

Charul Gupta



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Research Interest

Moving contact line dynamics, Computation Fluid Dynamics, Cavitation, Geophysical fluid flows.

Qualification

- PhD (August 2018 – October 2024) from Indian Institute of Technology Hyderabad (IIT Hyderabad)
Research area: An experimental study of flow dynamics near a moving contact line.
Advisor: [Harish N Dixit](#) and [Lakshmana D. Chandrala](#)
- MTech. in Thermal engineering (2016-2018) from National Institute of Technology Warangal, India
- BTech. in Mechanical engineering (2011-2015) from Motilal Nehru National Institute of Tech. Allahabad

Experience

- Postdoc (July 2024- pursuing) from Indian Institute of Technology Hyderabad (IIT Hyderabad), India
Research area: Behavior of a cavitation bubble near a blind hole: Experiments and Computations
Advisor: [Karri Badarinath](#), [Harish N Dixit](#) and [Lakshmana D. Chandrala](#)

Publications

- **Gupta, C.**, Choudhury, A., Chandrala, L. D., & Dixit, H. N. (2024). An experimental study of flow near an advancing contact line: a rigorous test of theoretical models. *Journal of Fluid Mechanics*, 1000, A45.
- **Gupta, C.**, Chandrala, L. D., & Dixit, H. N. (2024). An experimental investigation of flow fields near a liquid–liquid moving contact line. *The European Physical Journal Special Topics*, 1-11.
- Ghosh, S., Dutta, J., Garlapati, K. K., Parvin, M., **Gupta, C.**, Dixit, H. N., & Martha, S. K. (2024). LiF/LixPOy/LixPOyFz-based artificial interface on graphitic cathode for improving the cycle life of dual ion batteries. *Journal of Power Sources*, 623, 235440.
- **Gupta, C.**, Sangadi, A., Chandrala, L. D., & Dixit, H. N. (2022, December). A Study of Flow Patterns Near Moving Contact Lines Over Hydrophobic Surfaces. In *Conference on Fluid Mechanics and Fluid Power* (pp. 339-349). Singapore: Springer Nature Singapore. (DOI https://doi.org/10.1007/978-981-99-6074-3_32)
- **Gupta, C.**, Chandrala, L., & Dixit, H. (2022). An experimental study of flow patterns near a moving contact line. *Bulletin of the American Physical Society*, 67.
- Choudhury, A., **Gupta, C.**, & Dixit, H. N. (2019, November). Flow field near Contact Lines: Role of Inertia. In *APS Division of Fluid Dynamics Meeting Abstracts* (pp. M04-023).
- **Gupta, C.**, Chandrala, L. D., & Dixit, H. N. (2024). An experimental study of flow near a moving contact line at high contact angles (Under submission, *Phys. Rev. Fluid*).
- Gunda P., **Gupta, C.**, Chandrala, L. D., & Dixit, H. N., Badarinath K. (2024). Interaction of an air bubble with a cavitation bubble in a blind hole: Experiments and Simulations (Under Submission, *J. Fluid Mech.*)
- **Gupta, C.**^{*}, Sangadi, A.^{*}, Chandrala, L. D., & Dixit, H. N. Anomalous flow patterns near a moving contact line. (Under preparation, target journal: *Nature Phys.*).
- "Universality of slip flow near a moving contact line " (Under preparation, target journal: *Phys. Rev. Lett.*).

Skills

- Expertise in designing and developing experimental setup.
- Techniques used in flow visualization such as PIV, PTV and image processing techniques.
- Proficiency in OpenFOAM, Ansys, etc.,.
- Coding in MATLAB for data analysis in research work and in python for performing pattern recognition.
- CFD code development using C programming and MATLAB.

Postdoctoral work: *Interaction of a cavitation bubble with an air bubble placed in a blind hole*

This study investigates the interaction of a cavitation bubble with an air bubble placed in a blind hole. Cavitation bubbles are generated using a low spark discharge technique and recorded using high-speed camera. Different stages of cavitation bubble are quantified using machine learning pattern recognition techniques. Additionally, computations are performed using OpenFOAM, alongside a review of relevant theoretical models to gain a detailed understanding of the phenomenon.

PhD Thesis: *An experimental study of flow dynamics near a moving contact line*

The present study investigates the flow dynamics near the moving contact line using experimental methods and compares the results with the existing theories. The experiments involved immersing a plate into a liquid bath and concurrently measuring the interface shape, interfacial velocity, and fluid flow using digital image processing and particle image velocimetry. All experiments were performed at low plate speeds to maintain small Reynolds and capillary numbers for comparison with viscous theories. My thesis had three main goals: (i) To obtain flow fields in the vicinity of a moving contact line for several viscosity ratios and dynamic contact angles, (ii) To measure interfacial speed and interface shape and compare the results against predictions of theoretical models, (iii) To provide valuable experimental data using which new contact line models can be developed and validated.

MTech. Project: *Effect of MHD on inertial focusing: A Numerical Study*

The study is motivated by the goal of removing impurities from a liquid. We numerically investigated the problem using ANSYS Fluent software. Initially, we analyzed the flow through a rectangular channel mixed with uniformly distributed particles. These particles remained inert until exposed to perpendicular magnetic and electric fields. Consequently, we identified four distinct locations where the particles became focused. Additionally, the study was conducted using various geometries.

Courses Attended

Computational Fluid Dynamics, Turbulence, Advanced Mathematical Tools, Scientific Computing, Hydrodynamic Instability, Nonlinear Dynamical System

Conferences

- Complex Fluids and Soft Matter Conference 2023 (CompFlu 2023) at IIT Madras on the topic "Determining the flow fields near a moving contact line: comparison between experiments and theory". (poster presentation)
- ME@75 Research Frontiers Conference 2022 at IISc on the topic "An Experimental study of flow patterns near a moving contact line". (presented a talk)
- Complex Fluids and Soft Matter Conference 2021 (CompFlu) at IIT Gandhinagar on the topic "Flow patterns in the vicinity of a moving contact line: an experimental study". (presented poster)
- Thermal Analysis and Engineering Systems 2018 (ICTASE) at HiCET, Coimbatore on topic "Effect of MHD on inertial focusing: A Numerical Study". (presented a talk)

Training

- Supervised and trained master's students in [Fluid Physics Lab](#), IIT Hyderabad.
- Participated in the NPTEL+ workshop "**Dispersed Multiphase Flow Fundamentals**" (Oct 2024).
- Attended "**NVidia NSM DLI 2024**" workshop for High-Performance Computing (HPC) and deep learning (Sept 2024).
- Participated in summer course "**Dynamics of Biological Systems**" offered by ICTS (June 2024).
- Attended the NPTEL+ workshop "**Optical Measurement Techniques in Fluid Mechanics**" (Nov 2023).
- Teaching assistant: NPTEL courses on "[Interfacial Fluid Mechanics](#)" conducted by IIT Bombay (2022) and IIT Madras (2023).

References

Dr. Harish N. Dixit, Associate professor, hdixit@mae.iith.ac.in, Department of Mechanical & Aerospace Engineering, Indian Institute of Technology Hyderabad

Dr. Lakshmana D. Chandrala, Assistant professor, lchandrala@mae.iith.ac.in, Department of Mechanical & Aerospace Engineering, Indian Institute of Technology Hyderabad