

# Arpit Agarwal

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EDUCATION	<b>University of Wisconsin-Madison</b> Sep '15 - Jul '20 Ph.D. Mechanical Engineering; Computer Science Graduate Minor Emphasis: Computational Methods, Multiphase Flows, Turbulent Flows, Heat Transfer
	<b>Indian Institute of Technology, Bombay</b> Jul '10 - Aug '15 B.Tech & M.Tech in Mechanical Engineering
TECHNICAL SKILLS	<b>Simulation Tools:</b> Proficient with OpenFOAM, MATLAB, Pointwise, EnSight, Paraview, Blender; Experienced with ANSYS Forte, CFX, Fluent, Adams, Simulink <b>Languages/Libraries:</b> C, C++, Python, Fortran, Java, ScikitLearn, OpenMP, MPI, CUDA <b>Other Software:</b> git, L <sup>A</sup> T <sub>E</sub> X, Mathematica, Visual Studio, SolidWorks, Mathcad
DOCTORAL RESEARCH	<b>Two-Phase CFD Analysis – Liquid Jet Atomization</b> Sep '15 - present <i>Advisor: Professor Mario Trujillo</i> Published work through 3 journal and 4 conference publications (details on page 2) <b>Physics of Spray Atomization</b> <ul style="list-style-type: none"><li>• Theoretically &amp; computationally explained limitations of state-of-the-art atomization models</li><li>• Discovered &amp; explained the flow mechanisms that cause the high sensitivity of large-scale atomization behavior to tiny nozzle features</li><li>• Generated large boundary fitted grids for real injector geometries for high-fidelity simulations</li></ul> <b>Analysis of Two-Phase CFD Solvers</b> <ul style="list-style-type: none"><li>• Implemented and evaluated 3 curvature computation schemes in parallel multiphase solvers</li><li>• Developed curvature scheme with order-of-magnitude error improvement w.r.t. earlier schemes</li><li>• Conducted weak/strong scaling tests for the <code>interFOAM</code> solver (up to 80M cells, 960 processors)</li></ul>
MASTERS' THESIS	<b>Stability of Stratified Flow using Smoothed Particle Hydrodynamics (SPH)</b> Jun '14 - Aug '15 <i>Advisors: Professor A. Bhattacharya &amp; Professor P. Ramachandran</i> <ul style="list-style-type: none"><li>• Accurately captured flow instabilities (Kelvin-Helmholtz, Rayleigh-Taylor) using SPH</li><li>• Contributed to PySPH (open source): surface tension &amp; viscosity discontinuity schemes</li></ul>
INDUSTRY EXPERIENCE	<b>Management Consulting</b> <ul style="list-style-type: none"><li>• Joining Bain &amp; Company as a full-time consultant in Nov. 2020</li><li>• Attended highly selective consulting workshops by Bain &amp; Co., and McKinsey &amp; Co. (2019)</li></ul> <b>ANSYS, CFD Development Intern, San Diego</b> May '18 - Aug '18 <ul style="list-style-type: none"><li>• Worked on fully parallelized Fortran-based solver for spray droplet collision modeling</li><li>• Delivered breakthrough speedup, <math>O(N^2)</math> to <math>O(N)</math>, by improving collision detection algorithm</li><li>• Enhanced model accuracy through code &amp; model improvements; identified &amp; fixed bugs</li><li>• Published part of the work as an SAE conference paper (SAE WCX 2019)</li></ul> <b>Bosch, CFD Application Intern, India</b> May '13 - Jun '13 <ul style="list-style-type: none"><li>• Drafted a strategy for grid generation aimed towards capturing hydraulic and thermal boundary layers; tested it through ANSYS Fluent and CFX simulations</li></ul>
SELECT PROJECTS	<b>Machine Learning based CFD Modeling</b> <ul style="list-style-type: none"><li>• Developed models for binary droplet collisions using ScikitLearn with significantly higher accuracy than state-of-the-art mechanistic models (42%): Naive Bayes (69%), SVM (82%), Neural Nets (83%), k-NN (91%), Random Forests (92%) – (<i>paper under preparation</i>)</li><li>• Implemented several methods like Decision Trees, Neural Nets &amp; Naive Bayes from scratch</li></ul> <b>Acceleration &amp; Parallelization (OpenMP, MPI and CUDA) of CFD Solver</b> <ul style="list-style-type: none"><li>• Implemented multi-core (OpenMP), multi-node (MPI) and GPU (CUDA) parallelizations of a two-phase advection solver</li><li>• Demonstrated a speedup of 47.5X on GPUs and 22.4X on CPUs</li></ul>

## PUBLICATIONS

**Journal Publications**

- **Arpit Agarwal** & Mario Trujillo “A Closer Look at Linear Stability Theory in Modeling Spray Atomization.” International Journal of Multiphase Flow (2018)
- Mario Trujillo, Soumil Gurjar, Michael Mason & **Arpit Agarwal** “Global Characterization of the Spray Formation Process.” Atomization & Sprays (2018)
- **Arpit Agarwal** & Mario Trujillo “The Effect of Nozzle Internal Flow on Spray Atomization.” International Journal of Engine Research (2019)
- **Arpit Agarwal** & Mario Trujillo “Evaluation of Curvature Schemes in VoF simulations.” (Under preparation)

**Conferences**

- **Arpit Agarwal** & Mario Trujillo “A Closer Look at Linear Stability Theory in Spray Modeling.” 14<sup>th</sup> Triennial International Conference on Liquid Atomization & Spray Systems (ICLASS) 2018
- **Arpit Agarwal** & Mario Trujillo “Revisiting Linear Stability Theory in Spray Modeling Applications.” SAE World Congress 2018
- **Arpit Agarwal**, Yue Wang, Long Liang, Chitralkumar Naik, Ellen Meeks “The Computational Cost and Accuracy of Spray Droplet Collision Models.” SAE Technical Paper 2019
- **Arpit Agarwal** & Mario Trujillo “A Computational Study of Nozzle Internal Flow and Its Effect on Spray Atomization.” Institute for Liquid Atomization & Spray Systems (ILASS) 2019
- **Arpit Agarwal** & Mario Trujillo “High Fidelity Simulations of Nozzle Internal Flow and its Effect on Breakup Behavior.” International Multidimensional Engine Modeling Meeting (IMEM) 2019
- **Arpit Agarwal** “Machine Learning Based Binary Droplet Collision Modeling.” (Under prep.)

SELECT  
PRESENTATIONS &  
ACTIVITIES

Invited presentation: “The Role of Linear Stability in Primary Atomization using High Fidelity Spray A Simulations.” ECN Workshop 6.1, 2018  
Session Chair: International Conference on Liquid Atomization and Spray Systems, 2018  
Reviewer: ASTFE, SAE, IJER

VOLUNTEERING  
&  
LEADERSHIP

**Treasurer – Asha for Education** Jun '17 - May '18  
 Raising and disbursing funds to education related non-profit organizations in India

**Head – Departmental Academic Mentorship Program, IIT Bombay** Feb '14 - Jul '15  
 Headed a team of 30 mentors helping UG students facing academic problems

**Mentor & Coordinator – Avanti Fellows** May '11 - Aug '13  
 Mentored and tutored financially underprivileged students through High School for 2 years  
 Coordinated selection of students for the fellowship

**Mentor – Institute Mentorship Program, IIT Bombay** May '13 - Jul '15  
 Mentored 24 freshmen over 2 years towards achieving their personal, social and academic goals

GRADUATE  
COURSEWORK

**Computer Science & Mathematics**: Machine Learning, High Performance Scientific Computing, Data Structures, Methods of Computational Mathematics

**Mechanical Engineering**: Turbulent Flows, Particle Methods for Flow Simulations, Cryogenic Engineering, Geophysical Fluid Dynamics, Advanced Heat Transfer, Advanced Thermodynamics

MISCELLANEOUS  
ACTIVITIES

- Awarded DELF A2 certification in French (2015)
- Mountaineering: Certified Advanced Level Mountaineer; summited 5300 m peak in the Himalayas
- Jagriti Yatra: Traveled 5,000+ miles on rail across India in 2 weeks to explore entrepreneurship opportunities in rural India
- Endurance sports: Completed two 12-hour long swim-marathons; Running - Half marathon & 5k/10k runs