

# Ashish Pathak

Assistant Professor

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## Education

- **Ph.D. Engineering and Applied Science,** May 2017  
Computational Science and Engineering Option  
*Dept. of Mechanical Engineering, Univ. of Massachusetts Dartmouth* *Massachusetts, USA*  
CGPA: 3.96 / 4.0  
Dissertation: An advanced 3D computational framework for simulating fluid-structure interaction in two-fluid flows: Application in ocean wave energy conversion technology  
Advisor: Prof. Mehdi Raessi, Dept. of Mechanical Engineering, UMass Dartmouth
- **M. Tech. Thermal Science and Engineering,** August 2011  
Offered by the Dept. of Mechanical Engineering  
*Indian Institute of Technology Kharagpur* *West Bengal*  
CGPA: 9.06 / 10.0  
Thesis: A semi-analytical approach to model Mixed Convection Laminar Film Condensation  
Advisor: Prof. S. Ghosh Moulic, Dept. of Mechanical Engineering, IIT Kharagpur
- **B. Tech. (Honours) Mechanical Engineering** August 2011  
*Indian Institute of Technology Kharagpur* *West Bengal*  
CGPA: 9.06 / 10.0  
Thesis: Capturing Shocks in fluid flow using Essentially Non-Oscillatory (ENO) schemes  
Advisor: Prof. S. Ghosh Moulic, Dept. of Mechanical Engineering, IIT Kharagpur

## Professional Experience

- **Assistant Professor** May 2021–Present  
*Dept. of Mechanical Engineering, Indian Institute of Technology Jodhpur*
- **Postdoctoral Fellow** Sept 2017–Mar 2021  
*Multiphase Flow group, Univ. of Massachusetts Dartmouth*  
Project: Characterization of secondary droplets during (fuel) spray wall interaction; Development of a sharp interface evaporation solver  
Supervisor: Prof. Mehdi Raessi, Dept. of Mechanical Engineering, UMass Dartmouth  
Funding Agency: Department of Energy and Massachusetts Clean Energy Center

- **Research Assistant**

Jan 2012–Aug 2017

*Univ. of Massachusetts Dartmouth*

Project: Development of a Fluid-Structure Interaction solver to study Ocean Wave Energy Converters

Supervisor: Prof. Mehdi Raessi, Dept. of Mechanical Engineering, UMass Dartmouth

Funding Agency: National Science Foundation and the Office of Associate Provost

### Awards and Scholarships

Nature	Name	Awarded by	Awarded for	Year
Award	Milton Van Dyke Award	American Physical Society	Submission titled “Impact of high-speed diesel drop trains—pursuing cleaner diesel engines” at American Physical Society-Division of Fluid Dynamics (APS-DFD) meeting, Chicago, 2020	2020
Award	Best Poster Award	Center for Scientific Computing and Visualization Center, UMass Dartmouth	Poster titled “Advanced computational simulations of ocean wave energy converter” at High Performance Computing Day, UMass Dartmouth	2016
Award	APS Travel Grant	American Physical Society	Attending American Physical Society-Division of Fluid Dynamics (APS-DFD) meeting, San Francisco, 2014	2014
Fellowship	Doctoral Fellowship	UMass Dartmouth	Supporting first year of PhD at UMass Dartmouth	2012
Prize	Institute Silver Medal	IIT Kharagpur	Securing highest CGPA at the end at the end of 10th semester in Mechanical Engineering Dual Degree program	2011
Prize	Dwarka Nath Singh Memorial Prize	IIT Kharagpur	Best outgoing Dual Degree student of the Department of Mechanical Engineering scoring the highest CGPA at the end of the 10th Semester among all the degree students of the department	2011
Award	Certificate of Merit in Physics	Central Board of Secondary Education	Outstanding academic performance and being among the top 0.1% of the successful candidates in All India Senior Secondary School Certificate Examination (AISSCE)	2005

Peer Reviewed Publications

Citations<sup>1</sup> = 182, h-index = 7, i10-index = 5

## Journal Articles

- [1] **A. Pathak** and M. Raessi. “An Implicit, Sharp Numerical Treatment of Viscous Terms at Arbitrarily Shaped Liquid-Gas Interfaces in Evaporative Flows”. In: *Journal of Computational Physics* 418 (Oct. 2020), p. 109625. ISSN: 00219991. DOI: [10.1016/j.jcp.2020.109625](https://doi.org/10.1016/j.jcp.2020.109625).
- [2] D. Markt, **A. Pathak**, M. Raessi, S.-Y. Lee, and R. Torelli. “Computational Characterization of the Secondary Droplets Formed during the Impingement of a Train of Ethanol Drops”. In: *International Journal of Engine Research* 21.2 (Feb. 2020), pp. 248–262. ISSN: 1468-0874, 2041-3149. DOI: [10.1177/1468087419879623](https://doi.org/10.1177/1468087419879623).
- [3] **A. Pathak** and M. Raessi. “Steady-State and Transient Solutions to Drop Evaporation in a Finite Domain: Alternative Benchmarks to the  $d^2$  Law”. In: *International Journal of Heat and Mass Transfer* 127 (Dec. 1, 2018), pp. 1147–1158. ISSN: 0017-9310. DOI: [10.1016/j.ijheatmasstransfer.2018.06.071](https://doi.org/10.1016/j.ijheatmasstransfer.2018.06.071).
- [4] D. P. Markt Jr., **A. Pathak**, and M. Raessi. “Advanced Computational Simulations of Surface Impingement of a Train of Ethanol Drops: A Pathway to Developing Spray-Wall Interaction Sub-models”. In: *Computing in Science & Engineering* 20.4 (July 1, 2018), pp. 56–65. ISSN: 1521-9615. DOI: [10.1109/MCSE.2018.042781326](https://doi.org/10.1109/MCSE.2018.042781326).
- [5] **A. Pathak**, C. Freniere, and M. Raessi. “Advanced Computational Simulations of Water Waves Interacting with Wave Energy Converters”. In: *European Journal of Computational Mechanics* 26.1-2 (Mar. 4, 2017), pp. 172–204. ISSN: 1779-7179. DOI: [10.1080/17797179.2017.1306829](https://doi.org/10.1080/17797179.2017.1306829).
- [6] C. Freniere, **A. Pathak**, M. Raessi, and G. Khanna. “The Feasibility of Amazon’s Cloud Computing Platform for Parallel, GPU-Accelerated, Multiphase-Flow Simulations”. In: *Computing in Science & Engineering* 18.5 (Aug. 26, 2016), pp. 68–77. ISSN: 1521-9615. DOI: [10.1109/MCSE.2016.94](https://doi.org/10.1109/MCSE.2016.94).
- [7] **A. Pathak** and M. Raessi. “A 3D, Fully Eulerian, VOF-Based Solver to Study the Interaction between Two Fluids and Moving Rigid Bodies Using the Fictitious Domain Method”. In: *Journal of Computational Physics* 311 (Apr. 15, 2016), pp. 87–113. ISSN: 0021-9991. DOI: [10.1016/j.jcp.2016.01.025](https://doi.org/10.1016/j.jcp.2016.01.025).
- [8] **A. Pathak** and M. Raessi. “A Three-Dimensional Volume-of-Fluid Method for Reconstructing and Advecting Three-Material Interfaces Forming Contact Lines”. In: *Journal of Computational Physics* 307 (Feb. 15, 2016), pp. 550–573. ISSN: 0021-9991. DOI: [10.1016/j.jcp.2015.11.062](https://doi.org/10.1016/j.jcp.2015.11.062).
- [9] A. Ghasemi, **A. Pathak**, and M. Raessi. “Computational Simulation of the Interactions between Moving Rigid Bodies and Incompressible Two-Fluid Flows”. In: *Computers & Fluids* 94 (May 1, 2014), pp. 1–13. ISSN: 0045-7930. DOI: [10.1016/j.compfluid.2014.01.027](https://doi.org/10.1016/j.compfluid.2014.01.027).

## Conference Papers

- [10] D. P. Markt, L. Zhao, X. Zhu, **A. Pathak**, R. Torelli, S.-Y. Lee, and M. Raessi. “An experimental and computational study of a single droplet impinging on a dry surface”. In: *14th International Conference on Liquid Atomization and Spray Systems* (Chicago, IL). 2018.

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<sup>1</sup>Source: [scholar.google.com](https://scholar.google.com)

- [11] D. P. Markt, R. Torelli, **A. Pathak**, M. Raessi, S. Som, R. Scarcelli, S.-Y. Lee, and J. Naber. *Using a DNS Framework to Test a Splashed Mass Sub-Model for Lagrangian Spray Simulations*. SAE Technical Paper 2018-01-0297. Warrendale, PA: SAE International, Apr. 3, 2018. DOI: [10.4271/2018-01-0297](https://doi.org/10.4271/2018-01-0297).

**Conference Presentations**

\* indicates the presenter

- [1] C. Hoi\*, **A. Pathak**, and M. Raessi. “Computational investigation of plug flow dynamics and splitting through 3D multi-branching bifurcating lung airway models”. In: *Bulletin of the American Physical Society*. 72nd Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Seattle, WA). Vol. 64. 13. 2019.
- [2] D. Markt Jr\*, **A. Pathak**, M. Raessi, R. Torelli, and S.-Y. Lee. “On Splashing Dynamics of Diesel Drop Trains Under Engine-Relevant Impingement Conditions: a Computational Study”. In: *Bulletin of the American Physical Society*. 72nd Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Seattle, WA). Vol. 64. 13. 2019.
- [3] C. Hoi\*, **A. Pathak**, and M. Raessi. “3D computational investigation of plug motion and film deposition in straight and Y-shaped tubes with pre-wetted walls”. In: *Bulletin of the American Physical Society*. 71st Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Atlanta, GA). Vol. 63. 13. 2018.
- [4] D. Markt Jr\*, **A. Pathak**, M. Raessi, R. Torelli, R. Scarcelli, S. Som, S.-Y. Lee, and J. Naber. “Computational investigation of micron-sized diesel droplet trains impinging on thin liquid films”. In: *Bulletin of the American Physical Society*. 71st Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Atlanta, GA). Vol. 63. 13. 2018.
- [5] **A. Pathak** and M. Raessi\*. “Improving the numerical accuracy of sharp interface treatment of evaporation modeling”. In: *Bulletin of the American Physical Society*. 71st Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Atlanta, GA). Vol. 63. 13. 2018.
- [6] D. Markt Jr\*, **A. Pathak**, M. Raessi, S.-Y. Lee, and E. Zhao. “Computational Study of Droplet Trains Impacting a Smooth Solid Surface”. In: *Bulletin of the American Physical Society*. 70th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Denver, CO). Vol. 62. 14. 2017.
- [7] **A. Pathak**\* and M. Raessi. “A fully Eulerian fictitious domain method to study interaction between moving structures and two-fluid flows”. In: Southeastern Atlantic Section Conference (Tallahassee, FL). 2017.
- [8] **A. Pathak**\* and M. Raessi. “Towards a sharp-interface volume-of-fluid methodology for modeling evaporation”. In: *Bulletin of the American Physical Society*. 70th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Denver, CO). Vol. 62. 14. 2017.
- [9] C. Freniere\*, **A. Pathak**, and M. Raessi. “Computational modeling of pitching cylinder-type ocean wave energy converters using 3D MPI-parallel simulations”. In: *Bulletin of the American Physical Society*. 69th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Portland, OR). Vol. 61. 20. 2016.
- [10] **A. Pathak**\* and M. Raessi. “Computational simulations of the interaction of water waves with pitching flap-type ocean wave energy converters”. In: *Bulletin of the American Physical Society*. 69th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Portland, OR). Vol. 61. 20. 2016.

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- [11] M. Raessi\* and **A. Pathak**. “3D, GPU-accelerated and MPI-parallel simulations of two-fluid flows interacting with moving rigid bodies – application in renewable energy systems”. In: International Conference of Multiphase Flow (Firenze, Italy). 2016.
- [12] C. Freniere\*, **A. Pathak**, M. Raessi, et al. “Feasibility of Amazon Cloud Computing Platform for Parallel Multi-phase Flow Simulations”. In: *Bulletin of the American Physical Society*. 68th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Boston, MA). Vol. 60. 21. 2015.
- [13] **A. Pathak\*** and M. Raessi. “A 3D MPI-Parallel GPU-accelerated framework for simulating ocean wave energy converters”. In: *Bulletin of the American Physical Society*. 68th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Boston, MA). Vol. 60. 21. 2015.
- [14] **A. Pathak** and M. Raessi\*. “An advanced computational framework for analysis of ocean wave energy converters”. In: 9th International Conference on Energy Sustainability (San Diego, CA). ASME. 2015.
- [15] **A. Pathak\*** and M. Raessi. “A 3D GPU-accelerated MPI-parallel computational tool for simulating interaction of moving rigid bodies with two-fluid flows”. In: *Bulletin of the American Physical Society*. 67th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (San Francisco, CA). Vol. 59. 20. 2014.
- [16] **A. Pathak\*** and M. Raessi. “Towards an advanced computational framework for 3D simulations of Ocean Wave Energy Converters”. In: 8th International Conference on Energy Sustainability (Boston, MA). ASME. 2014.
- [17] A. Ghasemi, **A. Pathak**, R. Chiodi, and M. Raessi\*. “Computational simulation of the interactions between water waves and two-dimensional wave energy converters”. In: *Bulletin of the American Physical Society*. 66th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Pittsburg, PA). Vol. 58. 18. 2013.
- [18] A. Ghasemi\*, **A. Pathak**, and M. Raessi. “Computational simulations of wave energy converters by solving the Navier-Stokes equations”. In: 4th Annual Marine Renewable Energy Technical Conference (Providence, RI). 2013.
- [19] A. Ghasemi, **A. Pathak**, and M. Raessi\*. “Numerical modeling of the interaction between moving solid structures and two-fluid flows: Application in ocean wave energy converters”. In: Conference on Computational Science and Engineering (Boston, MA). SIAM. 2013.
- [20] **A. Pathak\*** and M. Raessi. “Three-dimensional advected normals method for calculating interfacial normals and curvatures in two-phase flows”. In: *Bulletin of the American Physical Society*. 66th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (Pittsburg, PA). Vol. 58. 18. 2013.
- [21] A. Ghasemi\*, **A. Pathak**, and M. Raessi. “Computational simulation of ocean wave energy converters using the fast fictitious domain method”. In: *Bulletin of the American Physical Society*. 65th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (San Diego, CA). Vol. 57. 17. 2012.
- [22] **A. Pathak\*** and M. Raessi. “A GPU-accelerated interfacial flow solver with advected normals: Application to contact line problems”. In: *Bulletin of the American Physical Society*. 65th Annual Meeting of the APS Division of Fluid Dynamics. APS-DFD (San Diego, CA). Vol. 57. 17. 2012.
- [23] M. Raessi\*, **A. Pathak**, J. Mostaghimi, and B. Markus. “On the accuracy and performance of the advected normals approach in simulating interfacial flows”. In: International Conference on Numerical Methods in Multiphase flows (University Park, PA). 2012.

## Teaching Assignment

- Dept. of Mechanical Engineering, Univ. of Massachusetts Dartmouth
  - EGR 242: Engineering Mechanics II: Dynamics
- Dept. of Mechanical Engineering, Indian Institute of Technology Jodhpur
  - MEP1010: Engineering Visualization
  - MEP1020: Engineering Realization
  - EEL2070: Modelling and Simulation
  - ME312: IC Engines
  - MEP7010: Engineering Fluids Lab
  - MEL7370: Microfluidics Technology
  - MEL7450: Hydropower
  - MEL7550: Turbulence

## Academic Services

- Reviewed manuscripts for publications in:
  - Applied Ocean Research
  - Computer and Fluids
  - International Journal of Computational Fluid Dynamics
  - International Journal of Engine Research
  - Journal of Computational Physics
  - Ocean Engineering
  - Physics of Fluids

## Research Interests

- Fluid-Structure Interaction
- Ocean energy
- Phase-change problems
- Multiphase flows
- High Performance Computing

## Skills

Programming Languages: Fortran, C, C++ (including `std=c++11`), CUDA  
Build Tools: GNU Make, CMake  
Parallel Computing: MPI, GPGPU  
Scripting Languages: EES, MATLAB, Python, Bash, Vimscript

Debuggers: GDB, Totalview  
Visualization: Matplotlib, VisIt and its Python API  
Version Control: Git  
Manuscript Typesetting:  $\LaTeX$   
Modal Editing: Vim