

# Arpit Agarwal

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## EDUCATION

### University of Wisconsin – Madison

Sep '15 - present

Ph.D. in Mechanical Engineering & Graduate Minor in Computer Science

Fields: Computational Methods, Multi-Phase, Turbulent, & Compressible Flows, Heat Transfer

GPA: 3.85/4.00

### Indian Institute of Technology Bombay

Jul '10 - Aug '15

B.Tech & M.Tech in Mechanical Engineering

M.Tech Specialization: Thermal & Fluids Engineering

Cumulative Performance Index: 7.91/10.00

## TECHNICAL SKILLS

**Simulation Tools:** Extensive experience with OpenFOAM, MATLAB, Pointwise and EnSight; Limited experience with ANSYS CFX & Fluent, Adams, Simulink

**Programming Languages & Libraries:** C, C++, Python, Java, OpenMP, MPI, CUDA, thrust

**Other Software:** git, L<sup>A</sup>T<sub>E</sub>X, Mathematica, Solidworks, Mathcad, HTML

## DOCTORAL RESEARCH

### Two-Phase CFD Analysis - Liquid Jet Atomization

Sep '15 - present

*Principal Investigator: Professor Mario Trujillo*

#### Assessment of Dominant Atomization Models

- Theoretically analyzed dominant atomization models & established the extent of their validity
- Proved that the most pivotal assumptions in the modeling theory are not valid for realistic conditions; this explains the failure of the models' predictive capabilities
- Generated boundary fitted grids for real injector geometries for high-fidelity simulations  
*Accepted for presentation at ICLASS, 2018 & SAE World Congress, 2018*  
*In progress: Journal paper titled 'The Case Against Linear Stability Theory Based Spray Modeling' for Fuel*

#### Identification of Universal Atomization Regimes

- Identified three breakup regimes in 3D atomizing liquid jets over a wide operating range
- Customized OpenFOAM based solvers for post-processing data  
*In progress: Journal paper titled 'Liquid-Gas Momentum Coupling in an Atomizing Liquid Jet' for International Journal of Multiphase Flow*

#### Analysis of Two-Phase CFD solvers

- Evaluating the performance of the two-phase `compressibleInterFOAM` solver
- Conducted weak/strong scaling tests for the `interFOAM` solver (up to 80M cells, 960 processors)
- Examined a mass conservation issue at the sub-grid level in Gradient Augmented Level Set Method; identified the problem of interpolation errors in the  $C^1$  level set function

## MASTERS' THESIS

### Stability of Stratified Flow using Smoothed Particle Hydrodynamics (SPH)

*Advisors: Professor A. Bhattacharya & Professor P. Ramachandran*

Jun '14 - Aug '15

- Accurately captured flow instabilities (Kelvin-Helmholtz, Rayleigh-Taylor) using SPH
- Implemented and tested surface tension, and viscosity discontinuity schemes in the open source framework, PySPH

## INDUSTRY EXPERIENCE

### Robert Bosch Engineering Solutions, India (Coimbatore)

May '13 - Jun '13

*Mesh Analysis for Boundary Layer Growth*

- Drafted a strategy for grid generation aimed towards capturing hydraulic and thermal boundary layers; tested it through Fluent and CFX simulations
- Worked with the simulation team at Bosch to improve the stability, accuracy and convergence rate of their finite volume CFD analyses

VOLUNTEERING AND LEADERSHIP	<p><b>Treasurer - Asha for Education</b> Jun '17 - present Raising and disbursing funds to education related non-profit organizations in India</p> <p><b>Head - Departmental Academic Mentorship Program, IIT Bombay</b> Feb '14 - Jul '15 Headed a team of 30 mentors helping UG students facing academic problems</p> <p><b>Mentor &amp; Coordinator - Avanti Fellows</b> May '11 - Aug '13 Mentored and tutored financially underprivileged students through High School for 2 years Coordinated selection of students for the fellowship</p> <p><b>Mentor - Institute Mentorship Program, IIT Bombay</b> May '13 - Jul '15 Mentored 24 freshmen over 2 years towards achieving their personal, social and academic goals</p>
TEACHING	<p><b>Teaching Assistantships</b></p> <ul style="list-style-type: none"> <li>• UW-Madison: Computational Fluid Dynamics (Fall 2017)</li> <li>• IIT Bombay: Graduate Fluid Dynamics (Spring 2015), Machine Design (Fall 2014), Thermodynamics (Spring 2013)</li> </ul>
ACTIVITIES	<p>Reviewer for Society of Automotive Engineers (SAE) Apr '17 - present</p>
RELEVANT GRADUATE COURSEWORK	<p><b>Mechanical Engineering:</b> Turbulent Flows, Particle Methods for Flow Simulations, Cryogenic Engineering, Geophysical Fluid Dynamics, Advanced Heat Transfer, Advanced Thermodynamics</p> <p><b>Computer Science &amp; Mathematics:</b> High Performance Scientific Computing, Methods of Computational Mathematics, Data Structures</p>
SELECT PROJECTS	<p><b>Acceleration &amp; Parallelization (OpenMP, MPI and CUDA) of CFD Solver</b> <i>Course Project, Advisor: Professor Dan Negrut</i></p> <ul style="list-style-type: none"> <li>• Implemented multi-core (OpenMP), multi-node (MPI) and GPU (CUDA) parallelizations of a GALS based two-phase advection solver</li> <li>• Demonstrated a speedup of 47.5X on GPUs and 22.4X on CPUs</li> </ul> <p><b>Turbulent Pipe and Channel Flow</b></p> <ul style="list-style-type: none"> <li>• Assessed the capability of the interFOAM solver to capture turbulence in pipe &amp; channel flows</li> <li>• Obtained relevant turbulent statistics from Direct Numerical Simulation (DNS) data; interpreted the results to verify and analyze features like Kolmogorov's <math>5/3^{rd}</math> law and log-law</li> </ul> <p><b>CFD Solver Development</b></p> <ul style="list-style-type: none"> <li>• <b>Eulerian Solver:</b> Solved the Lid-Driven Cavity Problem by developing a generic Finite Volume based steady state Navier-Stokes solver</li> <li>• <b>Lagrangian Solver:</b> Solved flow past a cylinder by developing a generic transient flow solver based on a 2D Vortex Particle Method; Achieved a 14X speedup through GPU acceleration</li> </ul> <p><b>Design of Steam-Separator in Solar Air Dehumidifier</b> May '12 <i>Undergraduate Research Project, Advisor: Professor M. Rane</i> Designed and conducted experiments to measure water fraction in the steam outflow; identified problems in the Steam-Separator and implemented solutions for the same.</p>
SCHOLASTIC ACHIEVEMENTS	<ul style="list-style-type: none"> <li>• Secured an All India Rank of 532 in IIT-JEE 2010 among over 450,000 candidates</li> <li>• Secured an All India Rank of 712 in AIEEE 2010 among over 10,00,000 candidates</li> <li>• Awarded a scholarship for securing a state rank of 15 in The Science Foundation Examination</li> </ul>
TEST SCORES	<p><b>GRE:</b> 332/340; <b>TOEFL:</b> 112/120</p>
EXTRA - CURRICULAR ACTIVITIES	<ul style="list-style-type: none"> <li>• Awarded DELF A2 certification in French (2015)</li> <li>• Mountaineering: Certified Advanced Level Mountaineer; summited 5300 m peak in the Himalayas</li> <li>• Endurance sports: Completed long distance swimming (15 km+) and triathlon competitions</li> </ul>