# Anuj Sethia

Indian Institute of Technology Bombay

**Research Interests:** Quantum Thermodynamics, Quantum Computing, Quantum Information Theory, Quantum Optics Qubit Technologies, Quantum Dechoherence

## EDUCATION

**Indian Institute of Technology Bombay** *[Jul 2016 - Apr 2020]*
*B.Tech*, Mechanical Engineering (GPA: 8.11/10 )
**Minor:** Physics (GPA: 9/10 )

## PUBLICATIONS

1. Visualization and Modelling of Pool Boiling Bubble Growth and Departure
   ***Anuj Sethia**, Amrita Birhman, Janani Srree Murallidharan*
   FMFP 2018 (*Published*)

2. Subcooled Pool Boiling on Ultra-thin strips of varying cross-sections
   *Amrita Birhman, Sanjid C S, John Pinto, **Anuj Sethia**, Janani Srree Murallidharan*
   JEES 2019 *(Published)*

## RESEARCH PROJECTS

**Nucleated Bubble Model** *[Nov '17 - Aug '19]*
*Guide: Prof. Janani Srree Murallidharan | Mechanical Engineering, IIT Bombay*

*Introduction: We studied boiling heat transfer for industrial systems like Pressurized Water Reactors (PWRs) in which safety crisis related events, such as the 'Critical Heat Flux' occurs frequently. The near-wall vapour dynamics which trigger CHF was studied for designing safe and efficient 1systems .*

- Studied bubble growth and departure dynamics (including lift-off) in **two-phase flows**, and in boiling **heat transfer** phenomena for both **pool and flow boiling** conditions
- Assessed the prediction capabilities and underlying assumptions of existing bubble departure models
- Developed a more accurate mechanistic **bubble growth and departure** diameter model with increased capability for low sub-cooling conditions up to 60 K
- Studied the applicability of the bubble growth models for operating conditions pertaining to boiling crisis in **nuclear reactors** i.e., critical heat flux prediction in PWR's

**Mechanics of Soft Material** *[May '19 - Jul '19]*
*Guide: Prof. Qu Shaoxing | School of Aeronautics and Astronautics, Zhejiang University*

*Introduction: Soft materials like gelatin and hydrogel are usually used to simulate the complex response of various human tissues under multiple loading conditions. These materials follow nonlinear dynamics, such as viscoelasticity, hyperelasticity, or hyper-viscoelasticity.*

- Devised a Matlab model for detection of cavitation size in the gelatin filled cuvette to extract diameter
- Experimented gelatin and hydrogel under various impact conditions to investigate the effect of cavitation nuclei on cavitation in tissue similar soft material
- Studied the behavior of gelatin under drop hammer impact load and devised constitutive model based on **Neo-Hookean hyperelasticity** to analyse dependancy of various parameters
- Reviewed several **hyperelastic constitutive models** for brain tissues for predicting response of tissues under blast and blunt impact conditions

**Sloshing in Liquid Nitrogen** *[May '18 - Jul '18]*

*Guide: Prof. Milind D. Atrey | Mechanical Engineering, IIT Bombay*

*Introduction: Sloshing refers to the free surface movement of a fluid inside a container. Sloshing in cryogens like $LN_2$ and $LO_x$ produces boil-off, eventually leading to loss of cryogen. Sloshing is studied to design tank by adding baffles to reduce loss in transit.*

- Studied (2-D) liquid sloshing phenomena in a moving tank subjected to various accelerations and **discovered its dependencies** on parameters like density, viscosity, amount of liquid
- Compared numerical methods and simulation software which are optimum to study **two-phase flow** and **free surface phenomenon** for closed and ambient environment
- Developed a numerical model based on VOF method on **ANSYS Fluent** to capture free surfacing and validated it with the experimental work already existing in the literature
- Investigated the applicability of sloshing in areas like spacecraft's fuel tanks, tanks subjected to oceanic motion, oceanographic and other engineering situations of free fluid surface

## SCHOLASTIC ACHIEVEMENTS

- Recipient of **Undergraduate Research Award** for exceptional research contribution *[ '19]*
- Secured **All India Rank 707** in JEE-Advanced among 200,000 engineering applicants *[ '16]*
- Recipient of the prestigious **KVPY Fellowship** for basic sciences by **IISc Bangalore** *[ '16]*
- Acquired rank of **86 (Gold Medal)** in **International Mathematics Olympiad** by SOF *[ '15]*
- Secured rank of **251 (Gold Medal)** in **National Science Olympiad** by SOF *[ '15]*
- Among the **top 9%** of participants in **UNSW** Global Mathematics Assessment *[ '16]*
- Secured a percentile of **99.68%** in JEE Mains among **1.5 million** engineering aspirants *[ '16]*

## RELEVANT COURSES & TECHNICAL SKILLS

| Mechanical Engineering | Physics | Maths & Others |
|---|---|---|
| **Cryogenics Engineering** | **Quantum Optics** | Numerical Analysis |
| Fluid Mechanics | Quantum Mechanics (I & II) | Differential Equations |
| Thermodynamics | Thermal and Statistical Physics | Linear Algebra |
| Heat Transfer | Classical Mechanics | Data Interpretation & Analysis |
| Solid Mechanics | Electricity and Magnetism | Computer Programming |
| Manufacturing Processes | Quantum Physics | Optimization Models |
| Machine Design | **Quantum Info. & Computing** | Operations Analysis |
| Engineering Metallurgy | Condensed Matter Physics* | Calculus |
| Microprocessor & Controls | Physics of Quantum Devices* | Probabilistic Models |

** To be completed by April 2020*

**Programming:** **Q#**, C/C++, Python, MATLAB, Mathematica, OpenCV, Arduino Studio, LaTeX
**Softwares:** ANSYS, FLUENT, ABAQUS, AutoCAD, SolidWorks, Photoshop, Premiere Pro

## OTHER KEY PROJECTS

**Dilution refrigerator** *[Spring '19]*

*Guide: Prof. Milind D. Atrey, ME420 Course Project, IIT Bombay*

- Reproduced perfect continuous counter flow heat exchanger models existing in the literature to study the performance of dilution refrigerator and its various dependencies
- Analyzed the effect of **Kapitza resistance** between solid-liquid, mixing temperature and effective surface area of the heat exchanger on the cooling power and studied the heat leaks
- Developed models and compared them with experimental data available in the literature for varying circulation rates and surface area

**SeDriCa: Self Driving Car** *[Oct '17 - Mar '18]*

*Unmesh Mashruwal Innovation Cell, IIT Bombay*

- Developing the first **autonomous driving car** suitable for Indian roads and conditions to compete in the 3-Staged **Mahindra Rise Driverless Car Challenge** for a prize of **$1 Million**
- Programmed and tested modules for instantaneous speed bumper and zebra-crossing detection through **image processing** using OpenCV libraries
- Attempted to enhance speed bumper detection using **Machine Learning** based on Indian roads with a combination of a synthetic and natural dataset of over **5000+** images

**Laser Cladding** *[Autumn '18]*

*Guide: Prof. Ramesh Singh, ME338 Course Project, IIT Bombay*

- Performed laser cladding experiments using CPM9V at multiple power and feed rates on mild steel
- Studied the Heat Affected Zone (HAZ) of laser cladded surface and analysed the depth and height of the melt by varying the input parameters like laser inensity, cross-section

## RESPONSIBILITIES

**Teaching Assistant** | IIT Bombay *[Jul '19 - Nov '19]*

- **Conducted weekly tutorials** and help sessions for course PH107: Quantum Physics & Applications
- Assisted the faculty in teaching and evaluating the performance of 60 undergraduate students
- Covered topics such as Quantum nature of light, Uncertainty Principle, Schrodinger Equation, Eigenvalue Problem, Tunneling, & Quantum Statistics

**Institute Student Mentor** | SMP, IIT Bombay *[Apr '19 - Present]*

- Part of a 105-member team, mentoring a total of 1000+ first-year undergraduate students
- Selected based on **strong overall performance**, inter-personal skills & peer-reviews
- **Mentoring 12** freshmen in academic and personal matters for a smooth transition to institute life

**Associate Secretary** | Mechanical Engineering, IIT Bombay *[Apr '17 - Mar '18]*

- Served as a bridge between the department and **500+ undergraduate** students
- Pioneered in conducting various Department activities like orientations, open day, excursion trips, **industrial visits**, merchandises for more than 800 students

## EXTRACURRICULAR

- Intermidiate level knowledge of **Chinese (Mandarin)**
- Completed **80+ hours of teaching** to secondary students for Education Outreach, NSS
- Helped in organizing CURED: a **diabetes awareness campaign** attempting Guinness World Record for the maximum number of glucose level check-ups covering 170+ camps in 10 states
- Conducted sciences experiments for underprivileged secondary students and also **YouTube** video demonstrations for Open Learning Initiative, NSS IIT Bombay
- **Won 1st prize** in the Biotech General Championship for preparing microscopic slides
- Part of the winning team of PAF-Performing Arts Festival bagging **13 out of 14 awards**
- **Wrote articles** for Summer Bucket list published in Freshmen Newsletter by Insight
- Interviewed 25+ professionals, 100+ participants for an event documentary which received over 20,000+ views for Inter IIT Cultural Meet - 2016

## REFERENCES


**Prof. Janani S. Murallidharan**
IIT Bombay
E-mail ◇ Webpage

**Prof. Milind D. Atrey**
IIT Bombay
E-mail ◇ Webpage

**Prof. Qu Shaoxing**
Zhejiang University
E-mail ◇ Webpage