Vatsal Sanjay

Thermal Engineering, Senior Year

Department of Mechanical and Industrial Engineering, IIT Roorkee
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Seeking doctorate position to continue the quest in the world of multi-phase flows

Research Interests

Two-phase flow
- Liquid jets & their interactions
- Computational multi-fluid dynamics
- Droplets & bubbles dynamics
- Liquid Sheets (curtains) formation & stability
- Interface reconstruction
- Boiling heat transfer

Fire
- Compartmental fire
- Fire propagation and soot flow

Education

Undergraduate

2013 – 2018 **Integrated Dual Degree: B.Tech (Mechanical Engineering) and M.Tech (Thermal Engineering)**, *Indian Institute of Technology Roorkee*, Uttarakhand, India

Thesis Understanding of mutual interactions between liquid jets: Entrainment and sheet formation.

CGPA **8.98**/10

High School

2013 **AISSCE**, *CBSE, Jesus and Mary Academy*, Darbhanga, Bihar, India

Graduated with **96.4%** marks and a percentile score of **99.73%**

2011 **AISSE**, *CBSE, DAV Public School MTPS Kanti*, Muzaffarpur, Bihar, India

CGPA **10**/10

Research Experience

Research Scholar

2014 **Two-phase and micro-fluidics group**, *Indian Institute of Technology Roorkee*, Uttarakhand, India

Supervisor: Prof. Arup Kumar Das

Research Intern

2016 **Laboratoire de Mécanique des Fluides et d'Acoustique - UMR 5509**, *Université Claude Bernard*, Lyon1, France

Supervisors: Prof. J. John Soundar, Prof. Jean-Philippe Matas, Prof. Mickaël Bourgoin

Journal Publications

2017 **Sanjay, V** and Das, A. K. "On air entrainment in a water pool by impingement of a jet". In: *AIChE Journal*. ISSN: 1547-5905. DOI: 10.1002/aic.15828

2017 **Sanjay, V** and Das, A. K. "Numerical Assessment of Hazard in Compartmental Fire Having Steady Heat Release Rate from the Source". In: *Building Simulation (In Press)*

2017 **Sanjay, V** and Das, A. K. "Liquid Chain Genesis by Collision of Two Laminar Jets". In: *Physics of Fluids (Under Review)*

2017 Jain, A., **Sanjay, V**, and Das, A. K. "On the inception and Interaction of bubble clusters formed by impingement of plunging liquid jets onto a pool". In: *Working Paper*

2017 Soni, A., **Sanjay, V**, and Das, A. K. "On the mutual interactions of liquid jets". In: *Working Paper*

2017 Rathia, S. K., **Sanjay, V**, and Das, A. K. "Investigation of the fire propagation across the patterned obstructions with single and two point ignitions". In: *Working Paper*

Technical Skills

CFD: Gerris, LAMMPS-SPH, Fire Dynamics Simulator, Paris Simulator, OpenFOAM, ANSYS-Fluent, Basilisk C

Lab based: LabView: Voltage module, Conductivity & Optical probes

Languages: C, C++, MATLAB, Python, LaTeX

Others: Octave, SolidWorks, AutoCAD

Research Description

Two-phase flows

2015

Bubble entrainment by plunging liquid jets on pool

Supervisor: Prof. Arup Kumar Das

- Captured the instance of pinch-off of first annular bubble to mark the entrainment inception.
- Studied the asymmetry arising in the inception stage and bubble cluster due to inclined jet impingement.
- Studied the interaction between bubble clusters formed by impact of two liquid jets onto pool surface.

2016

Collision of liquid jets

Supervisor: Prof. Arup Kumar Das

- Conducted full-scaled numerical simulations to explore the physics of liquid jet collision.
- Establishment of analogy between impact of liquid jets with colliding train of fluid quanta.
- Investigated the formation of finger like projections as a result of Plateau-Rayleigh instability.
- Studied effects of inertia induced asymmetries in the collision of liquid jets.
- Characterized atomization by collision of liquid jets: a result of Kelvin-Helmholtz instability.

2016

Multi-scale simulations

Supervisor: Prof. Arup Kumar Das

- Working on coupling of the Volume of Fluid (VOF) - Lagrangian Point Particle (LPP) methodology.
- Used the hybrid method to study the multi-scale phenomena, like jet atomization & bubble bursting.

2016

Numerical simulation of the drainage of kitchen sink

Supervisor: Prof. Arup Kumar Das

- Studied the mutual interplay of body forces and surface forces on the drainage of reservior.
- Higher surface tension tries to retain the shape of the pool while drainage.
- Viscous forces hinder the drainage of liquid, making it harder to flow.

2016

Numerical investigation of the Landau film entrainment and rotary entrainment

Supervisors: Prof. J. John Soundar, Prof. Jean-Philippe Matas, Prof. Mickaël Bourgoin

- Understanding of the classical Landau-Levich film entrainment problem.
- Studied the film characteristics using the perturbation theory.
- Conducted numerical simulations to understand the assumptions taken in the analytical analysis.
- Established the ground work for numerical simulation of rotary entrainment.

2017

Phase change heat transfer

Supervisor: Prof. Arup Kumar Das

- Understanding of the phase-change model incorporated in LAMMPS-SPH multiphase solver.
- Investigating preferential bubble pinch-off from staggered cylindrical arrangement.
- Future endevor: simulation of nucleate boiling with dynamic contact angle.

Fire dynamics

2014

Study of flame propagation

Supervisor: Prof. Arup Kumar Das

- Investigated compartmental fire in presence of furniture through numerical simulations.
- Simulated fire inside real-life modeled railway compartments to establish the critical spots.
- Studied fire propagation behavior in presence of patterned flammable obstructions.

Scholastic achievements

- AIR 2988 in Graduate Aptitute Test in Engineering - 2017 (Mechanical) among 190648 candidates.
- Received Summer Undergraduate Research Award in summers of 2015 at IIT Roorkee.
- Cleared IIT-JEE Advance (2013) with All India rank 1512 (in top 1% of the total appearing students) and JEE Mains (2013) with All India rank 765 and state rank 11 (Percentile score of 99.8%).

Extra-Curricular

Teaching Assistant (TA)

2017

Engineering Drawing (MIN-108)

- Conducting practical classes in the Autumn semester of 2017-18.

Mentor

2015 – 2016

Mechanical and Industrial Engineering Students' Society, *IIT Roorkee*

- Demonstrated advanced image processing techniques using MATLAB.

2015 – 2017

Academic Reinforcement Program, *IIT Roorkee*

- Taught Mechanics (PHN-001) and Mathematics (MAN-001) to the freshmen batch in the weekend classes.

2016 – 2017

Student Mentorship Program, *IIT Roorkee*

- Guided freshmen year students through the first year of college life.

Mechanical & Industrial Engineering Students' Society, *IIT Roorkee*

2014

President

- Joined as **Executive Member** in 2014-15 and served as **Joint Secretary** in the year 2015-16.
- Organized departmental social events and vocational workshops.

National Service Scheme, *IIT Roorkee*

2013 – 2014

Volunteer

- Participation in street plays on campus and villages nearby for awareness on socio-political issues.

Peer-reviewed conference proceedings

2017

Sanjay, V, Darshan, M. B., Kumar, P., and Das, A. K. "Spatial preference of film growth in boiling and localized suppression of bubble release". In: *Paper ID: IHMTC-2017-09-1283, 24th National and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference*

2017

Soni, A., **Sanjay, V**, and Das, A. K. "Fingering instability of liquid sheet formation by oblique collision of jets". In: *Paper ID: IHMTC2017-13-0806, 24th National and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference*

2017

Soni, A., **Sanjay, V**, and Das, A. K. "Consequences of interaction between asymmetric liquid jets". In: *Paper ID: 64, 44th National Conference on Fluid Mechanics and Fluid Power*

2017

Jain, A., **Sanjay, V**, and Das, A. K. "Asymmetry in air entrainment inside liquid pool due to impingement of an inclined jet". In: *Paper ID: IHMTC2017-13-0828; 24th National and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference*

2017

Jain, A., **Sanjay, V**, and Das, A. K. "Interaction of bubble clusters formed due to adjacent impingement of liquid jets in a pool". In: *Paper ID: 68, 44th National Conference on Fluid Mechanics and Fluid Power*

2017

Rathia, S. K., **Sanjay, V**, and Das, A. K. "Study of fire propagation in the presence of patterned flammable obstructions". In: *Paper ID: IHMTC2017-04-0814, 24th National and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference*

2017 Rathia, S. K., **Sanjay, V**, and Das, A. K. “Extent of fire spread during interaction of two ignition points”. In: *Paper ID: 65; 44th National Conference on Fluid Mechanics and Fluid Power*

2016 **Sanjay, V** and Das, A. K. “On the gas-liquid entrainment by impingement of liquid jet onto a pool”. In: *Reference #50, 9th International Conference on Multiphase Flow*

2016 Agarwal, A., Sarda, M., Kaushik, J., **Sanjay, V**, and Das, A. K. “Investigation of flame and soot Propagation in non-air conditioned railway locomotives”. In: *International Journal of Computer, Electrical, Automation, Control and Information Engineering* 10.9, pp. 1433–1441

2016 Kaushik, J., Agarwal, A., Sarda, M., **Sanjay, V**, and Das, A. K. “Study of fire propagation and soot flow in a pantry car of railway locomotive”. In: *International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering* 10.9, pp. 1617–1622

2016 Sarda, M., Agarwal, A., Kaushik, J., **Sanjay, V**, and Das, A. K. “Numerical simulations of fire in typical air conditioned railway coach”. In: *International Journal of Computer, Electrical, Automation, Control and Information Engineering* 10.9, pp. 1520–1527

2016 **Sanjay, V** and Das, A. K. “On the numerical simulations of kitchen sink vortex”. In: *Paper ID: 217, 6th International and 43rd National Conference on Fluid Mechanics and Fluid Power*

2016 Datta, S., **Sanjay, V**, Kumar, P., and Das, A. K. “Investigation of jet atomization - a multi-scale approach”. In: *Paper ID: 218, 6th International and 43rd National Conference on Fluid Mechanics and Fluid Power*

2016 Aggarwal, A., **Sanjay, V**, Kumar, P., and Das, A. K. “Generation of a liquid sheet by an oblique impingement of interacting jets: a numerical investigation”. In: *Paper ID: 267, Proceedings of CHEMCON*

2015 **Sanjay, V** and Das, A. K. “Bubble life cycle during entrainment by Jet impingment in liquid pool”. In: *ID FM-052, Proceedings of CHEMCON*

2015 **Sanjay, V** and Das, A. K. “Building fire safety: numerical simulation and evacuation planning”. In: *Proceedings of 14th International Conference of the International Building Performance Simulation Association*, pp. 897–904

References

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