Abhilash Reddy Malipeddi

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Professional Summary

Computational physicist specializing in multiscale, multiphysics fluid simulations for digital twins, health informatics and data-driven insights into fundamental phenomena. Leverages engineering experience to build high-performance algorithms, solving multi-physics challenges and translating biomedical data into clinical insights. Passionate about collaborating and mentoring to drive innovative solutions.

Core Competencies

High-Performance Computing • Numerical & Computational Methods • Multi-physics Modeling • Fluid Dynamics & Rheology • Biomedical Simulation • Digital Twins • Data Science & Machine Learning • Project Management

Education

The George Washington University, Washington, D.C., USA
Ph.D., Mechanical & Aerospace Engineering 2021
"Rheology, diffusion and micro-structure of sheared suspensions of deformable particles"
Advisor: K. Sarkar

Indian Institute of Technology Madras, Chennai, India
Master of Technology, Mechanical Engineering Specialization in Energy Technology
"Influence of duct geometry on the performance of Darrieus turbine"
Advisor: D. Chatterjee

Indian Institute of Technology Madras, Chennai, India
Bachelor of Technology, Mechanical Engineering

Professional Experience

University of Michigan Ann Arbor, MI, USA
Research Fellow, ME & BME. October 2021–present

- Contributed to developing digital twin frameworks that enhance health informatics, enabling precision cardiovascular care and biomedical device modeling through high-performance code.
- Designed and implemented scalable, multi-scale, multi-physics models within the CRIMSON cardiovascular modeling framework to simulate complex physiological interactions.
- Developed highly scalable parallel algorithms for domain coupling on unstructured grids for coupled multi-physics problems.

The George Washington University Washington, D.C., USA
Research Assistant, MAE/SEAS September 2014–July 2021

- Developed high-performance scalable parallel Fortran/MPI code to simulate flows of complex multi-specie multi-particle suspensions
- Applied dynamic structure factor-based methods to study the flow of inhohogeneous suspensions
- First computational prediction of shear-induced gradient diffusivity of suspensions of droplets and cells

NTPC Limited Chennai & Ramagundam, India
Assistant Manager (Operation, Commissioning) August 2011–July 2013

- Commissioned thermal power generation stations (VTPS Units 1 & 2)
- Led 10 person team in safe operation of a 500MW power generation unit
- Applied ML tools to solve process issues e.g. clinker formation in the furnace

Indian Institute of Technology Madras Chennai, India
Research Assistant (Turbo Machines Laboratory) July 2009-May 2011
- Developed Euler-Lagrange cavitation model based on Rayleigh-Plesset theory
- Designed performance improving ducts for vertical axis hydrokinetic turbines

Deccan Pumps Pvt. Ltd. Coimbatore, India
Intern (Special assistant to CEO) Summer 2009
- Designed cavitation resistant polymer impellers for centrifugal pumps
- Developed software to streamline design and manufacturing of turbomachines.

Indian Institute of Sciences Bangalore, India
Summer Fellow (Force Microscopy Lab) Summer 2008
- Designed sample holder for Transmission Electron Microscope *in-situ* nano-indenter
- Optimized the sample holder design using finite element analysis

Technical Skills

- **Programming:** Fortran, C, C++, Python, Julia with parallel computing expertise
- **HPC Technologies:** MPI, OpenMP, GPU acceleration, CUDA
- **Scientific Libraries:** hypre, PETSc, Trilinos, AMGX
- **Data Science:** SciPy, NumPy, pandas, scikit-learn, Keras, PyTorch
- **DevOps:** Bash, Git, Docker, cloud platforms, CI/CD pipelines, Automation

Leadership & Soft Skills

Project Management • Technical Team Leadership • Cross-functional Collaboration • Research Mentorship • Scientific Communication • Problem-solving • Data Analysis

Honors & Awards

1. Outstanding Accomplishment in Research awarded by Office of Vice President for Research, The George Washington University 2015
2. Travel Award by APS to present at the APS Physics Canada-America-Mexico Conference in Oaxaca, Mexico 2015
3. George Washington University Fellowship
4. Merit-cum-Means Scholarship awarded by Indian Institute of Technology Madras

Publications

1. **A. R. Malipeddi**, C. Alberto Figueroa, and Jesse Capecelatro. Volume filtered FEM-DEM framework for simulating particle-laden flows in complex geometries, *arxiv:2311.15989*, December 2023.
2. **A. R. Malipeddi**, A. Tarafder and K. Sarkar. Deformation and breakup of a viscoelastic drop in time-dependent extensional flows with finite inertia. *Journal of Non-Newtonian Fluid Mechanics*, 321, 105108, 2023.
3. A. Tarafder, **A. R. Malipeddi** and K. Sarkar. Pair interactions between viscous drops in a viscoelastic matrix in free shear: Transition from passing to tumbling trajectories. *Journal of Rheology*, 66 (3), 571-584, 2022
4. S. Mukherjee, A. Tarafder, **A. R. Malipeddi** and K. Sarkar. Shear-induced migration of a viscous drop in a viscoelastic liquid near a wall at high viscosity ratio: Reverse migration. *Journal of Non-Newtonian Fluid Mechanics*, 301, 104751, 2022
5. **A. R. Malipeddi** and K. Sarkar. Shear-induced diffusivity of a red blood cell suspension: effects of cell dynamics. *Soft Matter*, 17(37):8523-8535, 2021.
6. **A. R. Malipeddi** and K. Sarkar. Collective diffusivity in a sheared viscous emulsion: Effects of viscosity ratio. *Physical Review Fluids*, 4(9), 093603, 2019

7. **A. R. Malipeddi** and K. Sarkar. Shear-induced collective diffusivity down a concentration gradient in a viscous emulsion of drops. *Journal of Fluid Mechanics*, 868:5–25, 2019.
8. S. Singha, **A. R. Malipeddi**, M. Zurita-Gotor, K. Sarkar, K. Shen, M. Loewenberg, K. B. Migler, and J. Blawzdziewicz. Mechanisms of spontaneous chain formation and subsequent microstructural evolution in shear-driven strongly confined drop monolayers. *Soft Matter*, 15(24):4873–4889, 2019.
9. P. Srivastava, **A. R. Malipeddi**, and K. Sarkar. Steady shear rheology of a viscous emulsion in the presence of finite inertia at moderate volume fractions: Sign reversal of normal stress differences. *Journal of Fluid Mechanics*, 805:494–522, 2016.
10. **A. R. Malipeddi** and D. Chatterjee. Influence of duct geometry on the performance of Darrieus hydroturbine. *Renewable Energy*, 43:292–300, 2012.

Workshops Conducted

1. CRIMSON workshop at Summer Biomechanics, Bioengineering and Biotransport Conference (SB3C) 2024, Lake Geneva, Wisconsin
2. CRIMSON workshop at Summer Biomechanics, Bioengineering and Biotransport Conference (SB3C) 2023, Vail, Colorado.

Research Talks

1. USNCCM 2025, Chicago, Illinois, ”Eulerian-Lagrangian framework for simulations of particle-laden biological flows in complex geometries”
2. SB3C 2024, Lake Geneva, Wisconsin, ”Eulerian-Lagrangian framework for simulations of particle-laden biological flows in complex geometries”
3. USNCCM 2023, Albuquerque, New Mexico. ”Euler-Lagrange scheme for modeling particle-laden flows in medical image based geometries”
4. Advanced in Computational Mechanics 2023, Austin, Texas. ”Volume-filtered Euler-Lagrange approach for particle-laden flows in complex geometries”
5. APS Division of Fluid Dynamics Conference 2023, Washington D.C., ”Euler-Lagrange scheme for modeling particle-laden flows in medical image-based geometries”
6. Michigan Fluids Research Seminar 2023, University of Michigan, Ann Arbor, ”A numerical recipe for large-scale simulation of particle-laden biological flows”
7. APS Division of Fluid Dynamics Conference 2022, Indianapolis, Indiana, ”A scalable Euler-Lagrange strategy for particle-laden anatomical flows in subject-specific geometries”
8. Michigan Fluids Research Seminar 2022, University of Michigan, Ann Arbor, ”Self-organization of deformable particles in confined shear flow”
9. APS Division of Fluid Dynamics Conference 2019, Seattle, Washington, ”Shear induced gradient diffusivity of red blood cell suspensions”
10. Burgers Symposium 2019, Johns Hopkins University, Baltimore, ”Shear-induced diffusion of deformable particles using dynamic structure factor”
11. APS March Meeting 2018, Los Angeles, California, ”Shear-induced gradient diffusivity of emulsions at finite inertia”
12. Burgers Symposium 2018, The George Washington University, ”Hydrodynamic collective diffusion in emulsions under shear flow”
13. APS Division of Fluid Dynamics Conference 2017, Denver, Colorado, ”Shear-induced gradient diffusivity in emulsions”
14. Northeast Regional Soft Matter Workshop, 2017, Princeton University, ”Computation of shear-induced collective diffusivity in emulsions”
15. Burgers Symposium 2016, Johns Hopkins University, Baltimore, ”Computation of viscoelastic drop deformation in periodic planar extensional flows”

16. APS Physics Canada-America-Mexico Conference 2015, Oaxaca, Mexico, ”Effects of a fluid filament’s curvature on its stability”
17. Society of Rheology 87th Annual Conference 2015, Baltimore, ”Deformation of a viscoelastic drop in periodic planar extensional flows”

Posters

1. Summer Biomechanics, Bioengineering and Biotransport Conference 2023, Vail, Colorado. ”Euler-Lagrange approach for modeling particle-laden flows in biological applications”
2. SEAS R&D Showcase 2019, ”Shear induced gradient diffusivity of red blood cell suspensions”
3. SEAS R&D Showcase 2018, ”Computation of collective diffusivity in emulsions at finite inertia”
4. SEAS R&D Showcase 2017, ”Flow induced diffusion of deformable particles”
5. GWU Research Days 2015, ”Deformation characteristics of a viscoelastic drop in periodic plane extensional flows” (Award Winner)
6. SEAS R&D Showcase 2015, ”Dynamics of a viscoelastic drop in time-periodic flows”

Grants

1. ACCESS grant, 2023, ”Scalable Euler-Lagrange strategy for particle-laden anatomical flows in subject-specific geometries”
2. Extreme Science and Engineering Discovery Environment (XSEDE) research allocation grant, 2019. PI: K. Sarkar, ”Rheology, diffusion and micro-structural evolution of emulsions of complex fluids”, Grant # CTS180042 Renewal, Award value: **$16,682.00**
3. Extreme Science and Engineering Discovery Environment (XSEDE) research allocation grant, 2018. PI: K. Sarkar, ”Rheology, diffusion and micro-structural evolution of emulsions”, Grant # CTS180042 New, Award value: **$16,588.67**
4. Extreme Science and Engineering Discovery Environment (XSEDE) startup allocation grant, 2017. PI: K. Sarkar, ”Rheology of emulsions in the presence of inertia”, Grant # CTS170042

Teaching Experience

Graduate Teaching Assistant, *Mechanical and Aerospace Engineering*

- MAE 3166W: Materials Science & Engineering, (Writing G. A.) — fall 2017
- MAE 3187: Heat Transfer — *(multiple)*
- MAE 6229: Propulsion — spring 2016
- APSC 6213: Analytical Methods in Engineering III: PDEs — *(multiple)*

Professional Affiliations

- American Society of Mechanical Engineering (ASME)
- American Physical Society (APS)
- Society of Rheology (SOR)
- Society for Industrial and Applied Mathematics (SIAM)

Professional Service

Reviewer

- Journal of Fluids Engineering
- International Journal of Multiphase Flow

Activities & Interests

Physical Computing, Embedded Systems, Cloud Computing, Computational Geometry, Science Outreach, Mechanical Design