Dr. Himanshu Dave

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EDUCATION

Arizona State University — Tempe, Arizona, USA
Ph.D Mechanical Engineering - (GPA - 3.64/4.00) — *May 2024*
Advisors: Dr. Mohamed Houssem Kasbaoui (Chair), Dr. Marcus Herrmann (Co-Chair)
Thesis title - Towards high fidelity particle-laden simulations based on volume-filtering: from point-particle to interface resolved descriptions.

Arizona State University — Tempe, Arizona, USA
MSc. Mechanical Engineering - (GPA - 3.64/4.00) — *May 2023*

Arizona State University — Tempe, Arizona, USA
BSc. Mechanical Engineering (Honors) - (GPA - 3.25/4.00) — *May 2019*
Honors thesis title - Design and analyze a liquid-liquid co-axial swirl injector for a small-scale rocket engine using CFD for minimum pressure drop, and maximum spray angle.

FELLOWSHIPS AND AWARDS

National Science Foundation INTERN program — Los Alamos, NM, USA
Los Alamos National Laboratory — *Jul 2022 - Dec 2022*

COMPUTING GRANTS AWARDED

1. **XSEDE**: "Bridging the gap in multiphase flow simulations", PI: **Kasbaoui, M. H.**, Co-PI: Dave, H., 2M cpuh, Period: 01/01/2021 to 12/31/2021.

PEER - REVIEWED JOURNAL PAPERS

3. **Dave, H.**, Herrmann, M., Brady, P., & Kasbaoui, M. H., Characterization of the forcing and sub-filter scale terms in the volume-filtering immersed boundary method, Journal of Computational Physics, 525, 113765 (15/03/2025).

2. **Dave, H.** & Kasbaoui, M. H., Mechanisms of drag reduction by semi-dilute inertial particles in turbulent channel flow, Physical Review Fluids, 8, 084305 (21/08/2023). (** 12)

1. **Dave, H.**, Herrmann, M. & Kasbaoui, M. H., The volume-filtering immersed boundary method, Journal of Computational Physics, 487, 112136 (15/08/2023). (** 7)

PEER - REVIEWED CONFERENCE PAPERS

1. **Dave, H.** & Kasbaoui, M. H. Modulation of coherent structures by inertial particles in a turbulent channel flow, AIAA Scitech 2020 Forum, 1328 (01/05/2020).

CONFERENCE PRESENTATIONS AND PROCEEDINGS

9. **Dave, H.**, Herrmann, M., Kasbaoui, M. H., Brady, P, A novel approach to solve PDE's involving boundary conditions on complex geometrical bounding surfaces using the Volume-Filtered Immersed Boundary (VF-IB) method. Presented at: 75th Annual Meeting of the APS Division of Fluid Dynamics; November 2023.

8. Kasbaoui M. H., **Dave H.**, Herrmann, M. A novel mass and momentum conserving immersed boundary method based on volume filtering. Presented at: 74th Annual Meeting of the APS Division of Fluid Dynamics; November 2022.

7. **Dave, H.**, Herrmann, M., Kasbaoui, M. H. A new conceptual approach for immersed boundaries based on volume-filtering. Presented at: 75th Annual Meeting of the APS Division of Fluid Dynamics; November 2021.

6. Kasbaoui M. H., **Dave H.**, Herrmann, M. A novel mass and momentum conserving immersed boundary method based on volume filtering. Presented at: 74th Annual Meeting of the APS Division of Fluid Dynamics; November 2021.

5. **Dave, H.**, Kasbaoui, M. H. Skin-friction drag modulation and riblet-like clusters in a semi-dilute particle-laden turbulent channel flow at $Re_\tau = 180$. Presented at: 74th Annual Meeting of the APS Division of Fluid Dynamics; November 2021.

** Citation count from Google Scholar

4. **Dave, H.**, Kasbaoui, M. H. Modulation of Skin-friction Drag by Inertial Particles. In: 25th International Congress of Theoretical and Applied Mechanics. International Union of Theoretical and Applied Mechanics; 2021

3. **Dave, H.**, Kasbaoui, M. H. A Novel Approach to Immersed Boundaries Based on the Volume-Filtering Framework. Presented at the: ASME 2021 Fluids Engineering Division Summer Meeting; August 2021.

2. **Dave, H.**, Kasbaoui, M. H. Turbulence modulation by inertial particles in Eulerian-Lagrangian simulations of a semi-dilute particle-laden channel flow. Presented at: 73rd Annual Meeting of the APS Division of Fluid Dynamics; November 2020.

1. **Dave, H.**, Kasbaoui, M. H. Modulation of coherent structures by inertial particles in a turbulent channel flow. Presented at: 72nd Annual Meeting of the APS Division of Fluid Dynamics; November 2019.

EXPERIENCE

- **Max Planck Institute for Solar System Research**   Göttingen, Germany
  Postdoctoral researcher   *September 2024 - Present*
  1. Researching melting processes due to buoyancy-driven Rayleigh-Bénard convection in combination with rotational effects.
  2. Developed post-processing tools in Python to properly study interface morphologies and heat transfer rates for the melting process.
  3. Created memory-efficient visualization tools in Python to study the evolution of the melting process in 3D.

- **Arizona State University**   Tempe, AZ, USA
  Graduate teaching assistant, School of Engineering of Matter, Transport and Energy   *January 2024 - May 2024*
  1. Guided students in grasping thermodynamic fundamentals essential to comprehend heat transfer, for successful experimentation.
  2. Demonstrated HVAC system and cooling tower experiments to teach Brayton cycle refrigeration system for 100 students.

- **Los Alamos National Laboratory**   Los Alamos, NM, USA
  Graduate Research Associate   *May 2023 - September 2023*
  1. Assessed and improved the applicability of stability theories for higher-order numerical methods using dispersive wave theory models for the structured cut-cell method.
  2. Performed optimization procedures to obtain novel set of high-order stable-cut-cell stencils, for solving hyperbolic equations leveraging Mathematica and Python.
  3. Optimized large scale runs in Linux high performance computing environments achieving accuracy of 8th order using C++.

- **Arizona State University**   Tempe, AZ, USA
  Graduate Research Associate under Prof. Kasbaoui, M. H.   *Aug 2019 - May 2023*
  1. Developed a structured gas-solid multiphase flow solver for static and moving interfaces in FORTRAN using volume-filtering.
  2. Benchmarked the solver under various test cases and achieved 99.3% accuracy compared to experimental and analytical results.
  3. Extend the Volume-Filtered Immersed Boundary (VFIB) method to arbitrary PDE's involving surfaces that do not align with uniform meshes such as parabolic and hyperbolic PDE's used in thermal and acoustic analysis.
  4. Researched particle modulation on wall-bounded turbulence and achieved 20% drag reduction using Eulerian-Lagrangian methods.
  5. Post-processed data through temporal and spatial averaging to understand how vortical structures increase or decrease drag.
  6. Conducted large-scale parallel simulations using Linux HPC resources through OpenMPI for optimization of code.
  7. Mentored other Undergraduate researchers on HPC techniques and CFD research (see below for details).
  8. Managed code development using GIT.

- **Los Alamos National Laboratory**   Los Alamos, NM, USA
  National Science Foundation Graduate intern   *Jul 2022 - Dec 2022*

** Citation count from Google Scholar

1. Extended the Volume-Filtered Immersed Boundary (VF-IB) method to hyperbolic and parabolic PDE's, in order to conduct thermal and acoustic analysis around complex topological surfaces.

2. Evaluated results obtained using the immersed boundary method to the cut-cell solver created at the lab and achieved comparable accuracy, while the reducing computational cost.

3. Examined the effect of sub-grid scale terms within the volume-filtered immersed boundary method to determine its significance.

- **Arizona State University** Tempe, AZ, USA
  Honors thesis project *Aug 2018 - May 2019*

  1. Designed a liquid-liquid coaxial swirl injector for a rocket engine using Large-Eddy simulations under the CharLES platform.

  2. Manufactured the injector and tested it against simulation data through PIV techniques experimentally.

  3. Conducted thermal analysis on the entire engine assembly to stay within safe thermal ranges to prevent thermal runoff scenarios.

  4. Co-founded a rocketry club in the process and became propulsion lead while completing my final honors thesis.

- **Arizona State University** Tempe, AZ, USA
  Teaching Assistant *Aug 2018 - May 2019*

  1. Supervised, graded and conducted lectures to a class of larger than 50 students in 3-D CAD modeling in Solidworks.

  2. Created tutorial videos and conducted weekly recitations.

- **Helios Rocketry** Tempe, AZ, USA
  Co-founder and Propulsion lead *Jul 2018 - Jun 2019*

  1. Created a rocketry club at Arizona State University to design and manufacture a rocket to reach the Karman line (100 km).

  2. Led a team of 10 students within the propulsion department to design a propulsion system.

  3. Performed thorough engineering analysis ranging from thermal, acoustic, flow and structural analysis on the rocket engine to keep it within safe engineering limits.

- **AzLoop** Tempe, AZ, USA
  Team Lead - Braking, stability and manufacturing *Mar 2017 - Jul 2018*

  1. Conducted thermal analysis using ANSYS Fluent to mitigate thermal runoff scenario within the high-speed braking system.

  2. Manufactured braking systems using CNC machines, Lathes, and other machinery according to design specifications.

  3. Performed vehicle stability and vibrational analysis using MATLAB to ensure system reliability and safety.

  4. Analyzed drag coefficient of the pod using CharLES to optimize Aerodynamic performance for maximum speed.

MENTORING

1. **Joseph Crespo**: Fulton Undergraduate Research Initiative (FURI) student working on large domain particle-laden channel flows to understand the effects of increasing particle size in a semi-dilute regime

2. **Jack Madden**: Barrett Honors thesis student working on how filter types and sizes affect the drag coefficient on a sphere using the volume filtered immersed boundaries approach.

SKILLS

Computing Language Proficiency: Linux, FORTRAN, C++ 20, Python
Software: Matlab, Mathematica, ANSYS Fluent, OpenFOAM, STAR-CCM+, Solidworks, CharLES, Gmsh, VisIt, Paraview

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