SHARUN KUHAR

EDUCATION

- **Ph.D. in Mechanical Engineering** Sep. 2020 - Apr. 2025
  Johns Hopkins University Baltimore, MD
  Dissertation: Computational fluid dynamics based models of gastric digestion in health and disease
  Advisor: Rajat Mittal

- **B.E. + M.E. in Mechanical Engineering** 2014 - 2019
  Indian Institute of Technology, Kanpur (5-year program)
  GPA: 9.9/10.0 in B.E. & 10.0/10.0 in M.E. UP, India
  Dissertation: DNS and Stability Analysis of Flow Past a Square Cylinder Placed in a Channel
  Advisor: Arun K. Saha

HONORS AND AWARDS

- **Creel Family Teaching Assistant Award** (2025): Recognizes the best teaching assistants in the mechanical engineering department [link]
- **Quad Fellowship** (2023): Cohort of 100 graduate students in STEM from Australia, India, Japan, and the USA who demonstrate academic excellence and passion for problems at the intersection of science, society, and policy-making [link]
- **General Proficiency Medal** (2019): Graduated at the top of the department [link]
- **O.P. Bajaj Memorial Award** (2017): Best final year undergraduate in the department [link]
- **Academic Excellence Awards** (2018, 2016, 2015) [link]
- **Summer Undergraduate Research Grant for Excellence (SURGE)** (2016) [link]

RESEARCH INTERESTS

Fluid dynamics, applied mechanics, computational fluid dynamics, multiphase flows, biological flows, immersed boundary methods, multi-physics modeling

RESEARCH EXPERIENCE

- **Purdue University** May 2025 - Present
  Postdoctoral Research (Advisor: Arezoo Ardekani) – *Department of Mechanical Engineering*
  - Developing improved delivery of injectable medicines with the goal of enabling better patient compliance and overall health.
  - Research into the physiology of drug delivery with the purposes of developing technologies to improve delivery of pharmaceuticals for better patient outcomes

- **Johns Hopkins University** Sep. 2020 - Apr. 2025
  Ph.D. Thesis (Advisor: Rajat Mittal) – *Department of Mechanical Engineering* Baltimore, MD

  Development:
  - Developed an imaging data based computational model of the stomach using an immersed boundary solver
  - Incorporated chemical reactions of food hydrolysis to perform chemo-fluid dynamic simulations [p3] [cp1]
  - Employed particle resolved simulations to model tablets and large food particles [p9] [p2]
  - Implemented Lagrangian Point Particle Model (LPPM) to simulate small sized food particles
  - Built a pipeline for patient-specific stomach models using cine-MRI data
  - Used Volume of Fluids (VOF) approach to account for different density fluids [p6] [p7]

Application:

- Studied the effect of posture and motility disorders on the dissolution of an oral tablet [p2]
- Quantified the effects of motility disorders on the mixing and hydrolysis function of the stomach [p3] [cp1]
- First of its kind modeling of the consequences of pyloric surgery in different emptying rate disorder patients [p4]
- Simulated the mechanism of gastritis due to bile reflux in patients [p6]
- Captured the forces responsible for the breakdown of large solid food particles inside the stomach [p9]

(Conference presentations on all of the above: [pre2-15])

- **Sterlite Technologies** Jun. 2019 - Sep. 2020
  Modeling and Simulations Division – *Research & Development* Dadra & Nagar Haveli, India
  - Developed theoretical and semi-empirical models to predict the onset of signal attenuation in fiber optic cable designs under crush force and winding tension
  - Simulated structural deformation in finite-element software to analyze cable designs
  - Developed excel-sheet based tools for predicting fiber-optic cable behaviors in extreme temperatures
  - Patented grooved cable designs with higher drag to enable air blowing cables to longer distances [pat2]
  - Patented flexible ribbon design to enable more efficient packing of fibers inside the cable [pat1]
- **Indian Institute of Technology, Kanpur** May 2018 - Jun. 2019
  Masters Thesis (Advisor: Arun K. Saha) – *Department of Mechanical Engineering* UP, India
  - Using a Marker-and-Cell (MAC) based solver, studied the flow past a square cylinder at different blockages
  - Developed a code to perform the linear stability analysis of the steady symmetric flow
  - Studied the effect of wall proximity on transition from steady to unsteady (Hopf bifurcation) and from symmetric to asymmetric flow (Pitchfork bifurcation) [pre1]
- **McGill University** May 2017 - Jul. 2017
  MITACS Globalink Summer Internship – *Department of Mining Engineering* Quebec, Canada
  Advisor: *Agus P. Sasmito*
  - Studied the flow of mine backfill slurry (40-70% solid fraction) through the hydraulic network in mines
  - Modeled the slurry as a two-phase mixture, using Dense Discrete Phase Model (DDPM), and as a Bingham fluid to predict the pumping requirements through different approaches
  - Compared the simulations against different friction factor model predictions and against in-situ data [p1]

JOURNAL PUBLICATIONS

[p9] **S. Kuhar**, J. H. Seo, and R. Mittal, "*In-silico* study of the forces causing solid food breakdown inside the stomach", *Journal of the Royal Society Interface*, 22.229 (2025): 20250291. [doi]

[p8] W. Li, **S. Kuhar**, J. H. Seo, and R. Mittal, "Computational Study of Gastric Emptying in Microgravity: The Role of Density and Viscosity Variations", *Physics of Fluids*, 37.7 (2025). [doi]

[p7] W. Li, **S. Kuhar**, J. H. Seo, and R. Mittal, "Modeling the Effect of Sleeve Gastrectomy on Gastric Digestion in Stomach: Insights from Multiphase Flow Modeling", *Journal of Biomechanical Engineering*, 147.6 (2025). [doi]

[p6] **S. Kuhar**, J. H. Seo, M. Camilleri, P. J. Pasricha, and R. Mittal, "Duodenogastric Reflux in Health and Disease: Insights from a Computational Fluid Dynamics Model of the Stomach", *American Journal of Physiology-Gastrointestinal and Liver Physiology*, 328.4 (2025): G411-G425. [doi]

[p5] **S. Kuhar** and R. Mittal, "Computational Models of the Fluid Mechanics of the Stomach." *Journal of the Indian Institute of Science*, 104.1 (2024): 65-76. [doi]

[p4] **S. Kuhar**, J. H. Seo, P. J. Pasricha, and R. Mittal, "In silico modelling of the effect of pyloric intervention procedures on gastric flow and emptying in a stomach with gastroparesis", *Journal of the Royal Society Interface*, 21(210), (2024). [doi]

[p3] **S. Kuhar**, J. H. Lee, J. H. Seo, P. J. Pasricha, and R. Mittal, "Effect of stomach motility on food hydrolysis and gastric emptying: Insight from computational models", *Physics of Fluids*, 34(11), 111909, (2022). [doi]

[p2] J. H. Lee, **S. Kuhar**, J. H. Seo, P. J. Pasricha, and R. Mittal, "Computational modeling of drug dissolution in the human stomach: Effects of posture and gastroparesis on drug bioavailability", *Physics of Fluids*, 34(8), 081904, (2022). [doi]

[p1] B. Bharathan, M. McGuinness, **S. Kuhar**, M. Kermani, F. P. Hassani, and A. P.Sasmito, "Pressure loss and friction factor in non-Newtonian mine paste backfill: Modelling, loop test and mine field data." *Powder Technology*, 344, 443–453, (2019). [doi]

CONFERENCE PAPERS

[cp1] **S. Kuhar**, J. H. Seo, P. J. Pasricha, and R. Mittal, "Computational Fluid Dynamics of Digestion Inside the Stomach." *Proceedings of the 10th International and 50th National Conference on Fluid Mechanics and Fluid Power (FMFP)*, BFM-057 (2023). [pdf]

PATENTS

[pat2] **S. Kuhar**, V. Shukla, S. Sharma, and K. Sahoo, Sterlite Technologies Ltd, 2021. "Ribbed and grooved cable having embedded strength member with water blocking coating". U.S. Patent Application 17/347,080 (Granted: 2023). [link]

[pat1] H. Kondapalli, S. Sharma, **S. Kuhar**, A. Nath, V. Shukla, and B. Sarkaar, Sterlite Technologies Ltd, 2021. "Intermittently bonded optical fibre ribbon with unequal bond and gap lengths". U.S. Patent Application 17/139,508 (Granted: 2023). [link]

CONFERENCE PRESENTATIONS

[pre15] **S. Kuhar**, J. H. Seo, P. Pasricha, and R. Mittal, "Digital Twin of the Stomach: Applications to Digestive Disorders and Surgery Planning" *American Physiology Summit*, (2025). [link]

[pre14] **S. Kuhar**, J. H. Seo, and R. Mittal, "Towards a Digital Twin of the Stomach with application to Digestion and Gastric Reflux" *APS Division of Fluid Dynamics*, L04.00005 (2024). [link]

[pre13] W. Li, **S. Kuhar**, J. H. Seo, and R. Mittal, "Food Digestion in the Stomach after Bariatric Surgery: Insights from Multiphase Flow Modeling" *APS Division of Fluid Dynamics*, L04.00007 (2024). [link]

[pre12] **S. Kuhar**, A. Menys, J. H. Seo, and R. Mittal, "Computational modeling of solid food digestion inside the stomach." *APS Division of Fluid Dynamics*, L10.00008 (2023). [link]

[pre11] **S. Kuhar** and R. Mittal, "Computational modeling of digestion and drug-dissolution inside the stomach." *ReCoVor*, 64A, (2023). [link]

[pre10] **S. Kuhar**, A. Menys, J. H. Seo, and R. Mittal, "StomachSim: An in-silico model of stomach biomechanics based on patient-specific imaging data." *NeuroGASTRO-2023*, (2023). [link]

[pre9] **S. Kuhar**, J. H. Seo, P. J. Pasricha, and R. Mittal, "StomachSim: An in-silico simulator of gastric biomechanics with application to pyloroplasty." *American Physiology Summit*, 38, 5729950 (2023). [link]

[pre8] **S. Kuhar**, J. H. Seo, P. J. Pasricha, and R. Mittal, "StomachSim: An in-silico simulator of gastric biomechanics with application to pyloroplasty." *Digesta Disease Week*, 164.6 (2023). [link]

[pre7] **S. Kuhar**, J. H. Lee, J. H. Seo, P. J. Pasricha, and R. Mittal, "StomachSim: an in-silico simulator of gastric biomechanics" *The Johns Hopkins Department of Medicine & Whiting School of Engineering Research Retreat*, (2023).

[pre6] **S. Kuhar**, J. H. Lee, J. H. Seo, P. J. Pasricha, and R. Mittal, " Biofluid dynamics of digestion in the stomach: Insights from computational modeling." *APS Division of Fluid Dynamics*, Z07.00004 (2022). [link]

[pre5] **S. Kuhar**, J. H. Lee, J. H. Seo, P. J. Pasricha, and R. Mittal, "Biofluid dynamics of digestion in the stomach: Insights from computational modeling." *The Johns Hopkins Department of Medicine & Whiting School of Engineering Research Retreat*, (2022).

[pre4] **S. Kuhar**, J. H. Lee, J. H. Seo, P. J. Pasricha, and R. Mittal, "The Chemo-Fluid Dynamics of Digestion in the Stomach: Insights from Computational Modeling." *CEAFM Burgers Symposium*, (2022). [link]

[pre3] **S. Kuhar**, J. H. Lee, J. H. Seo, P. J. Pasricha, and R. Mittal, "The Chemo-Fluid Dynamics of Digestion in the Stomach: Insights from Computational Modeling", *APS Division of Fluid Dynamics*, T15.00006, (2021). [link]

[pre2] J. H. Lee, **S. Kuhar**, J. H. Seo, P. J. Pasricha, and R. Mittal, "The Fluid Dynamics of the Dissolution of an Oral Drug in the Human Stomach", *APS Division of Fluid Dynamics*, T15.00007, (2021). [link]

[pre1] **S. Kuhar**, Arun K. Saha, "Linear Stability Analysis Of Two-Dimensional Flow Past A Square Cylinder At Different Blockage Ratios", *Research Scholar Day*, Association of Mechanical Engineers, IITK, FTS-18, (2019). [link]

PROFESSIONAL SERVICE

- **Engineer, Modeling & Simulations Division** Jul. 2019 - Sep. 2020
  Research & Development, Sterlite Technologies Limited
  - Worked with multiple teams to oversee the development of new fiber optic cable designs
  - Created and validated models to predict whether the cable designs would pass standard mechanical and optical test requirements (tension, crush, thermal cycling, etc.)
  - Developed reduced-order-models to perform those calculations to be used by other teams
  - Organized 'Failure Festival' and regularly released 'Modeling & Simulations Newsletter'
  - Investigated unexpected cable failures at customer end (e.g., kinking during installation)

VOLUNTEERING

- **Core Team Member** Mar. 2016 - Apr. 2017
  Institute Counseling Service, IIT Kanpur
  - Part of 10 member team responsible for campus-wide counseling service activities
  - Negotiated with banks to raise 150k INR in scholarship for needy students
  - Led a team of 137 student-guides during 6-day long orientation program for freshers with a budget of 450k INR
  - Worked with professional counselors to aid in providing emotional, mental, and financial support to students
  - Hosted sessions aimed at providing academic or career help to students

MENTORING

- PhD Students: Daira Sofia Velasco Vega, Purdue University — Aug. 2025 - Present
- Masters Students: Weixuan Li, Johns Hopkins University — Aug. 2023 - Apr. 2025
- Undergraduate Students: Aditi Gupta, Johns Hopkins University — May 2023 - Jul. 2023

TEACHING EXPERIENCE

- Teaching Assistant at IIT Kanpur:
  - Numerical Methods, Fall 2018
  - Turbulent Flow, Spring 2019
- Teaching Assistant at Johns Hopkins University:
  - Numerical Methods, Fall 2021 and Fall 2023
  - Computational Fluid Dynamics, Spring 2022 and Spring 2024