Akashdeep Singh

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Education

Indian Institute of Technology Kharagpur — **Kharagpur, India**
Bachelor of Technology (Hons.) in Aerospace Engineering ***[CGPA: 8.81/10]*** — *July '19 – Present*

Higher Secondary Education — **Navy Children School Kochi, India**
Central Board of Secondary Education – ***94.4%*** — *July '17 – May '19*

Secondary Education — **Kendriya Vidyalaya Karwar**
Central Board of Secondary Education – ***CGPA: 10/10*** — *May '17*

Key Interests

Experimental Fluid Dynamics, Computational Fluid Dynamics, Bio-Inspired Flow, Instabilities & Turbulence, Spray Physics

Publications

Rahul Ranjan, ***Akashdeep Singh****, Jit Sinha, Sunil Manohar Dash, "Effects of Flapping Frequency on the Aerodynamic Performance of the Elliptical Tandem Flapping Wings",* ***9th International and 49th National conference, FMFP-2022***

Technical Skills

Languages: C, C++, Python(NumPy, OpenCV), MATLAB, GNU Octave, LaTeX
Softwares: SOLIDWORKS, Ansys(Fluent & Structural), MATLAB/Simulink, AutoCAD, Simscale, OpenVSP, APP-6.0, LTspice
Experimental: Hot-Wire Anemometry, Machining & Welding, Water Tunnel Operation & Pressure Measurements

Professional Experience

Spray and Turbulence Analysis in an Atomizer — **LEGI, Université Grenoble Alpes, France**
Summer Research Intern | Supervisor: Dr. Nathanael Machicoane | [Certificate] — *May '22 - Jul '22*

- Studied about **gas-assisted liquid jets** influenced by **gas swirl** and **helicoidal instabilities** and attended live seminars
- Produced liquid probability plots to estimate the **near-field spray angle** and **virtual origin** by fitting **gaussian distributions**
- Performed **Hot-Wire Experiments** for gas flow rates from ***Re* 13000** to **110000** for 3 distinct acquisition frequencies
- Inspected multiphase flow parameters like momentum flux ratio to scale spray angle using **power law dependance**
- Estimated **turbulence length scales, dissipation rate, and energy spectra** from velocity time series for **gas *Re* up to 400**

Aerodynamic Design of an Expendable UAV — **ADE, DRDO, Bangalore, India**
Summer Intern | Supervisor: Dr. Bhavneet Kaur (Scientist - E) | [Certificate] — *Jul '21 - Aug '21*

- Conducted a **market survey** of over **10** existing UAVs and compiled information on flight performance & powerplant
- Generated the **CAD model** of an initial UAV configuration from its 3-view drawing using **OpenVSP Geom Browser**
- Validated a **Vortex-Lattice solver** by plotting the variation of aerodynamic coefficients with angle of attack and sideslip angle
- Implemented a **Low-Fidelity analysis** on the UAV for multiple wing/airfoil geometries, gaining max. increment of **36%** in C_L
- Evaluated the **flight envelopes** for different geometries and iteratively revised the configuration based on **range** and ***L/D***

Projects

Chassis Development | TeamKART - Formula SAE | [Website] — **IIT Kharagpur**
Supervisor: Dr. Dhananjay Kumar Srivastava | Mechanical Engineering Department | [Certificate] — *Jul '19 – Present*

- Modelled a spaceframe chassis with a torsional stiffness of **1800 Nm/deg** and **7mm** deflection in case of a head-on crash
- Designed mounts and computed stress contours considering FSAE rules for safe integration of other components to chassis
- Built a customized mild steel-based fixture to manufacture the chassis in a **triangulated** and orderly manner
- Developed a jig setup for experimentally analyzing the torsional stiffness of chassis, including **flanges**, and **I-beams**
- Planned and managed the procurement of components from vendors across India, and got hands-on experience in machining

Aerodynamics of Tandem Flapping Wings | BIAHL | [Website] — **IIT Kharagpur**
Undergraduate Researcher | Supervisor: Dr. Sunil Manohar Dash | Aerospace Engineering Department — *Sept '21 - Present*

- Reviewed over **40** research papers on bio-inspired flow and flapping wing aerodynamics for the design of MAVs and UUWVs
- Analyzed **overset** and standard dynamic grids to finalize and adopt the optimum grid type for simulations
- Constructed 4 sets of dynamic grids for flapping foil simulations and carried out grid convergence with **max 2.38% error**
- Simulated tandem flapping wings on a supercomputer for 6 values of *St* to model thrust variation with frequency
- Currently investigating the effect of the wing pivot points and high *St* (> 0.7) on vortex interactions and propulsive efficiency

Design of a Small-Scale ShockTube | **Aerodynamics Laboratory** **IIT Kharagpur**
Supervisor: Dr. Sandeep Saha | Aerospace Engineering Department | [Final Presentation] *Aug '21 - Nov '21*

- Built a small-scale steel shocktube with **4** layers of aluminium foil as diaphgram, and driven-to-driver section **length ratio 2.3**
- Measured the dynamic and kinematic effects by a shock on different geometries attached to a spring-damper system
- Assessed the structural strength of shocktube and supporting mounts at **4 bar maximum differential pressure** on Simscale
- Experimented to observe the effect of outgoing shockwaves from the shocktube on a water lamina flowing downhill
- Designed a Schlieren imaging setup design for visualization of shocks and their interaction with water lamina

Design of a 2D FishTail Propulsor | **Propulsion Laboratory** **IIT Kharagpur**
Supervisor: Dr. Srinibas Karmakar | Aerospace Engineering Department | [Final Presentation] *Jan '22 - Apr '22*

- Studied about a wide range of fishtail motions categorized in terms of oscillating frequency, wake formation, and thrust
- Simulated fish body-tail system modeled as airfoils on Ansys, for different Strouhal numbers and angular amplitudes
- Designed a gear mechanism for the fishtail and mathematically derived the equations of motion
- Created a **Simulink model** based on the equations of motion and force profiles and recorded a thrust of up to **7 N** for ***St* 0.37**
- Manufactured a water tank using perspex and assembled an **Arduino-controlled fishtail** model for experimental analysis

Competitions

Formula Bharat Virtuals 2021-22 **Formula Bharat**
[Link] | [Design Presentation] *Apr '21 - Sept '21*

- Won the **Formula Bharat Virtuals' 2021** by securing an **overall 1st place** among **31** participating teams at the national level
- Secured **1st** place in **Engineering Design Event** and received the **"Best Powertrain Package"** award
- Secured **11th place** in the **Business Plan Presentation** Event

Honours & Awards

Charpak Lab Scholarship, 2022 **Embassy of France in India**
[Certificate] *Mar '22*

- Selected for the prestigious **Charpak Lab Scholarship** awarded to (**20 – 30 out of** $\sim$**1000**) applicants from all over India to undertake a research internship at a Laboratory in France

Coursework

- **Aerospace:** Aerodynamics (Low Speed, High Speed, Unsteady), Flight Stability & Controls, Flight Mechanics, Structural Dynamics, Thermodynamics & Aerospace Propulsion, Aircraft Design
- **Fluid Mechanics:** Physics of Fluid Flow Experiments, CFD, Atomospheric Flow, Turbulence, Viscous Flow
- **Mathematics:** Linear Algebra, Probability & Statistics, Numerical Solutions to ODE & PDE, Transform Calculus,
- **Miscellaneous:** Basic Electronics, Science & Humanism, International Business
- **MOOC:** Machine Learning (Stanford University, Coursera), Deep Learning (DeepLearning.AI, Coursera), MATLAB Onramp

Positions of Responsibility

Head of Chassis Subsystem | **TeamKART - Formula SAE** **Formula Bharat**
[Certificate] *Jul '19 – Present*

- Responsible for the **procurement** of components and management of finances to manufacture chassis and overall vehicle
- Involved in the mentoring of **48** first-year students and **5** second-year students to ensure smooth functioning of the team
- Managed to reduce the cost of the vehicle by **INR 16000** by engineering customized components for the chassis
- Supervised and trained **4** students in the Chassis Subsystem to ensure smooth workflow of the subsystem.

Student Mentor | **Student Welfare Group** **IIT Kharagpur**
[Certificate] *Nov '21 - Present*

- Volunteered to guide **5** first-year students of Aerospace Engineering and help them transition from school to college smoothly

Extra Curricular Activities

- Represented my residence in the badminton general championship held by Technology Students Gymkhana, IIT Kharagpur
- Participated in inter-school public speaking and elocution competition and won second prize