Karan Jain - Curriculum Vitae

Contact Information

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Research Interests

Propulsion; Gas dynamics; Space Exploration & Research; Aerial vehicles; Applied Controls; Robotics; System modelling; Dynamics; Nanotechnology

Education

Indian Institute of Technology Bombay, Mumbai, India — July 2014 - Present

Bachelor of Technology with Honors in **Mechanical Engineering**; CGPA: **9.75/10**

- **Ranked 1st** in a class of 153 students
- Minor degree in **System and Controls Engineering** with a CGPA of **9.80/10**

Academic Achievements and Awards

- Secured an **All India Rank** of **35** in the Joint Entrance Exam - Advanced 2014 among 1.4 million candidates; ranked 1st in Mumbai and 3rd in Maharashtra state
- Awarded **AP grade** for distinctive performance (top 1%) in 5 courses at IIT Bombay: Kinematics and Dynamics of Machines (**1** out of **155**), Solid Mechanics (**1** out of **177**), Solid Mechanics Lab (**1** out of **154**), Computer Graphics and Product Modelling, and Engineering Graphics and Drawing
- **Grader** and **scrutinizer** for the **International Physics Olympiad** (IPhO) - 2015
- Awarded **Institute Technical Special Mention** 2015-16 (**13** out of **7000** students) by IIT Bombay for exemplary contribution towards institute technical activities
- Felicitated by Hostel 4, IIT Bombay as the **Technical Person of the Year** 2015-16 for outstanding overall performance in inter-hostel technical competitions and events
- Qualified to appear for **Indian National Mathematics Olympiad** (INMO) 2013-14, being **one of the only six** candidates from the nation to be chosen from 12th grade
- Qualified to appear for Indian National Physics Olympiad (INPhO) 2013-14; placed among **top 300** students in the nation in National Standard Examination in Physics
- Won **1st place** in open category of **Physics Brawl Online** 2016, an international online competition hosted by Charles University, Czech Republic

Product Development Experience

Design and Fabrication of an Electric Vehicle for Formula Student

Student Team Project, IIT Bombay Racing, IIT Bombay — August 2015 - May 2017

Faculty Advisor: Prof. Ramesh K. Singh

A team of 30 students from 7 departments with a common aim of designing, fabricating and assembling electric racecars for the Formula Student international design competition held annually at Silverstone Circuit, UK

- Involved with the IIT Bombay Racing team in design and manufacturing roles for two years, mainly in the powertrain design, analysis, manufacturing and dynamic testing
- Developed a mathematical model in Simulink including dynamics of a racecar such as torque-RPM-efficiency characteristics of motors, traction data of tyres and aerodynamics to simulate acceleration runs of the car at different gear ratios, obtain an **optimum gear ratio**, and **minimize lap times** for all dynamic events at Formula Student
- Designed a compact, light-weight, high efficiency gearbox of the optimum gear ratio
- Developed 3D CAD models of all parts of the drivetrain in SolidWorks
- Carried out **Finite Element Analysis** (FEA) in ANSYS of every component of the drivetrain, to check their structural integrity
- Achieved a **38% weight reduction** in the gearbox as compared to previous year
- Learnt about design of cooling systems of automobiles using heat exchangers
- Led a team of six Junior Design Engineers imparting them the knowledge and skills related to automotive engineering and powertrain design

*The team was conferred with **Formula Student Award** by IMechE for **three** consecutive years; awarded to only **2 out of 48** non-UK based teams.*

Design and Prototyping of an Exoskeleton suit for Flight

B.Tech. Project, IIT Bombay July 2017 - Present

Guide: Prof. Arindrajit Chowdhury, Mechanical Engg. Dept., IIT Bombay

Involved in the development of compact motor-propeller attachments for upper and lower limbs which can generate enough thrust to lift a person safely

- Analyzed motor and propeller data to select the ones with high efficiency and thrust
- Selected high energy density Lithium-Polymer batteries based on considerations of weight, acceleration and flight time
- Designing a testing rig to characterize the RPM-power-thrust response of **contra-rotating propellers** with varying separation

Professional Experience

R&D Internship at **Sysmex Corporation, Kobe, Japan** May 2017 - July 2017

Supervisor: Mr. Yusuke Miida, Elemental Technology Development Dept.

*Contributed to the development of **Compact Immunoassay Device** to detect levels of different hormones (TSH, PSA and FT4) in blood using very small blood samples ∼100 µL*

- Developed image processing algorithms for the following purposes:
  - to detect the concentration of a colored reagent (magnetic beads) in a chamber
  - to estimate the volume of a transparent liquid in a chamber
- **Designed micro-channels** for our device to homogeneously distribute a 100 µL blood sample into 3 equal volumes, by centrifugation of the cartridge. Manufactured these cartridges on 3-axis micro-milling machine and tested them in the device.

Nation Building Workshop

Ideation Workshop for **Nation Building** by **Petronet LNG Foundation** July 2017

- Surveyed 2 villages in Rajasthan state about gas and electricity connections
- Spread knowledge about government schemes to the village residents
- Proposed a novel idea of **solar shutters**, discussed the potential of **nuclear energy** and suggested changes to existing schemes to improve the **energy security of India**
- Presented these ideas to Mr. Jitendra Singh, Minister of State for Prime Minister Office Personnel, in the **Parliament of India**

Selected Projects

Centrifugal Compressor and Wind Turbine Design Spring 2016-17

Guide: Prof. Bhaskar Roy, Aerospace Engg. Dept. *[Course Project]*

- Designed and manufactured a centrifugal compressor - used 3-axis CNC milling for the impeller and 3D printing for the volute casing
- Developed a novel idea to use ducts instead of blades to harness wind energy; fabricated the ducts by 3D printing and assembled them to make a horizontal-axis wind turbine

Swarm Robotics Simulations Spring 2016-17

Guide: Prof. Arpita Sinha, Systems and Control Engg. Dept. *[Course Project]*

- Developed an algorithm using graph theory (Adjacency and Laplacian matrices) to simulate multiple randomly oriented ground vehicles moving with some velocities, and command them to head in the same direction using feedback from adjacent vehicles

Chatter Characterization Autumn 2016-17

Guide: Prof. Ramesh Singh, Mechanical Engg. Dept. *[Course Project]*

- Performed micro-milling to machine multiple slots on Ti-6Al-4V surface
- Varied the spindle speed, depth of cut and feed for each slot
- Obtained chatter data of the micro-milled slots using **focus variation microscopy**
- Developed an algorithm to characterize this chatter using signal processing

Digital Holography and Numerical Reconstruction Dec 2015 - July 2016

Guide: Prof. Atul Srivastava, Mechanical Engg. Dept.

- Developed an algorithm in MATLAB to numerically reconstruct the image of an object from its hologram (interference pattern) using Fresnel and Angular Spectrum Method

Position of Responsibility

Convener of Aeromodelling Club, IIT Bombay April 2015 - April 2016

- Organized and managed a Radio-controlled (RC) Plane Competition which saw a record participation of more than 400 students
- Conducted a workshop on designing **quadcopters** and mentored 40 students
- Delivered a Lecture on **The Concept behind Flying Cars** to more than 100 students

Industrial Visits and Exhibitions Attended

- *Inside 3D Printing 2015*: Exhibition on how 3D printing works (December 2015)
- *Grindex 2016*: Products related to grinding and surface finishing (March 2016)
- *Steelstrong Valves India Pvt. Ltd*: Manufacturing and machining of 3 types of valves: gate valves, globe valves and check valves (June 2016)
- *Rakesh Flock Fibre Pvt. Ltd.*: Cutting, powdering and dying of nylon and rayon; this is supplied to other industries to make finished products such as velvet (June 2016)
- *Jyotitech Industries*: Sheet metal forming - CNC punching, bending and welding to make finished products such as lockers or enclosures for IT industries (June 2016)
- *Pradeep Metals*: Forging, heat treatment, cooling, cleaning (using shot blasting) and machining of metal blocks (July 2016)

Teaching Experience

Undergraduate Teaching Assistant at **IIT Bombay** for 4 courses:

Calculus	Autumn 2015-16	Basics of Electromagnetism	Spring 2015-16
Differential Equations	Spring 2016-17	Biology	Autumn 2017-18

- Organized weekly tutorial sessions for about 50 freshmen on different topics pertaining to the course for making their concepts crystal clear
- Assisted the instructors in comprehensive and timely evaluation of the students

Software Skills

Computer Aided Design (CAD)	: SolidWorks, AutoCAD
Computer Aided Engineering (CAE)	: ANSYS, MSC ADAMS
Computer Aided Manufacturing (CAM)	: G-code for CNC
Mathematical Analysis and Simulations	: MATLAB, Simulink
Programming Languages	: C++, Python (with OpenCV)
General Purposes and Productivity	: MS-Excel, MS-Powerpoint, LaTeX

Selected Courses

- Applied Thermodynamics, Fundamentals of Gas Dynamics, Turbomachines
- Rapid Product Development, Machine Design, Nanomanufacturing Processes
- Advanced Topics in Mobile Robotics, Linear and Nonlinear systems, Microprocessors and Automatic Control, Signals and Feedback Systems

Language Skills

- Fluent in English and Hindi
- Learnt **French** for 6 years - 5^{th} to 10^{th} grade (2006-2012)
- Underwent basic **Japanese** language training (30 hours)

Social Activities

- Collected donations for cancer patients on behalf of the **Cancer Aid Society** in 2007
- Volunteered to teach underprivileged high school students near our campus through LCCWA (a non-profit organization associated with IIT Bombay) (May - June 2016)

Extra-Curricular Activities

- Received grade B in both Elementary Drawing Examination (2008) and Intermediate Drawing Examination (2010) conducted by the Government of Maharashtra
- Completed **Special Personality Development Course** (SPDC) under Dr. Tushar Guha at Nrityanjali Institute in 2015
- Love to play Football, Table Tennis, Badminton and Cricket
- Silver medalist in the Inter-hostel Table Tennis General Championship 2017-18

Hobbies

- **Collecting Coins** of different countries. It helps me increase my knowledge about cultures of other countries and gives me a chance to interact with other coin collectors by exchanging coins with them
- **Trekking** - as a recreational and physical activity. My favorite trek was of **Mt. Fuji**