



**Nakul Ghat**  
**Mechanical Engineering**  
**Indian Institute of Technology Bombay**  
**Specialization: Computer Integrated Manufacturing**

**150100085**  
**Dual Degree (B.Tech+M.Tech.)**  
**Male**  
**DOB: 23/05/1997**

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2020	8.93
Intermediate/+2	CBSE	Ram Krishna Vidya Mandir	2015	94.00
Matriculation	CBSE	Kiddy's Corner Hr. Sec. School	2013	10.00

- Received **Undergraduate Research Award** for outstanding contribution in Laser surface modification [‘17]
- Completed **Honors** in Mechanical Engineering and **Minor** degree in Computer Science and Engineering [‘19]
- Selected for KVPY academic fellowship [‘15] • Int. rank **13** in Silverzone IMO [‘15]
- 2 × **Gold** in Annual Inter-hostel Cricket GC [‘15, ‘16] • Awarded with **Special mention** in PAF [‘17]

## JOURNAL PUBLICATIONS

- **Nakul D. Ghat**, & A. Shrivastava, *Numerical and experimental investigation of surface topology evolution during laser surface modification with raster scan* (Under review).
- **Nakul D. Ghat**, A. Sood, A. Srivastava, & A. Shrivastava, *Ductile fracture base joint formation mechanism during friction stir welding* (Under review).

## CONFERENCE PUBLICATIONS

- **Nakul D. Ghat**, & A. Shrivastava, (2018). *Numerical and experimental analysis of laser surface modification of Ti6Al4V for biocompatible applications*. World Congress on Micro and Nano Manufacturing, Portoroz, Slovenia.
- **Nakul D. Ghat**, & A. Shrivastava, (2020). *Effect of scanning strategy on additively manufactured Ti6Al4V*. 149th The Minerals, Metals and Materials Society (TMS) Conference (February), San Diego, USA (Accepted for presentation).
- **Nakul D. Ghat**, A. Pandey, & A. Shrivastava, (2020). *Annealing of additively manufactured Inconel 625*. 149th The Minerals, Metals and Materials Society (TMS) Conference (February), San Diego, USA (Accepted for presentation).

## INTERNATIONAL EXPERIENCE

**World Congress of micro and nano manufacturing** | 4M Conference | *Remisens, Portoroz, Slovenia* [Sept’18]

- Presented my conference paper on ‘Numerical investigation of surfaces using LSM for biocompatible applications’
- Emphasized on the importance of **numerical modelling** to determine the set of optimum parameters for LSM
- Established connection with Experts working in similar fields of manufacturing and built my own research network

**University of Montreal** | Guide: Jean-Yves Trepaneur | *Montreal, QC, CA* [May’18-Jun’18]

- Numerically simulated the shape and solidification of droplet falling in a viscous medium on a flat cold surface
- Determined the temporal variation of scalar temperature and velocity fields using **Lattice Boltzmann** method

## RESEARCH PROJECTS

**System development in Additive Manufacturing (AM)** [May’17-Ongoing]

*Masters Project with Prof. Amber Shrivastava; inspired by selective laser powder melting*

- Assembling a **powder bed fusion** based AM system for efficient printing of metallic parts using fiber laser source
- Designed the optical path and precise layer motion, strategizing scanning control algorithm and powder spreading
- Targeted to build the AM system with an estimated cost of Rs. **5 million**; <20% of the commercial printers
- Developed a complete model of material deposition and thermal field evolution during selective laser melting

**Laser Surface Modification (LSM)** | Project Guide: Prof. Amber Shrivastava [May’18-Jun’19]

*Developed a complete CFD solver for complex material flows and surface evolution during rapid scanning laser process*

- Implemented CFD subroutines of Heat transfer and fluid flow for solving meltpool dynamics during LSM
- Generated **topological response** and **phase evolution** of Ti-64 alloy subjected to change in process variables
- Predicted the simulation based surface roughness and microhardness post processing with an error < 10%

**Highly Ordered Anodized Nanotubes** | Project Guide: Prof. Amber Shrivastava [Dec’18-Apr’19]

*Fabricated self standing anodized titanium nanotubes for enhanced implant biocompatibility*

- Explored the chemical kinetics and role played by reagent and fluoride compositions on TNT formation rate
- Performed numerous experiments to identify the niche group of compounds aiding the growth of TNTs

### **Laser Welding of Dissimilar Metals** | Guide: Prof. Amber Shrivastava | N2-Bay IIT Bombay [Dec'18-Jan'19]

- Researched on efficient and consolidated joining of thin sheets (1.5 mm) of **copper** with **Duplex stainless steel** (DSS)
- Developed a dedicated fixture to apply and examine the effects of interfacial force at the junction of Cu | DSS

### **Optimisation of LSM parameters for Biocompatibility** [May'18-July'19]

Research Project with Prof. Amber Shrivastava | **Received Undergraduate Research Award**

- Investigated the effects of melt pool dynamics on the implant's surface characteristics and overall biocompatibility
- Demonstrated the direct relation between grain morphology and surface features on surface roughness & hardness
- Proposed a categorical process map for implant types listing optimum LSM parameters for surface enhancement

## **SELECTED ACADEMIC COURSE PROJECTS**

### **Finite Element Analysis of Functionally Graded materials** | Guide: Prof. Parag Tandaiya [Jan'19-Apr'19]

- Presented a review paper on 'A new **beam** finite element for the analysis of **functionally graded materials**'
- Developed 1D and 2D displacement models in MATLAB for different configurations of beams and shaped plates

### **Simulation of Direct Laser Metal Deposition** | Guide: Prof. Ramesh Singh [Jan'19-Apr'19]

- Simulated the spatial powder distribution, thermal fields and powder melting during Direct Laser Metal Deposition
- Proposed a new design of **discrete coaxial nozzle** with an elliptical CS for a more flexible powder delivery
- Demonstrated the effects of **nozzle tilting** on the thermal and spatial profile of distributed powders on the substrate
- Discovered the optimum tilt and elliptical rotation angle of the nozzle for the most efficient powder deposition

### **Novel technologies in additive manufacturing** | Guide: Prof. Ram Kumar Singh [Aug'18-Dec'18]

- Reaped the cost, power and efficiency benefits of **diode lasers** in metal AM over gas and commercial fiber laser
- Designed a robust diode laser setup equipped with collimation optics, fiber delivery and air cooling system
- Proposed the overall system cost **under USD 5000**, reduced system cost to **one-third** of commercial gas lasers

### **Finite Element analysis of Focused Ion Beam** | Guide: Prof. Rakesh G Mote [Aug'18-Dec'18]

- Simulated the FIB process in SRIM to calculate the force distribution of various elemental ion beam on the substrate
- Built a Finite Element framework to simulate cantilevered Mo-wire displacement kinematics bombarded by Ga ions

### **Adaptive Control of an Autonomous Underwater Vehicle** | Guide: Prof. S. Sukumar [Jan '18-Mar'18]

- Devised an Adaptive controller to overcome discrepancies in Non-linear dynamic model utilizing **quaternions**
- Implemented the algorithm on AUV over **6** degrees of freedom achieving asymptotic convergence of tracking error

### **Compact heat Sink Models in Natural Convection** | Guide: Prof. S. Krishnan [Feb '19-Apr'19]

- Developed analytical-numerical approach to replace complex heat sink with **compact** one saving computation times
- Extensively tested the model in NC cooling for both Extruded-fin (**Error < 8%**) and pin-fine Heat sinks (**Error<4%**)

## **POSITIONS OF RESPONSIBILITY**

### **Placement Coordinator** | Elected unanimously (1 out of 40) to represent department [Apr18 - Present]

- **Strategized** effective timeline and developed **framework** for **24** activities to enhance skill-set of students
- Responsible for the proper verification of the resumes of 100+ students appearing for placements from Mech. Engg.

### **Department Academic Mentor** | Selected among 90 applicants on basis of strong **peer reviews** [Apr17 - Mar18]

- **Mentored 12** students via one-to-one counseling to improve their performance and develop **purposeful leadership**
- Provided guidance on academic related queries including semester exchange programs and university internships

### **Teaching Assistant** | Differential Equations [Jan17 - Apr17], Manufacturing Processes II [Ongoing]

- Mentored **40** students, initiated two way learning by in-class interaction and encouraging **independent thinking**
- Involved in exam evaluation, solving assignments and conducting tutorials to encourage problem solving skills

## **TECHNICAL SKILLS**

- **Computational Skills:** CFD, FEM, Discrete element method, JMAK, Lattice Boltzmann, DEFLUX, VOF, SIMPLEX
- **Software Skills:** MATLAB, Maple, Mathematica, ABAQUS, SolidWorks, AUTOCAD, ANSYS, MSC Adams, L<sup>A</sup>T<sub>E</sub>X
- **Programming Languages:** C, C++, Python, HTML, CSS, JavaScript, Android Studio, PHP, FORTRAN, SQL, C#s

## **KEY COURSES UNDERTAKEN**

- **Theoretical courses:** Data Analysis and Interpretation, Steam and Gas Turbines, Linear System Theory, Design of Welded Structures, Applied Thermodynamics, Industrial Engineering and Operations Research I, Quantum Physics
- **Computational courses:** Computational Fluid Dynamics and Heat Transfer, Laser Material Processing, Moving Boundary Problems in Solidification, Finite Element Methods, Design and Analysis of Algorithms, Computer Numeric Control and Programming, Thermal design of Electronic Equipments, Intelligent Manufacturing Process Lab