; Hernández-Ortiz, J.P.; de Pablo, J.J. Structure and dynamics of hydrodynamically interacting finite-size Brownian particles in a spherical cavity: Spheres and cylinders, *Journ. Chem. Phys.*, **2020**, 152 (20):204109.

[**12**] **Singh, A.**; Li, J.; Jiang, X; Hernández-Ortiz, J.P.; Jaeger, H.M.; de Pablo, J.J. Shape induced segregation and anomalous particle transport under spherical confinement, *Phys. Fluids*, **2020**, 32 (5):053307. Featured Article of the Issue.

[**11**] Gameiro, M.; **Singh, A.**; Mischaikow, K.; Kondic, L.; Morris, J.F. Force network analysis in shear thickening suspensions, *Phys. Rev. Fluids*, **2020**, 5 (3), 034307.

[**10**] Thomas, J.; Goyal, A.; Bedi, D.S.; **Singh, A.**; del Gado E.; Chakraborty B. Investigating the nature of discontinuous shear thickening: Beyond a mean-field description, *J. Rheol.*, **2020**, 64 (2), pp 329-341.

[**9**] Sedes, O.; **Singh, A.**; Morris, J.F. Fluctuations at the onset of discontinuous shear thickening in a suspension, *J. Rheol.*, **2020**, 64 (2), pp 309-319.

[**8**] Xu, Q.; **Singh, A.**; Jaeger, H.M. Stress fluctuations and shear thickening in dense granular suspensions, *J. Rheol.*, **2020**, 64 (2), pp 321-328.

[**7**] Seto, R.; **Singh, A.**; Chakraborty, B.; Denn, M.M.; Morris, J.F. Shear jamming and fragility in dense suspensions, *Gran. Matt.*, **2019**, 21 (3), pp 1500-1511.

[**6**] **Singh, A.**; Pednekar, S.; Chun, J.; Denn, M.M.; Morris, J.F. From yielding to shear jamming in a cohesive frictional suspension, *Phys. Rev. Lett.*, **2019**, 122 (9), 098004.

[**5**] Thomas, J.; Ramola, K.; **Singh, A.**; Mari, R.; Morris, J.F.; Chakraborty B. Microscopic origin of frictional rheology in dense suspensions: correlations in force space, *Phys. Rev. Lett.*, **2018**, 121, 128002. Editor's suggestion.

[**4**] **Singh A.***; Mari, R.; Denn, M.M.; Morris, J.F. A constitutive model for simple shear of dense frictional suspensions, *J. Rheol.*, **2018**, 62, 457.

- JOR 2020 Publication award.
- Featured Article of the Issue.

- Featured at AIP desk during SOR Meeting in the list of most downloaded & cited articles of the year 2018 & 2019

[3] Roy, S.; **Singh, A.**; Luding, S.; Weinhart, T. Micro-macro transition and simplified contact models for wet granular materials, *Comp. Part. Mech.*, **2016**, 3, pp 449.

[2] **Singh, A.***; Magnanimo, V.; Saitoh, K.; Luding, S. The role of gravity or pressure and contact stiffness in granular rheology, *New Jour. Phys.*, **2015**, 17.

[1] **Singh, A.***; Magnanimo, V.; Saitoh, K.; Luding, S. Effect of cohesion on shear banding in quasistatic granular materials, *Phys. Rev. E*, **2014**, 90, 02202.

Book Chapter

[1] Shi, H.; Vescovi, D.; **Singh, A.**; Roy, S.; Magnanimo, V.; Luding, S. Granular flow: from dilute to jammed states, *Granular Materials*, **2010**.

Graduate Mentoring

Armin Aminimajd (Joint with Prof. Joao Maia)	22– Present
Muzaffar Rafique	23– Present

Undergraduate Mentoring

Alessandro d'Amico (Chemical Engineering)	Fall 22– Present
Ryan Papalardo (Chemistry)	Fall 22– Present
Caroline Kier (Macromolecular Science & Engineering)	Spring 23– Present
Temple Shema (Computer & Data Science)	Spring 23– Present
Lucas Maciel Bueno (Physics)	Spring 23– Present

Student Awards

Alessandro d'Amico and Ryan Papalardo, 2nd place Nestle Innovation Challenge	Spring 23
Ryan Papalardo, CWRU summer SOURCE fellowship	Summer 23

Selected Invited Presentations

(**Total of 18 across various universities and countries**)

[14] "Hidden Hierarchy in Dense Suspension Rheology" CWRU Macromolecular Science & Engineering 2023

[13] "Messy behavior of particle-laden systems: How can simulations and a simple theory help?" CWRU Mechanical Engineering 2023

[12] "Rheology of dense suspensions: a playground where Physicists, Chemists, and Engineers can Play Together" CWRU Chemistry Department 2023.

[11] "Macroscopic response as a lens to particle properties in dense suspensions" STMS Virtual Seminar Series 2022.

[10] "Shear Thickening in Dense Suspensions: The Constraints and a Master Curve" UIC Chemical Engineering Seminar, UIC, IL, USA (virtual) January 2021.

[9] "Shear thickening in dense suspension: a master-curve unifying rheology" JNNFM Seminar Series, (virtual) December 2020.

[8] "Constitutive modeling of dense suspensions, and the "roll" of friction" Nonequilibrium Yukawa Seminar, Kyoto, Japan, (virtual) August 2020.

[7] "Shear Thickening and Jamming of Dense Suspensions: Towards a Generic Picture" Granular Materials Seminar, Montpellier, France (virtual). May 2020

[6] "Towards a General Constructive Model of Dense Frictional Suspensions" The Institute for Molecular Engineering, University of Chicago, Chicago (USA). July 2018

[5] "Flow of particulate systems: from dry granular matter to shear-thickening suspensions" The School of Physical Sciences, JNU, New Delhi, India. September 2017

[4] "Shear Thickening and its Relation to Shear Jamming" GRS Seminar, Granular Matter, Stonehill College, Easton, MA, USA. July 2016

[3] "Effect of Cohesion on the Flow Behavior: From Dry Granular Matter to Suspensions" Fluid Mechanic and Waves Seminar, NJIT, Newark, NJ (USA). April 2016

[2] "Micro-macro in sheared non-homogeneous shear in cohesive granular media" Process & Energy

Department, Delft University, Delft (NL). April 2014
[**1**] "Cohesive Frictional Powders, From Micro-to-Macro" Tsinghua University, Beijing. June 2012 .

Selected Contributed Presentations

(**Total: 30**)
[**15**] "Rigid Structure in Dense Frictional Suspensions" AIChE Meeting, Phoenix (AZ) November 2022.
[**14**] "Stress-activated constraints in dense suspension rheology" NATAS Meeting, Cleveland (OH) July 2022.
[**13**] "Dynamics of Complex Fluids and Soft Materials" AIChE Annual Meeting, Boston (MA) November 2021.
[**12**] "Shear thickening and normal stresses in dense frictional suspensions: The "Roll" of Friction" ICR 2020, (Virtual) December 2020.
[**11**] "Shear thickening and jamming of dense suspensions: the "roll" of friction" Physics of Dense Suspensions, (Virtual) July 2020.
[**10**] "Shape induced segregation and anomalous diffusion of particles under confinement" APS March Meeting, (Virtual) March 2020.
[**9**] "Towards a general constitutive model of dense frictional suspensions" SOR Meeting, Houston (TX) October 2018.
[**8**] "Correlation between percolation and non-affine motion in shear thickening suspensions" SES Meeting, Boston (MA) July 2017.
[**7**] "Microstructure in discontinuous shear thickening suspensions" Powders & Grains, 2017, Montpellier, France July 2017.
[**6**] "Towards a continuum description of shear thickening suspensions" SOR Meeting, Tampa (FL) February 2017.
[**5**] "How does a granular material fail on the moon?" PhysicsFOM, Veldhoven, Netherlands January 2014.
[**4**] "From Particles Towards Continuum Theory: Shear banding, Jamming, and Dilatancy" APT 2012, Singapore, Singapore June 2012.
[**3**] "Stability Analysis of fully coupled equations in granular avalanches" ICMM2, Paris, France September 2011.
[**2**] "Microstructure analysis in shear bands for cohesive-frictional powders" Southern Granular Matter Workshop, Santiago, Chile December 2010.
[**1**] "Flow behavior with random driving in sheared cohesive frictional powders" Jamming & Rheology Conference, Cargese, Corsica April 2010.

Teaching & Pedagogy

EMAC 125 – Polymer research experience for undergraduates	Fall 2023 – Present
EMAC 473 – Numerical & Computational Methods in Soft Matter Systems	Spring 2023 – Present
Simulating Suspension Dynamics – An Introduction, *University of Illinois Chicago (UIC)*	November 2020
Teaching Assistant (Elasticity Theory), *Twente University*	2012, 2013
Teaching Assistant (Programming & Modeling), *Twente University*	2012

Proposals

Funded

[1] **Nestle Innovation Challenge**, "Removal of ice in frozen Nestle food"	$10,000

Pending

[1] **NSF CDS&E**, "Upscaling Particulate Simulations via Machine Learning in the Loop." PI	$600,000

Unfunded

[5] **MDS Rely**, "Upscaling Particulate Simulations via Machine Learning in the Loop." PI	$60,000
[4] **NSF DMREF**, "COLLABORATIVE RESEARCH: SOFTCOLL - Multiscale design of multi-functional responsive SOFT COLLoidal systems." Co-PI	$2,000,000
[3] **ACS PRF**, "Rheology of adhesive wall bound slurries." PI	$110,000
[2] **Lubrizol**, "ML-Informed Structure-Properties Relationships in Polymeric Coatings." PI	$96,000
[1] **Lubrizol**, "Simulation-based approach to reduce the viscosity of drug products." PI	$60,000

Academic Service and outreach

Judge: Poster Session: *AIChE Meeting*	2022
Judge: Poster Session: *SOR Meeting*	2022
Organizer: Session: "Micro-Mechanics of Dense Suspension Flow", *USNCTAM*	2022
Organizer: Session: "Constraint-based rheology of dense suspensions and granular materials", *APS March meeting*	2022
Founder: "Virtual Shear Thickening Discussion Series"	2021 - Present
Founder: "Postdoc Advisory Board", *UChicago*	2021 - 2022
Chair & Organizer: Virtual session: "Suspensions and dry grains: thickening and jamming", *APS March meeting*	2020
Outreach Volunteer: "SoR Outreach Event", *SOR, North Carolina*	2019
Volunteer: "Computing for All: Coding and Beyond", *Harper Court*	2019
Tour Guide and Volunteer: "Physics with a bang!" *UChicago*	2018-2019
Co-Chair: "Mechanics of dry granular media" *ESMC Conference, Graz, Austria*	2012

Journal Reviewer: Nature Materials, Physical Review Letters, Physical Review E, Journal of Rheology, Journal of Fluid Mechanics, Physics of Fluids, Tribology Letters,Computational Particle Mechanics, Fluids, Granular Matter, Physical Review Fluids, Communications Physics, Journal of Non Newtonian Fluid Mechanics