# Sardar Vallabhbhai National Institute of Technology, Surat

## *Department of Mechanical Engineering*

### *Research opportunities at Advanced Fluid Dynamics Lab*

**Dr. Jyotirmay Banerjee**
Professor, DoME

Ph.D. (Czochralski Growth of Oxide Crystals: Numerical Simulation and Experiments) from **IIT Kanpur**, January 2005

**Area of Research**

Computational Fluid Flow and Heat Transfer, Multiphase Flow, Non-linear Analysis, Phase Change Applications, Turbomachines

## Completed Projects

### Sponsored Projects

1. Principal Investigator (PI) of the **ARDB** sanctioned project, "Towards development of an upward swirl can type gas turbine combustor", sanction letter: DARO/08/1041553/M/I dated 16 July 2010, Amount: **Rs. 19.45 lakhs.**
2. Co-PI of **BRNS** sanctioned project entitled "Development of a dispersion model for radionuclides for Motichar lake at Kakrapara nuclear power station", sanction letter: CED/project/1566/2009-10, Amount: **Rs. 23.34 Lakhs.**
3. Principal Investigator (PI) of **SERB, DST** sanctioned project "Experimental analysis of slug regime in gas-liquid two-phase flow through pipes", sanction letter: SB/S3/MMER/0111/2013, dated 23.05.2014, Amount: **Rs. 25.184 lakhs.**
4. Principal Investigator (PI) of **BRNS** sanctioned project "Mathematical modeling of thermal dispersion of heated effluent released in Motichar lake at KAPS", sanction letter: 36(4)/14/22/2014-BRNS/1143 dated 21.07.2014, Amount: **Rs. 24.996 lakhs.**
5. Principal Investigator (PI) of **ARDB** sanctioned project "Parametric Investigations on Upward Swirl Can Type Combustor", sanction letter: ARDB/01/1041742/M/I, dated 07.10.2014, Amount: **Rs. 20.12 lakhs.**
6. Co-PI of **BRNS** sanctioned **project** "Estimation and prediction of near field concentration of KAPS discharged radionuclides (3H,137Cs,60Co) in the aquatic environment of Motichar Lake", sanctioned letter:36(4)/14/05/2014-BRNS/1075 dated 14.07.2014, Amount: Rs.**12.718 lakhs**.
7. Principal Investigator (PI) of **MATRICS**-SERB**, DST** project "Linear Stability Analysis of Interface Dynamics in Two Phase Jets", SERB/F/9855/2019-2020, MTR/2019/000941 dated 06 February, 2020, Amount **Rs. 6.20 lakhs**.

### Centre of Excellence and Infrastructure Projects

1. Member of Project implementation group for project entitled "Development of facilities: (a)Helium Leak Detector, (b)Liquid Nitrogen plant, (c) Pulse Tube Cryo Generator and (d) Hot wire anemometer for PG students", of Rs. 1.4 Crores from DST under FIST (sanction letter no. SR/FST/ETI-194/2007 dtd 26.05.08) (Office Order no. MED/1248/2007-08 dated 27.11.07).

### Contract for Acquisition of Research Services (CARS) Project

1. CARS project from DRDO Pune, entitled "Analysis of generated heat flow through linear motor and cooling solutions for project MFME-MK-II" Contract No. N21177 dated 05/10/2011, amount: Rs. 5,84,590/- (Five Lakhs eighty-four thousand five hundred and ninety only.

### Industrial Consultancy

1. CFD analysis of Maneri Bhali Hydroelectric Power Plant Stage II for Uttaranchal Jal Vidyut Nigam Ltd. (UJVNL), Dehradun, offer no. MED/JB_PLP/UJVNL/529/2009 dated 14.05.2009 and Order no. 582/E&M Design-II/CFD dated 31.07.09), Associated faculty: Prof. P L Patel and Prof. P D Porey.a. Part-I Analysis of the tailrace channel (Rs. 8, 10,000/-) b. Part-II Analysis including the runner and the draft tube (Rs. 5, 30. 000/-)
2. CFD simulation of River Pocket in front of TRT1 and TRT2 of THDC HPP, THDC India Ltd., Rishikesh, Order no. THDC/RKSH/AGM(D)/HPP/F04/117/8, dated 23.12.2011, amount: Rs. 7,75,000/-. Associated faculty: P L Patel.
3. Conducting Computation Fluid Dynamics (CFD) Simulation of Hydro Turbine Unit including tailrace channel of Koteshwar Hydrelectric Project, MOU Signed with THDCIL Rishikesh and SVNIT Surat on 07.07.2014, amount: Rs. 15,60,000/-, Associated faculty: Prof. P L Patel.
4. Conducting Computational Fluid Dynamics Study for bottom slab orifices in two upstream surge shafts and downstream surge shafts; Order No: 16063005; Dated 24.12.2021, Tehri PSP PDE; Hindustan Construction Co. (HCC) Ltd. Khandkhala, Tehri garhwal Uttaranchal, Amount Rs. 1,486,800/- (Fourteen Lakhs eighty-six thousand eight hundred), Associated faculty: Prof. P L Patel.

### Significant Outreach

1. PhD guided: 14; M-Tech guided: 80; Ongoing research scholars: 05
2. Dean of Academics at SVNIT Surat, 1st Jan 2018 to 31st Dec 2021, vide office order no. SVNIT/E/1330, dated 2/11/2017.
3. Head of Department, Department of Mechanical Engineering, at SVNIT Surat, 15th April 2021 to 15th April 2023 vide office order no. SVNIT/E/HEADSHIP/24, dated April 06, 2021.
4. Professor In-charge, Research Park, at SVNIT Surat, 24th Dec 2015 to 23rd Dec 2022, vide office order no. SVNIT/DIR/OO/2015/962 dated 24/12/2015.
5. Director, Board of Governors of Association for Harnessing Innovation and Entrepreneurship (ASHINE), a not for profit Technology Business Incubator (TBI) set up at SVNIT Surat during Dec 2017 to Dec 2022.

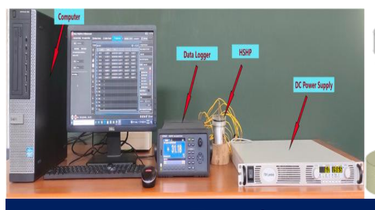
### Books/Monographs

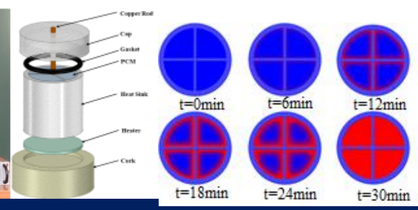
1. K Muralidhar and Jyotirmay Banerjee, Conduction and Radiation, Alpha Science International Ltd., Oxford, UK (Indian ed.- Narosa Publishing house, New Delhi), 2010.
2. Jyotirmay Banerjee and K. Muralidhar , Czochralski Growth of Oxide Crystals: Numerical Simulation and Experiments, Monograph under Contemporary Research In Emerging Science and Technology (CREST), TechScience Press, U.S.A, 2007.

## On Going Projects

### Sponsored Research Project

**1) Heat pipe coupled PCM based heat sink test facility and Numerical modelling**

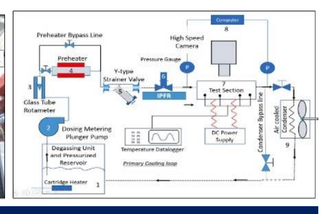



Experiment | Numerical

**Title:** Proposal for a novel hybrid phase change materials based heat sink coupled with heat pipe for efficient thermal management of electronic systems.
**CRG, SERB Amount: Rs 33,42,196.**

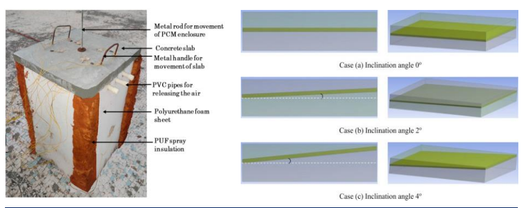
**2) Microchannel Heat Sink and plenum**


Experiment

**Title:** Development of novel tapered variable channel width microchannel heat sink for futuristic high-end microelectronics.
**GUJCOST, Amount: Rs 14,20,000.**

**3) Cooling of building using phase change material**




Experiment | Numerical

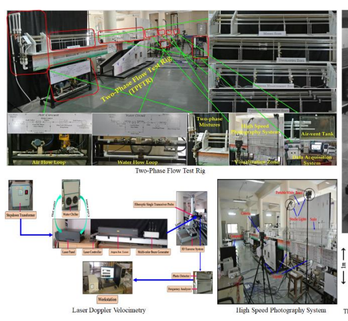
**Title:** Design and Development of PCM based Passive cooling system of E-House.
**GUJCOST, Amount: Rs 32,09,200.**

### DST-FIST

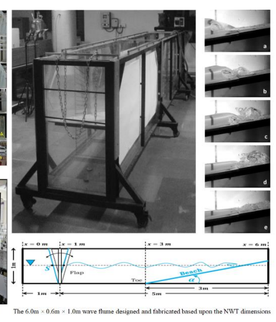
**Title:** Experimental analysis using Particle Image Velocimetry (PIV) and Direct Numerical Simulations (DNS) of jets, sprays and atomization process. **DST-FIST, Amount Rs. 1,02,00,000.**

### Laboratory Facilities

**Experiment (Multi-Phase Flow Test Facility)**

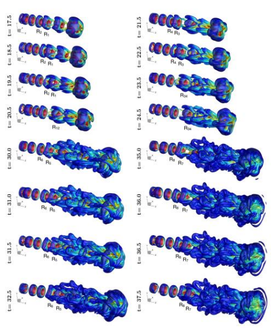



Gas-Liquid Two-Phase Flow Test Rig

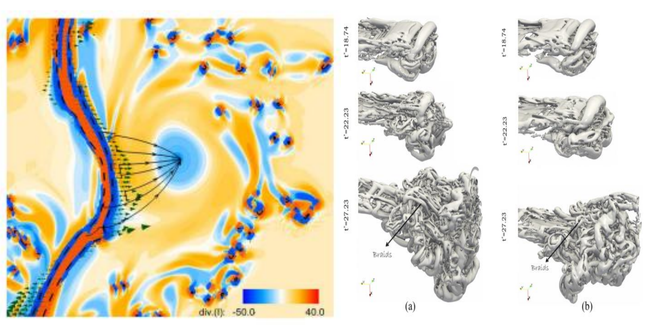



Ocean Wave Energy Convertor

**Numerical (High-End Computation Facility)**



Single Phase Jet Flow




Oscillating Jet Flow

### Research Opportunities

**Multiphase Flow**

1. Analysis of the turbulence and Reynolds stress induced by the slug flow in the horizontal pipeline. [Experiment]
2. Prediction of flow regime and their transition using Artificial Neural Network and Deep Learning. [Experiment and Non-Linear Analysis]
3. Experimental analysis using Particle Image Velocimetry (PIV) of jets, sprays and atomization process.

**Thermal Management System**

1. Thermal assessment of heat pipe coupled with phase change material based heat sink for electronic device cooling. [Experiment and Numerical]
2. Experimental analysis of gas-liquid flow in micro-channel heat sink for cooling the high-end micro-electronics. [Experiment]

**Computational Fluid Dynamics**

1. Direct Numerical Simulations (DNS) of jets, sprays and atomization process.

To apply for the PhD post if you're interested in working in any of the fields **Click Here**.

### FEW SUCCESS STORIES OF PAST STUDENTS

- Placed in companies like Roll Royce, Tata Motors, Bajaj, ABB, Xylem, Donaldson's etc.
- Pursuing post-doctoral studies and in senior research positions in reputed institutes. Like Shimane University, Japan; UCL, London.
- Journal article of doctoral students where adjudged as ***Editor's Pick***.
- Received best paper award for conference paper presentations.
- Journal Article in the top ten list of the ***Elsevier SSRN,*** in the field of nuclear energy.

### Contact

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Webpage: Homepage, ResearchGate, Google Scholar, Scopus

### Salient Publications

**Experimental**

- Thaker, J. and **Banerjee, J.**, 2017. Transition of plug to slug flow and associated fluid dynamics. *International Journal of Multiphase Flow*, 91, pp.63-75.
- Saini, S. and **Banerjee, J.**, 2023. Turbulence in liquid phase and its influence on aeration and pressure surge in intermittent type two-phase flow. *Nuclear Engineering and Design*, 413, p.112477.
- Shailesh, K., Naresh, Y. and **Banerjee, J.**, 2023. Heat transfer performance of a novel PCM based heat sink coupled with heat pipe: An experimental study. *Applied Thermal Engineering*, 229, p.120552.
- Shah, N., Mehta, H.B. and Banerjee, J., 2024. Experimental investigations on a novel instability suppression mechanism for subcooled flow boiling in microchannel heat sink. Applied Thermal Engineering, 239, p.122006.
- Bhamare, D.K., Saikia, P., Rathod, M.K., Rakshit, D. and **Banerjee, J.**, 2021. A machine learning and deep learning based approach to predict the thermal performance of phase change material integrated building envelope. *Building and Environment*, 199, p.107927.

**Non-Linear Numerical**

- Saini, S. and **Banerjee, J.**, 2021. Recurrence analysis of pressure signals for identification of intermittent flow sub-regimes. *Journal of Petroleum Science and Engineering*, 204, p.108758.
- Saincher, S. and **Banerjee, J.**, 2015. A redistribution-based volume-preserving PLIC-VOF technique. *Numerical Heat Transfer, Part B: Fundamentals*, 67(4), pp.338-362.
- Zinjala, H.K. and **Banerjee, J.**, 2017. Refined moment-of-fluid method. *Numerical Heat Transfer, Part B: Fundamentals*, 71(6), pp.574-591.
- Anghan, C., Dave, S., Saincher, S. and **Banerjee, J.**, 2019. Direct numerical simulation of transitional and turbulent round jets: Evolution of vortical structures and turbulence budget. *Physics of Fluids*, 31(6).
- Arote, A., Bade, M. and **Banerjee, J.**, 2020. On coherent structures of spatially oscillating planar liquid jet developing in a quiescent atmosphere. *Physics of Fluids*, 32(8). ***Editor's Pick***
- Dave, S., Anghan, C., Saincher, S. and **Banerjee, J.**, 2021. Direct numerical simulation of forced turbulent round jet: Effect of flow confinement and varicose excitation. *Physics of Fluids*, 33(7). ***Editor's Pick***

**Analytical**

- Chakraborty, B. and **Banerjee, J.**, 2016. A sharpness preserving scheme for interfacial flows. *Applied Mathematical Modelling*, 40(21-22), pp.9398-9426.
- Anghan, C., Bade, M.H. and **Banerjee, J.**, 2021. A modified switching technique for advection and capturing of surfaces. *Applied Mathematical Modelling*, 92, pp.349-379.