Charul Gupta

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Research Interest

Moving contact line dynamics, Interfacial flows, Cavitation, Geophysical fluid flows, Pattern recognitions.

Qualification

- Postdoc (2024- pursuing) from IIT Hyderabad
  Research area: Behavior of a cavitation bubble near a blind hole.
  Advisor: Karri Badarinath, Harish N Dixit and Lakshmana D. Chandrala
- PhD (currently pursuing) from IIT Hyderabad (I expect to defend my thesis by August 2024.)
  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 NIT Warangal
- BTech. in Mechanical engineering (2011-2015) from MNNIT Allahabad

Skills

- Expertise in designing and developing experimental setup.
- Techniques used in flow visualization such as PIV, PTV and image processing techniques.
- Basic 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: *Behavior of a cavitation bubble near a blind hole.*

This study investigates the behavior of cavitation bubbles near a blind hole through a combination of experiments, computations, and theoretical analysis. Experiments involve generating cavitation bubbles using a low spark discharge technique, with recordings made via high-speed imaging. Computations are conducted using OpenFOAM, alongside a review of relevant theoretical models.

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. A key finding in my thesis was the discovery of a *variable* slip near the moving contact line. The extent of the slip was found to be much larger than previously imagined and the deviation from the classic no-slip condition provides a clear pathway for the resolution of the moving contact line singularity.

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.

Publications

- Gupta, C., Choudhury, A., Chandrala, L. D., & Dixit, H. N. (2023). An experimental study of flow near an advancing contact line: a rigorous test of theoretical models. *arXiv:2311.09560*. (**Accepted in *J. Fluid Mech.***).
- 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.
- “An experimental study of flow near a moving contact line at high contact angles” (Under preparation, target journal: *Phys. Rev. Fluid*).
- "Universality of slip flow near a moving contact line " (Under preparation, target journal: *Phys. Rev. Lett.)*.

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)
- International Conference on Multiphase Flow 2023 (ICMF 2023) at Kobe, Japan on the topic “An experimental study of flow patterns near a moving contact line”. (presented a talk)
- 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)
- 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)
- 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).
- Thermal Analysis and Engineering Systems 2018 (ICTASE) at HiCET, Coimbatore on topic "Effect of MHD on inertial focusing: A Numerical Study". (presented a talk)

Experience/Training

- Supervised and trained master’s students in Fluid Physics Lab, IIT Hyderabad.
- Participated in 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).
    - Preparing assignments and demonstrating experiments for the undergraduate Fluid Mechanics course
- Participated in Indian National Young Academy of Sciences (INYAS) Flagship Event for Post-PhD Opportunities 2022
- Industrial Training at Shree Grinding Unit Lakshar (Shree Cement Ltd.), Haridwar. (2013)

References

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