Sakshi **Dayal**

CURRICULUM VITAE ● IIT BOMBAY ENGINEERING UNDERGRADUATE

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Research Interest

Seeking to pursue a Master's degree to hone skills in mechanical designing, computer aided design, structural mechanics, multi-body dynamics, and explore new areas of robotics, smart materials and automobiles, with a long-term goal of working as an industry-oriented researcher.

Education

Indian Institute of Technology, Bombay   *July 2017 - Present*

B.TECH. IN DEPARTMENT OF AEROSPACE ENGINEERING

- Bachelor of Technology (Honors) in Aerospace Engineering | GPA = **8.79/10** (after 6 semesters)
- Minor degree in Department of Systems and Controls
- Ranked 8th in B.Tech 2021 batch of 63 students

Work Experience

Space Renaissance International - Indian Chapter   *May '20 - July '20*

ROBOTIC SEGMENT AND APPLICATIONS, TECHNICAL RESEARCH   *Hyderabad, India*

- Constructed **mathematical and control model** for deformation and thermal dissipation for **Shape memory helical spring**
- Proposed **four** linkage mechanism designs for **deploying** folded thin metal foil with Miura ori crease pattern and **retracting** it back into a sealed box to be used as solar sail, actuated solely by shape memory alloy in different environmental conditions like temperature and humidity
- Achieved projected metal foil area reduction to **28.99%**, **20%**, **17.15%** & **10.18%** with proposed mechanisms inspired by scissors, torsion hinge, alphabet 'Z' & Japanese fan respectively supported by relevant force and kinematic calculations and boundary constraints
- Conceived actuation using off-shelf SMA helical springs, normal torsion springs and **one-way heat annealed SMA** strips
- **Impact:** Achieved goal with **91.4% accuracy**, proposed designs approved for further project evolution by prototyping

AIRBUS Group India Private Limited   *May '19 - July '19*

MULTIBODY SIMULATION, R&T DEPARTMENT, AIRFRAME   *Bangalore, India*

- Performed dynamic simulation on current **overhead bins** mechanism used in single-aisle aircraft with central storage on MSC Adams
- Estimated forces, kinematic motion and clearances for current **four bar linkage** retracting mechanism to optimise its performance
- Conceptualised new **retraction mechanism** based on Trammel of Archimedes with elliptical trajectory to avoid clash of central garage storage and bin door, increasing the current clearance without compromising on baggage space or manufacturing cost
- Designed and modeled ratchet and pawl mechanism for **discrete rotation** of neck pillow for an AIRBUS startup, Nap-eezy
- **Impact:** Achieved **2 fold** increase in crucial clearance and proposed design to be developed further

IITB Mars Rover Team   *April '18 - July '20*

BIO-ASSEMBLY SUBSYSTEM HEAD   *Mumbai, India*

Awards		
IRDC 2020 -	Secured overall **4th** position among **28** international teams
IRC 2019 -	Secured **1st** position in Critical Design Review among **19** Asian teams
URC 2019 -	Secured **20th** position in System Acceptance Review among **84** international teams
URC 2018 -	Secured overall **31st** position among **95** international teams

- Spearheaded a team of **5 members** to design and fabricate soil acquisition, sample distribution and in-situ bio assay
- Contrived microscopy experiment to detect living form, employing open loop control **6 DoF parallel manipulator** to mimic motion of slide
- Designed and simulated soil acquisition using **4 DoF** robotic arm actuated by linear actuators, **double scoop digger** based on inverted slider crank mechanism and **hollow auger drill** with shutter at the opening to collect sample from surface and in-depth
- Developed remotely operated UV-Visible range spectrometer to quantify presence of organic molecules like ATP and protein in the sample

Research Experience

Multibody Dynamic Simulation   *Autumn '20 - Present*

FACULTY ADVISOR: PROF. AMUTHAN A. RAMABATHIRAN, DEPARTMENT OF AEROSPACE ENGINEERING

- Studied rigid and flexible **multi-body dynamics** theories with a **computational structural mechanics** approach to reduce computation effort
- Implementing **Direct stiffness matrix method** with Rayleigh damping approximation to simulate dynamics of a generalised **linkage mechanism** with constraints (open and closed loop) with simplified bistable elements using a **python code**
- Modelling bistable spring using simplified multi potential well theory with damping characteristics to study position-velocity behaviours
- Brainstorming and designing **mechanical metamaterials** with **bistability** and combination of rigid-flexible parts for engineering applications

Study of Behaviour of Shape Memory Alloys using Reinforcement Learning

Autumn '19

Faculty Advisor: Prof. PJ Guruprasad, Department of Aerospace Engineering

- Predicted response (strain) of shape memory material subjected to stimuli - temperature and stress, using **ML algorithm** and training data
- Fitted given experimental training data in **hysteresis model** (modeled by tanh curve) to estimate values for governing parameters
- Employed the $\mathcal{E}$ **greedy approach** and **k nearest neighbour** state space discretization to achieve required strain state
- To be implemented in variable camber aircraft wing, eliminating separately actuated high lift devices and drag due to surface discontinuity

Origami Mechanisms and Metamaterials

Summer '20

Faculty Advisor: Prof. Prasanna Gandhi, Department of Mechanical Engineering

- Reviewed literature on robotic **minimal invasive surgical equipments** like endoscope, active catheter and end effectors
- Studied history and development of Origami from paper origami to rigid origami in engineering areas with relevant modifications in the hinges
- Investigated mathematical theories governing flat foldability of **rigid origami mechanisms** as a special case of constrained paper origami
- Brainstormed novel methods involving implementation of **multistability in mechanical metamaterials** using snap joints and tessellations

Technical and Course Projects

WinClin : High Rise building Automatic Glass Cleaning robot

Autumn '20 - Present

Course Instructor: Prof. Shantanu Tripathi, Department of Mechanical Engineering

- Designed modular, self route planning and user-friendly cleaning robot to be used in different configurations according to the requirement
- Conceived drive using vacuum based adhesion with timing belt-pulley and vacuum suction cups at regular intervals, along with special mechanism to avoid de-tangling of vacuum pipes and mechanical valves engaged with variable thickness guide rails for switching valve on/off
- Employed jet atomiser and active brush roller based cleaning system with on-board pressure stabilizing water tank

Loop cutting machine - Tomcat Project

Autumn '19

Course Instructor: Prof. Prasanna Gandhi, Department of Mechanical Engineering

- Constructed the machine based on gear trains and cam follower to cut 1 cm diameter circular loops taking feed from metal wire spool
- Designed three sets of cam follower to press deform straight wire into a circle inspired by cake-mould manufacturing process
- Fabricated and manufactured three layered rotational motion transmitting model by laser cutting acrylic sheets and screw based assembly

6 DOF Stewart Platform

Summer '18

Institute Technical Summer Project, ITC

- Constructed servo actuated 6 DoF **spatial parallel manipulator** with Arduino controlled position and orientation of the platform
- Implemented the closed loop control algorithm on the platform using **inverse kinematics** and **linear algebra** concepts
- Successfully achieved the aim of project with maximum error of **5 degrees** in orientation and **2 mm** in platform position

Multiscale modelling - Bridging Scale Method

Autumn '20

Course Instructor: Prof. Amuthan A. Ramabathiran, Department of Mechanical Engineering

- Reviewed literature on Bridging Scale Method to reduce computational effort without compromising on accuracy in a mathematical framework
- Studied implementation of the method to reduce reflections at the grid interface and resulting numerical errors due to the approximation on examples like Harmonic Lattice, Anharmonic lattice and Lennard–Jones potential

Optimisation Engineering Problem

Spring '20

Course Instructor: Prof. G R Shevare, Prof. Abhijit Gogulapati, Department of Aerospace Engineering

- Solved **7 DoF** optimisation problem of uniform illumination of a wall in cubical room using 3 light bulbs, maintaining a minimum intensity level
- Implemented **Genetic Algorithm**, **Gradient Descent** and **Simulated Annealing** methods to reduce standard deviation by **64.9%**

Teaching and Mentorship Experience

Institute Student Mentor

Autumn '20 - Present

Institute Student Mentorship Program

- Part of a team of **108** members selected from **300** applicants based on strong overall performance, personal interviews and peer review
- Responsible for mentoring 12 undergraduate freshmen by providing counsel pertaining to academic and extra curricular endeavors

Department Academic Mentor

Autumn '20 - Present

Department of Aerospace Engineering

- Among **13** mentors selected from **32** candidates to **mentor under-performing** undergraduate students by comprehensive semester planning
- Mentoring **two** third-year undergraduate students to help them overcome academic, non-academic and personal challenges

Teaching Assistant

Spring '20

Engineering Graphics & Drawing, Mechanical Engineering Dept.

- Mentored **120+** undergraduate students in Engineering Drawing by guiding them in using software like AutoCAD and SolidWorks
- Assisted in conducting **lab sessions** and provided support to conduct semester exams and helped the academically weaker students by solving their doubts and clearing key concepts related to the subject

Awards and Achievements

2020   **Scholarship**, Selected and offered scholarship for **ESEP Research Internship 2020** at **University of Tokyo**

2017   **99.54 percentile**, Secured **99.54** percentile in JEE Mains out of 1.2+ millions aspirants who appeared

2017   **95.89 percentile**, Bagged **95.89** percentile in IIT-JEE Advanced out of 0.2+ millions candidates

2017   **Top 0.1%**, Amongst the **top 0.1%** of successful candidates in **English Core** CBSE Class 12 Examination

2013   **Bronze medal**, Awarded with **Bronze** medal in **XXIX Manav Sthali Maths Talent Test** at **National** level

Skills

Software   ANSYS, SOLIDWORKS, MSC Adams, CATIA, AutoCAD, Fusion 360

Programming   Python, C++, MATLAB, HTML, MySQL, LOGO

Publishing   LaTeX, MS Office

Relevant Courses

Mechanics   Machine Design, Kinematics and Dynamics of Machines

Structures   Vibrations and Structural Dynamics, Aerospace Structural Mechanics, Finite Element Method, Multiscale Modelling of Materials

Controls   Games and Information, Analytical and Geometric Dynamics, Linear and Nonlinear Systems, Signals and Feedback Systems

Others   Optimization for Engineering Design, Introduction to Numerical Analysis, Calculus

Extra Curriculars

2019   **Dramatics**, Participated in **Performing Arts Festival** (inter hostel competition) and secured **1st position**

2019   **Mentoring**, Mentored a group of 4 mentees in summer reading projects on topics including CFD, Relativity

2018   **Dramatics**, Volunteered to perform in **Republic Day skit**, at Gymkhana grounds as NSS representative

2018   **Tech**, Fabricated RC plane prototype from scratch, and investigated optimum design parameters

2017   **Dramatics**, Performed in Freshiezza **street play** (inter hostel competition) as hostel 10 representatives

2017   **Writing**, Worked as panelist for **Freshmen Newsletter** published by Insight, the student media body

2017-18   **Social Service**, Devoted **80 hours** of social service under Events, National Service Scheme, IIT Bombay

2017-18   **Social Service**, Actively participated in events such as **Cloth Collection Drive** and **Meals of Content**

2017-18   **Social Service**, Conducted basic **English speaking session** for poor children at educational NGO, Aasha